**Haramaya University**

**VICE-PRESIDENT FOR ACADEMIC AFFAIRS**

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**Syllabi for Masters programs**

**Compiled By THE OFFICE OF ACADEMIC ProgramS Directorate**

**May 2020**

**Haramaya University**

**COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES**

**Masters Programs**

**School of Agricultural Economics and Agribusiness**

Agribusiness and Value Chain Management

The Collaborative Masters in Agricultural and Applied Economics (CMAAE)

Agricultural Economics

**School of Animal and Rangeland Sciences**

Animal Breeding and Genetics

Animal Production

Range Ecology and Biodiversity

Animal Nutrition

Dairy Science

Dairy Technology

**School of Natural Resource Management and Environmental Sciences**

Agro-forestry

Agro-meteorology and Natural Risk Management

Environmental Science and Management

Irrigation Agronomy

Soil Science

**Department of Rural Development and Agricultural Extension**

Rural Development and agricultural extension (Streams: Agricultural Communication and Innovation for Development; Rural Development)

Agricultural Information and Communication Management

**School of Plant Sciences**

Agricultural Entomology

Agronomy

Horticulture

Integrated Pest Management

Plant Breeding

Plant Pathology

Seed Science and Technology

Weed Science

**African Center of Excellence for Climate Smart and Biodiversity Conservation**

Climate Smart Agriculture

Biodiversity Conservation and Ecosystem Management

**College of Agriculture and Environmental Sciences**

**School of Agricultural Economics and Agribusiness**

**PROGRAM: AGRIBUSINESS AND VALUE CHAIN MANAGEMENT**

**Distribution of Courses by Semester**

**Year I: Semester I**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Courses** | **Cr hr** |
| ABVM 511 | Managerial Economics in Agribusiness | 3 |
| ABVM 521 | Agricultural Marketing & Price Analysis | 3 |
| ABVM 531 | Value Chain Analysis and Development | 3 |
| ABVM 541 | Crop Value Chain Development | 3 |
| ABVM 551 | Applied Econometrics | 3 |
| ABVM 561 | Gender in Agribusiness & Value chain Management (E) | 2 |
| ABVM 571 | Business Communication and Leadership in Agribusiness (E) | 2 |
| Total |  | 15/19 |

**Year I: Semester II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Cr Hr** |
| ABVM 512 | Livestock Value Chain Management | 3 |
| ABVM 522 | Investment Analysis and Business Plan Development | 3 |
| ABVM 532 | International trade (E) | 2 |
| ABVM 542 | Financial and Risk Management | 2 |
| ABVM 552 | Research Methods in Agribusiness and Value Chains | 2 |
| ABVM 562 | Agribusiness Organization and Management | 2 |
| ABVM 572 | Economics of Climate Change (E) | 2 |
| ABVM 582 | Operations Research in Agribusiness (E) | 2 |
| ABVM 592 | Graduate Seminar | 1 |
| CBE 622 | DTTP (for Jimma University) | 3 |
| Total |  | 13/19 |

**Year II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Cr. Hr** |
| ABVM 602 | MSc. Thesis Research | 6 |

**Course Descriptions**

**Managerial Economics in Agribusiness**

Course Code: ABVM 511

Credit Hour: 3

**Course Description**

The course covers fundamental principles and tools of managerial economics, its nature, objectives and uses, and its relationships with economic theory; demand and supply applications together with estimation and forecasting techniques; production theory and profit maximization; cost theory and optimum input allocation for cost minimization; market structures and pricing under different market models; externalities, public goods, information asymmetry, market failure and the role of government.

**Course Objectives**

The general objective of this course is to provide students with a basic methods and principles of economic analysis and analytical tools that can be used in managerial decision making processes within various organizational settings such as business firms, not-for-profit organizations and government agencies. It enables students to identify problems and opportunities, examine alternative courses of actions, and make optimal choices.

After completing this course, students will be able to:

* Apply economic theory and methods to business and administrative decision making;
* Explain how prices get determined in markets, how market participants benefit in the form of consumer surplus and producer surplus, and what are the consequences of government intervention;
* Measure the responsiveness (Elasticities) of consumers' demand to changes in the different determinants of demand and the importance of these elasticities in decision making;
* Explain the different costs of production and how they affect short run and long run decisions, describe economies and diseconomies of scale, and discuss break even analysis;
* Apply how game theory can be used in explaining business decisions;
* Explain what an externality, public good, information asymmetry and market failure; and the measures to be taken by government.

**Expected competence**

* To decide
* To advice
* To apply
* To research
* To explain

**Course Content**

1. **Introduction: The Fundamentals of Managerial Economics** 
   1. What is economics and managerial economics
   2. The roles of managerial economics
   3. Firms and Managerial Objectives
   4. Managerial Tools of Economic Analysis
   5. Principles of Managerial Economics and managerial decision making
2. **Applications of Demand and Supply Theories**
   1. Demand and supply theories
   2. Price Ceilings and Price Floors
   3. Changes in Demand and Supply
   4. Market Equilibrium
   5. Demand Sensitivity Analysis: Elasticity
   6. Consumer and producer surplus
   7. Price Elasticity, Total Revenue and Marginal Revenue
   8. Determinants of Price Elasticity
   9. Elasticity for Non-linear Demand Functions
   10. Demand Estimation and Forecasting using Regression Analysis
3. **Production and Costs in Managerial Decision Making**
   1. The Technology of Production and its property
   2. Profit-Maximization and optimal Input choice
   3. Costs Minimization & Decision Making: Level of Production & Mix of Resources
   4. Cost and benefit analysis
   5. Long-run Costs, Plant size, and Economies of Scale
   6. Empirical Analysis and Estimation of Production and Costs
4. **Market Structures** 
   1. The Nature of Industry
   2. Perfect Competition
   3. Pure Monopolies
   4. Monopolistic Competition
   5. Oligopolies
5. **Game Theory and Strategy**
   1. Simultaneous Moves
   2. Repeated Games
   3. Credibility
   4. Collusion.
6. **Price and Pricing Strategies** 
   1. Meaning of Price to Consumers and its Economic Role
   2. Pricing Objectives/Strategies
   3. Pricing Methods
   4. Price control: effect of government intervention
   5. Demand Forecasting
   6. Components of Time Series Data
   7. Forecasting Methods
7. **Information asymmetry, Externalities, public goods, and the role of Governments**
   1. Externalities
   2. Public Goods
   3. The Role of Government in the Marketplace
   4. Information asymmetry and Market failure

**Mode of Delivery**

This course will rely on a variety of learning methods. Instructor facilitated learning experiences and lectures will be combined to students-led discussions and presentations. Some specific methods include lectures, reading assignments, group discussions, and case studies use real life case from the business.

**Assessment Methods**

**Continuous Assessment**: There will be two case studies about consumer analysis in marketing. Continuous assessment should account 50% of the evaluation. **Final Exam**: There will be one final exam (50%). The exam covers material from class and the text as well as any readings by the students. The exam will generally consist of essay questions and problems that need analytical skills as well as other relevant types as deemed necessary.

**References**

Baye, M. (2008).Study guide for use with Managerial Economics and Business Strategy. 6th Edition. Boston: McGraw-Hill Irwin

Baye, M. (2010) Managerial Economics and Business Strategy.6th Edition. Boston: McGraw-Hill Irwin

Brickley, J., Smith, C., and Jerold, Z. (2007) Managerial Economics and Organizational Architecture, McGraw Hill – Irwin, 2007, 4th Edition.

Edwin, M. (1996) Managerial Economics: Theory, Applications and cases. W.W. Norton and company New York. 3rd edition

Hirschey, M. (2003) Managerial Economics, 10th edition, Thomson/South-Western College Publishing

James, M. G. (1989) Managerial Economics. Allyn and bacon publishers.Massachusets

Mansfield Edwin, (1996) Managerial Economics: Theory, Applications and cases. W.W. Norton and company New York. 3rd edition,

Robert S.P. and Daniel L.R. (1996).Microeconomics.3rd edition. Prentice-Hall international inc.

Salvatore, D (1989). Managerial economics, McGraw Hill, 3rd edition

**Agricultural Marketing and Price Analysis**

Course code: ABVM 521

Credit hour: 3

**Course Description**

The course generally covers the basics of agricultural marketing, market performance analysis, spatial and inter-temporal market integration, demand for agricultural products, supply response and commercialization.

**Course Objective**

The general objective of this course is to equip students with knowledge, skill and attitude that enable them to support the efforts to produce market oriented agricultural goods for sustainable profit and consumer satisfaction; it also provides students with relevant methodological tools of agricultural market and price analysis.

At the end of this course, learners will be able to:

* Identify the economic roles of prices and markets
* Characterize properties of agricultural products and prices
* Conceptualize the basic methodologies of agricultural market and price analysis
* Analyze the structure of agricultural markets
* Investigate the conduct of agricultural markets
* Evaluate the efficiency of agricultural markets and channels
* Identify methods of price decomposition
* Measure the spatial integration of agricultural markets
* Identify approaches and models of demand analysis
* Estimate complete demand systems for agricultural products
* Assess the distinction between revealed and stated preferences
* Analyze the market orientation and commercial behavior of agricultural producers
* Distinguish the various methods of supply response in agriculture

**Expected Competence**

* To identify
* To analyze
* To assess
* To apply
* To compare

**1: Introduction**

* Definition
* Economic Roles of Markets and Prices
* Characteristics of Agricultural Products and Prices
* Approaches and Methodologies to the study of Agricultural Marketing
  + Approaches
  + Alternative market analysis methodologies
  + Marketing Functions and Stages
* Agricultural Marketing Information System

**2: Market Performance Analysis**

* Market Structure
  + Features of market structure
  + Measuring market and industrial concentration
* Market Conduct
* Market Performance
* Basics of Marketing Channels
* Factors of Channel Performance
* Market Outlet Choices

**3: Spatial and Inter-temporal Market Integration**

* Methods of Price Decomposition
* Measuring Price Instability and Seasonality
  + Index of price instability
  + Seasonal price analysis
* Spatial Market Integration
  + Factors of spatial market integration
  + Measures of spatial market integration
* Spatial Equilibrium Models (SEM)
  + Conditions for spatial equilibrium
  + Geometrical approach to simple SEM analysis
  + Mathematical models to SEM analysis
  + Welfare benefits without trade
  + Welfare benefits with trade

**4: Empirical Demand Analysis**

* Objectives of Demand Analysis
* Alternative Approaches to Demand Analysis
* The Basic Model of Demand Analysis
* Estimation of Engel Functions and Income Elasticities
* Estimation of Price Elasticities
* Estimation of Complete Demand Systems
  + The Linear expenditure system (LES)
  + The Almost Ideal Demand System
  + The Generalized Almost Ideal Demand System (GAIDS)
  + Estimation problems
  + Effects of household characteristics

**5: Revealed and Stated Preference Analyses**

* Revealed preference and Hedonic Pricing
* Stated Preference Analysis
  + The basics of CV
  + Censored models
  + Single-bounded binary choice CV
  + Double-bounded binary CV
  + Structure of economic valuation
  + Components of total economic value
  + Choice of valuation techniques

**6: Agricultural Supply Response and Commercialization**

* Market Orientation
* Market Participation and Commercialization
* Net Market Positions and Commercial Behavior
* Alternative Approaches to the Measurement of Supply Response
* Nerlovian Models of Supply Response
* The Rational Expectations Approach to Supply Response
  + General model
  + Estimating supply response
* Gender deferential in market participation

**Mode of Course Delivery**

This course will be delivered through lectures, seminar papers and presentations, case studies and presentations, assignments, brainstorming sessions, and crossover discussions.

**Assessment Methods**

Continuous assessment will be employed. The assessment will be based on active participation in discussion of case-based tasks, presentations, seminars, assignments, and will account for at least 50% of the evaluation. The remaining goes for final exam.

**References**

Abbot, J., (ed), 1993. *Agricultural and Food Marketing in Developing Countries: Selected Readings*. C.A.B. International, UK.

Amarchand, D., and B. Varadharajan, 2000.*A Text Book of Marketing,*Konark Publishers, New Delhi.

Bruce E. Winston, 1997. *Principles of Marketing: A Text Book*, Regent University, School of Business.

Crawford, L.M., 1997. Agricultural and Food Marketing Management. Marketing and Agribusiness Texts 2, FAO, Rome.

Dixie, G., 2005. *Horticultural Marketing: Marketing Extension Guide 5*, Food and Agriculture Organization of the United Nations, 2005.

Ferris, J. N., 2005. *Agricultural Prices and Commodity Market Analysis*. Michigan State University Press, Michigan.

Goodwin, J.W., 1994. *Agricultural Price Analysis and Forecasting*, John and Sons, USA and Canada.J. Brian Hardaker, Ruud B.M. Huirne and Jock R. Anderson, 1997, Copying with Risk in Agriculture, CAB International, Wallingford, UK.

Harrigan, J., R. Loader, and C. Thirtle, 1992.*Agricultural Price Policy: Government and Market*, Training Material for Agricultural Planning 31, FAO, Rome

Harriss-White, B., (ed), 1999. *Agricultural Markets from Theory to Practice: Field Experience in Developing Countries*, MacMillan Press Ltd, Great Britain.

Kohl, R.L and J.N. Uhl, 2011. Marketing of Agricultural Products.Prentice hall, tenth edition.

Kotler, P., 2010. *Marketing Management: Analysis, Planning, Implementation, and control*, 109th edition, Prentice-Hall, Inc., USA.

Scott, G.J., (ed) 1995. *Prices, Products, and People: Analyzing Agricultural Markets in Developing Countries*.Lynne Rienner Publishers, Inc., London.

Slater, C.J., 1993, *Market channel coordination and economic development* In: Agricultural and Food Marketing in Developing Countries: Selected Readings, C.I.B, UK.

Tomek, W.G., and K.L. Robinson 1990.*Agricultural Product Prices*, third edition. Cornell University Press, London

**Value Chain Analysis and Development**

Course Code: ABVM 531

Credit Hours: 3

**Course Description**

The course will provide learners with grounded knowledge and skills of value chains analysis and development in agriculture; enabling environment for value chain development, chain governance and business ethics.

**Course Objective**

This course aims to equip learners with concepts and principles of value chain to diagnose sustainable value chains and identify the best intervention strategies. It also aims at discerning the functions and relationships among actors to build robust value chain systems.

After completion of this course, students will be able to:

* Examine the underlying assumptions, principles, characteristics and importance of the value chain approach
* Distinguish between the various approaches in identifying the challenges and opportunities for value chain development.
* Identify value-adding activities in the chain.
* Analyse and map commodity value chain
* Apply different value chain approaches and principles for the improvement of the chain
* Evaluate chain governance to facilitate chain formation
* Identify the critical/leverage points among the constraints in value chain development
* Identify active, innovative and leading change agents in value chain.
* Develop participatory approach for value chain development.
* Develop intervention strategies for addressing identified constraints and utilize prevailing opportunities,
* Monitor and evaluate the value chain process.
* Assure quality and safety along the value chain
* Explain the importance of policy issues in the value chain approach

**Expected Competence**

* To apply
* To analyse
* To assure
* To explain
* To Facilitate
* To develop
* To monitor
* To evaluate
* To negotiate

**Course Content**

1. The Value Chain Approach: Concepts, Importance, and Principles

* Concepts of Value Chain
* Global Value Chain
* Underlying Assumptions and Importance of Value Chain Approach
* Principles of Value Chain Approach in Agriculture
* Characteristics of Value Chain Approach
* Dimensions of Value Chain

1. Value Chain Analysis

* Principles and Criteria in Selecting a Value Chain to Upgrade
* Steps in Value Chain Analysis
* Horizontal and Vertical Linkages in the Value Chain Concept
* Value chain Performance & metrics
* Logistics in value chain
* Gender differentials in Value Chain Analysis

1. Value Chain Development

* Approaches to Identify Challenges and Opportunities in the Value Chain
* Challenges in Value Chain Development
* Opportunities for Value Chain Development
* Steps in Value Chain Development
* Identifying Leverage Points from Constraints and Opportunities
* Chain Formation, Networks, Contracts, Relationships and Strategies
* Value Chain Upgrading
* Gender Roles in Value Chain Development
* Monitoring and Evaluation

1. Enabling Environment for Value Chain Development

* Frameworks in Value Chain Development
* Business Environment & Policy Assistance
* Enabling Institutional Support for Chain Development
* Improving Access to Business Development Services
* Specific Direct Interventions and Program
* Cluster and Network Development
* Support to Small and Medium Agro-Enterprises

1. Value Chain Governance and Business Ethics

* Chain Governance
* Social and Environmental Standards
* Safety and Quality Assurance Along the Value Chain
* Business Law and Ethics

**Mode of Course Delivery**

The teaching learning process of the course will mainly depend on lectures, presentations, discussions and group work to enhance student centeredness and competence. The instructor is expected to use case studies, simulations, videos to support practical learning and contribution of the students. Learners will be given a scenario on existing value chain so that they will develop value chain by identifying best strategies, process, and environment. Moreover, learners will be asked to form different groups and act as different actors within the value chain, and practice the role of facilitator and negotiator.

**Assessment Method**

Continuous Assessment (Assignment-scenario analysis, tests, presentations...) accounts for at least 50% of the evaluation, and the remaining is final exam.

**References**

Alberta. 2004. Value Chain Guide Book: A process for Value Chain Development. AFCA, Edmonton.

Alberta. 2002. Value Chain Hand Book: New Strategies to create more rewarding positions in the market place. AFCA, Edmonton.

Altenburg, T., 2006. The Rise of Value Chain Governance and its Implications for UNIDO’s

Development Policy, presentation on behalf of the German Development Institute, Bonn.

Danida, 2010.Gender and Value Chain Development, the Danish Institute for international studies (DIIS).Strandgade 56, 1401 Copenhagen K, Denmark.

Gherzi research, 2005. Value Chain Analysis and Strategy Outline for Textile and Garment

Industry, report prepared on behalf of UNIDO Investment and Technology Promotion Branch, Vienna, Austria, 2005.

Hardwick, T. and John K. 2010.Quantitative Value Chain Analysis: An Application to Malawi. The World Bank Policy Research Working Paper 5242.

John H. 2005. Shaping Value Chains for Development: Global Value Chains in Agribusiness.

Eschborn, GTZ.

John, H. and Hubert S. 2001.Governance in Global Value Chains.IDS Bulletin 32.3, 2001.Institute of Development Studies.

Maker Associates Ltd. 2006. Value Chain Research Methodologies: VCD 2006 .

Matthias L. H. and Tapera J. M. 2009.Value Chain Development for Decent Work: A guide for development practitioners, government and private sector initiatives.Geneva, International Labour Office.

Sergio G. Lazzarini1 Fabio R. Chadda & Michael L. Cook, 2001. Integrating supply chain and network analyses: The study of net chains. Chain and network science (2001:7).

[**www.acdivoca.org**](http://www.acdivoca.org): Value Chain Approach to Economic Development

**Crop Value Chain Management**

Course Code: ABVM 512

Credit Hours: 3

**Course Description**

This course is designed to address:Principles of crop value addition and supply chain development, Pre-and postharvest management of horticultural and field crops, Major causes of pre- and postharvest losses of horticultural and field crops, Characteristics of crop produces in relation to pre- and postharvest losses of horticultural and field crops, Postharvest handling systems, Processing, preservation, and storage mechanisms of horticultural crops, Processing and storage of field crops, Value addition in horticultural and field crops, Storage, processing, fortification, packaging, Economic feasibility, social acceptability and environmental friendliness of processing, preservation, fortification and storage of horticultural and field crops, Safety and quality control; national and international safety and quality standards; logistics, storage and distribution, Mapping of value chain in major horticultural and field crops, and The role of women in pre- and postharvest management, processing and preservation of major crops.

**Course Objectives**

After completing this course students will be able to:

* Describe pre-and postharvest factors that affect production of horticultural and field crops and their management options
* Describe structural, physiological and bio-chemical changes that take place in crop produces
* Assess and estimate pre- and postharvest losses
* Identify economically feasible pre- and postharvest operational systems
* Monitor the implementation of safety measures and quality assurance procedures in harvesting, transporting, storage, grading and standardization and marketing of crop products at national and international levels.
* Apply basic principles of processing, fortification, preservation, packaging and value addition of crop produces
* Assess the economic feasibility, social acceptability and environmental friendliness of processing, preservation, fortification and storage of crop produce
* Apply national and international safety and quality standards during production, processing, storage and distribution of crop products
* Analyze the role of women in pre- and postharvest management, processing and preservation of major crops.

**Expected Competence**

* To analyze
* To advise
* To explain
* To manage
* To apply
* To assess
* To monitor

**Course Content**

**1: Introduction --- 2 hr**

1.1. Principles of crop value addition and supply chain development

1.2. Business oriented crop production systems

1.3. Basic concepts of value addition and supply chain

1.4. Economic benefits of crop value addition

**2: Factors Affecting Production and Loss of Crop Produces – 5hr**

2.1. Pre-harvest factors

2.1.1. Environmental factors – (biotic and abiotic)

2.1.2. Agricultural inputs – (variety, agrochemicals, fertilizers)

2.1.3. Management practices – (site selection, land preparation, agronomic practices)

2.2. Postharvest factors

2.1.1. Time of harvesting

2.1.2. Method of harvesting

2.3. Importance of supply and value chain development and mapping in plant produces

**3: Value Addition & Marketing of Fruits, Vegetable, Root & Tubers, Mushrooms etc.-- 12 hr**

3.1. Specific pre- and postharvest management requirements

3. 2. Grading

3.3. Bio-fortification

3.4. Preservation

3.5. Processing

3.6. Marketing of value added commodities

**4: Value Addition and Marketing ofOrnamental Plants ---3 hr**

4.1. Handling of Cut Flowers, Fillers, Rooted Cuttings, Potted Plants etc.

4.2. Plant growth regulators and preservatives in value addition of ornamental plants

4.3. Packaging of ornamental plants

4.4. Storage and transportation of ornamental plants

4.5. Marketing of ornamental plants

**5: Value Addition and Marketing of Coffee and Tea – 4 hr**

5.1. Pre-harvest management practices and value addition

5.2. Postharvest management practices and value addition

5.2.1. Processing

5.2.2. Grading

5.2.3. Packaging

5.2.4. Marketing

**6: Value Addition in Field Crops --- 8 hr**

6.1. Cereals

6.2. Pulses

6.3. Oil crops

6.4. Industrial crops (fiber crops, sugar crops and stimulant crops)

**7: Value Addition and Marketing of Non-timber Forest Products – 3 hr**

7.1. Frankincense

7.2. Resin

7.3. Volatile products

**8: Value Addition and Marketing of Herbs and Spices -- 4 hr**

8.1. Herbs - (Basil, rosemary, mint etc.)

8.2. Spices – (Ginger, Turmeric, Cardamon, Black pepper, Kororima, cumin, etc.)

**9: Safety and Products Quality 4hr**

9.1. Pre- and postharvest safety in crop/plant products

9.2. National and international quality and safety standards

9.3. National and international quality standards

9.4. Quality assurance and accreditation

**10: Gender roles in crop value chains --- 4hr**

10.1. Pre-harvest management practices

10.2. Postharvest management practices

10.3. Marketing of crop produces

**Method of Delivery**

Interactive lectures, group discussions and presentations, term paper, field and company visits: students will visit crop farms and processing companies and identify the possible loss types, factors affecting product quality, post-harvest handling methods by chain actors.

**Assessment Methods**

Students will be assessed on continuous bases and summative exam. The continuous assessment consists of term paper writing, presentation, tests, and field reports. The minimum total weight for the elements in continuous assessment is 50%. The rest will be covered by final exam.

**References**

Brennan, J. G., 2006.Food Processing Handbook.Wiley VCH Weinheim, Germany.

Chakraverty, A., Mujumdar, A. S., Raghavan, G. S. V. and Ramaswamy, H. S., 2003.Handbook of Post-harvest Technology –Cereals, Fruits, Vegetables, Tea and Spices, Marcel Dekker Ink. NY.

Florkowiski, W. J., Shewfelt, R., Brueckner, B. and Prussia, S. E., 2009. Post-harvest Handling A Systems Approach, 2nd ed. Elsivier Ink., New York, USA.

Simson, S. P., and Straus, M. C., 2010.Post-harvest Technology of Horticultural Crops, Oxford Book Company, New Delhi.

Chakraverty, A., Mujumdar, A.S., VijayaRaghavan, G. S., Ramaswamy, H. S. 2003. Handbook of Postharvest Technology Cereals, Fruits, Vegetables, Tea, and Spices Marcel Dekker, Inc.

Siddiq, M., Ahmed, J., Lobo, M. G., Ozadali, F. 2012. Tropical and Subtropical Fruits Postharvest Physiology, Processing and Packaging. John Wiley & Sons, Inc.

Thompson A.K. 2015. Fruit and Vegetables Harvesting, Handling and Storage,*Volume 1.*Introduction and Fruit, *Volume 2* ***Vegetables, Mushrooms, Herbs.***3rd Ed., JohnWiley& Sons, Ltd

<http://edepot.wur.nl/199075>

[http://www.beneluxshs.eu/wp](http://www.beneluxshs.eu/wpcontent/uploads/2008/10/vandervorst_globalsourcing23november2007handout.pdf)

[content/uploads/2008/10/vandervorst\_globalsourcing23november2007handout.pdf](http://www.beneluxshs.eu/wpcontent/uploads/2008/10/vandervorst_globalsourcing23november2007handout.pdf)

<http://ageconsearch.umn.edu/bitstream/121848/2/van%20der%20Vorst-ok.pdf>

<http://informs-sim.org/wsc05papers/204.pdf>

**Applied Econometrics**

Course Code: ABVM 551

Credit Hours: 3

**Course Description**

The classical multiple regression model; functional forms; specification analysis (specification errors, non-normality, Heteroskedactity, Autocorrelation, Multicollinearity and outliers ) and model selections; the generalized regression model; maximum likelihood, simultaneous equation methods; econometric models for limited dependent variables; introductory time series regression (stationary time series models; modeling economic time series; trends and volatility; testing for trends and unit roots; cointegration and error- correction models). Each method discussed in the course should be demonstrated with appropriate statistical packages for econometric analysis (SPSS, STATA, EVIEWS…).

**Course Objective**s

After completing this course, students will be able to?

* Formulate econometric models in an empirically testable form
* Estimate and test econometric relationships with observed data
* Apply econometric tools for prediction and policy decisions
* Analyze and interpret quantitative socioeconomic data
* Assess cause and effect relationship of socioeconomics variables

**Expected Competence**

* To Build
* To Interpret
* To analyze

**Course Content**

1. The classical/ordinary multiple regression model
   1. Review of simple linear regression and correlation
   2. Assumptions of the classical least squares
   3. The matrix approach to regression analysis
   4. Regression equation with two independent variables
   5. Regression equations with more than two independent variables
   6. Tests of hypothesis about regression equation
   7. Data analysis with relevant software/practice
2. Functional forms
   1. Deviations from linearity
   2. Selecting appropriate functional forms
   3. Different methods of linearizing equations
3. Model specification analysis
   1. specification errors
   2. non-normality
   3. Heteroskedactity
   4. Autocorrelation
   5. Multicollinearity
   6. Outliers
   7. Data analysis with relevant software/practice
4. The generalized regression model (GLM) with Data analysis with relevant software/practice
5. The maximum likelihood Estimation (MLE) method with Data analysis with relevant software/practice
6. Econometric models for limited dependent variables
   1. Logit models
   2. Probit models
   3. Multinomial logit, and probit models
   4. Tobit and selection models
   5. Data analysis with relevant software/practice
7. Simultaneous equations methods
   1. The simultaneous equation problems
   2. Types of variables in simultaneous equation models
   3. Identification problems
   4. Solutions to simultaneous equation problems
   5. Data analysis with relevant software/practice
8. Introductory time series regression
   1. Components of time series
   2. Stationarity
   3. Trends and volatility
   4. Fitting autogressive models
   5. Testing for trends and unit roots
   6. Co-integration and error correction models
   7. Data analysis with relevant software/practice

**Mode of delivery**

Lecture, practical lab sessions, presentations

**Mode of assessment**: Continuous assessment (assignments, lab practices and presentations) out of 50% and final written examination (50%)

**References**

Verbeek M. (2004): A Guide to Modern Econometrics. 2nd edition.*Erasmus University Rotterdam*

Gujarati D.N. (2004): Basic Econometrics. 4th ed. *The McGraw-Hill.*

Wooldridge, J.M. (2009). Introductory Econometrics.4th edition, South-Western.

Cameron A. C. &Trivedi P. K. (2005): Microeconometrics Methods and Application. Cambridge University Press, New York

Cameron A. C. &Trivedi P. K. (2009): Micro econometrics Using Stata. Stata Press Publication.Stata Corp LP. College Station. Texas

Greene, W.H. (2008). Econometric Analysis.6th edition, Prentice-Hall.

Greene W.H and Hensher D.A (2010): Modelling ordered Choices. Cambridge University Press

**Gender in Agribusiness &Value Chain Management**

Course Code: ABVM 56.1

Credit Hour: 2

**Course Description**

The course equips learners with conceptsofgender in relation to agribusiness and value chain management. It advocates gender sensitive value chain development and provides input on how to make value chain interventions; promotes women’s empowerment, gender equity for improving chain performance. The course also discusses how development organizations and private entrepreneurs could find ways to improve the position of women in value chains – especially small-scale women farmers and primary processors.

**Course Objectives**

At the end of this course, students will be able to:

* Explore the concept of gender in line with agribusiness and value chain management
* Analyzegenderrolesandgenderequityinvaluechain management
* Explain gender analysis frameworks/tools
* Mainstream gender in value chain development
* Explain policy concerns in relation to gender dimension

**Expected competence**

* To analyze
* To explain
* To explore

**Course Content**

1. Introduction to gender concepts

* The Concept of Gender
* Poverty and Gender Inequality in Agriculture
* Gender Division of Labour
* Practical and Strategic Gender Needs
* Gender Equitable Value Chain Development

1. Gender Analysis Framework / Tools

* Harvard Analytical Framework
* The Moser Framework
* The Gender Analysis Matrix (GAM) Framework
* Women’s Equality and Empowerment (Longwe) Framework
* The Capacities and Vulnerabilities Analysis (CVA) Framework
* The Social Relations Approach Framework (SRA)

1. Gender mainstreaming in Agribusiness &Value Chain Management

* Gender Sensitive Indicators and their Usefulness
* Importance of Gender Equity in Agricultural Value Chains
* Gender Mainstreaming Systems

1. Policy Issues Related with Gender

* Gender in International and National Policy Packages
* Gender Context in Agribusiness Firms in Ethiopia
* Policy Briefs and Case Studies on Gender and Value Chain Development

**Mode of Course Delivery**

Interactive lecture, reading assignment, presentation, educational excursions to women owned small scale enterprises, government and non-government offices working in the area of gender and development issue.

**Assessment Methods**

Continuous assessment methods (assignments students analyze for a firm/ company the current gender situation and write report of their findings, their personal opinion on gender policy and purposes in general, their recommendation for this firm based on their findings and opinion, group discussion/work, quiz, test) which accounts for at least 50% of the evaluation and the remaining will be final exam.

**References**

Agriterra/IIMF, (2009). ‘Gender in value chains case study, organised coffee producers in Change’, Thesis presented at the University of Oxford.

Brambilla, P. (2001), ‘Gender and Monitoring: A review of practical experiences’, Swiss Agency for Development and Co-operation (SDC), BRIDGE (development-gender),IDS, Brighton, UK. (111).

Corporate Network Agriculture SNV, (2011).Mainstreaming gender in value chain development: Practical guides and tools. [One line], Available at: <http://www.snvworld.org/sites/www.snvworld.org/files/publications/gender_mainstreaming_in_vcd.pdf>. Accessed 17/07/2012 at 10:30 am

FAO (Food and Agriculture Organization), 2010. Gender dimensions of agricultural and rural employment: Differentiated pathways out of poverty. Status, trends and gaps.Food and Agriculture Organization of the United Nations.[www.fao.org/](http://www.fao.org/)docrep/013/i1638e/i1638e.pdf

Farnsworth et al, 2011, Gender-Aware Value Chain Development: Enabling rural women’s economic empowerment. [Online] ,Available at: <http://www.un.org/womenwatch/daw/csw/csw56/egm/Farnworth-EP-1-EGM-RW-Sep-2011.pdf>.

Gender and Rural Employment - Differentiated Pathways out of Poverty.<http://www.faoilo.org/more/workshop>, Gender and Value Chains Learning Network’,

Goetz, A-M.andHassim, S. (2003) ‘Introduction: women in Power in Uganda and South Africa’,in A-M. Goetz and S. Hassim (eds), NoShortcuts to Power: African Women in Politics and Policy Making, London: Zed Books Accessed 18/07/2012 at 3:00 pm

Perú (Junta Nacional de Café), 2008’, Background case study for Laven, A., A. van Eerdewijk, A. Senders, C. van Wees and R. Snelder, (2009), Gender in Value Chains emerging lessons and questions, Agri- ProFocus working paper, unpublished, ICCO

**Communication and Leadership in Agribusiness**

Course code: ABVM 571

Credit hour: 2

**Course Description**

The course covers introductory concepts of communicating, basics of communicating, types of communication, and leadership theories and styles.

**Course objectives**

At the end of completion of this course, students will be able to

* Develop their personal business communication skill
* Present information that is visually appealing and professionally produced
* Recognize the importance of communication in gaining a better understanding
* Employ communication skills to solve problems, learn new things, and build career.
* Demonstrate the skills of managing business correspondence and report writing
* Indentify the various leadership theories and styles
* Demonstrate the leadership skills and qualities

**Course content**

**1: Introduction**

* Definitions of communication
* Role of communication in business
* The communication situation
* The communication process/cycle
* Key factors for effective communication
* The barriers to effective communication
* Role of Communication in Leadership
* Leadership versus management

**2: The Basics of Communicating**

* Importance of language
* Non-verbal communication and self-presenting
* Effective reading
* Verbal skills
* Listening
* Effective note taking

**3: Types of Communication**

* Written Communication
* Oral Communication
* Organizing a Presentation
* Presentational Skill
* Using the Telephone
* Visual Communication
* Electronic Communication Systems
* The Use of IT in Business
* IT and Presenting Information
* Information Processing

**4: Leadership Theories and Styles**

* Leadership Approaches
* The personal characteristics approach
* The leader-follower situation approach
* The contextual (or contingency) approach
* Leadership Theories
  + Trait theory
  + Behavioral theory
  + Situational/Contingency theory
  + Transformational and transactional theory
* Roles of a Leader
* Leadership Qualities
* Barriers to successful leadership
* Leadership Styles
* Gender empowerment and leadership

**Mode of Course Delivery**

This course will be delivered through lectures, seminar papers and presentations, case studies and presentations, assignments, brainstorming sessions, crossover discussions, and practical demonstration.

**Assessment Methods**

Continuous assessment will be employed. The assessment will be based on active participation in discussion of case-based tasks, presentations, seminars, assignments, and will account for at least 50% of the evaluation. The remaining goes for final exam.

**References**

Andrews, Deborah C., 1998. **Business Communication**, New York, Macmillan Publishing Company

Andrews, Patricia H., and John E. Baird, JR., 1989.**Communication for Business and the professiona**l, 4th ed., Deboque, Lowa, Brown publishers

Angell A. Pamela, Business, 2007. **Communication Design- Creativity, Strategies, and Solutions,** McGraw-Hill, 2007

Bowman Joel P. **1980. Successful Communication in Business,** San Francisco Harper and Row, Publishers

Bisen V. and Priya, 2009.**Business Communication**, New Age International, New Delhi.

Buddy Krizan, 1999. **Business Communication,** 4th ed., South Western Publishing.

Krizan, et.al, 2008.**Business Communication**, 7th ed., South-Western Publishing Company.

Rentz k., Marie E. Flatley, et.al, 2011.**Lesiker’s Business Communication-Connecting in a Digital World**, 12th ed., McGraw-Hill.

Adler. Ronald B. Communication at Work: Principles and Practices for Business and the Profession.

Angella Pamela, 2004. Business Communication, Design, Creativity, Strategies and solutions.

BelewGashaye, 1998. Business Communication Skill

Bovee,Courtlan L., 1992. Business Communication Today.

Fiedler, Fred Edward, Theory of Leadership Effectiveness.

Guffery, Ellen Marry,2006. Business Communication.

Harris Alona, 2003, Building Leadership Capacity for Improvement.

Locker Kity, 2006.Business and Administration Communication.

N.C. Jain,2006. Business Communication

Pearson, J., & Nelson, P., 2000. *An introduction to human communication: understanding and sharing,* Boston, MA: McGraw-Hill.

R.K. Madhukar. Business Communication and Customer Relation.

Raymond M. Olderman, 1999. Guide to Business Communication.

**Livestock Value Chain Management**

Course Code: ABVM 512

Credit Hours: 3

**Course Description**

This course tries to address the role of livestock in Ethiopian economy, challenges and opportunities in commercializing livestock agriculture, economics of livestock products processing, livestock supply chains; post-harvest handling of livestock/animal products; characteristics of livestock/animal products as it relates to their loss; major causes of deterioration in livestock/animal products; development of livestock products handling systems; major components of livestock products handlings; efficient and effective utilization of animal product processing facilities; the role of women in livestock products handling processing and preservation; importance, principles and techniques of processing and preservation of animal/livestock products; safety measures and quality assurance procedures in transporting, storing, grading and standardization of livestock products, economic feasibility, social acceptability and environmental friendliness of processing and preservation

**Course Objectives:**

At the end of this course students will be able to:

* Explain the role of livestock in Ethiopian economy
* Identify the challenges and opportunities of commercializing livestock agriculture in Ethiopia
* Describe the changes (structural and bio-chemical) in agricultural products
* Assess and estimate post-harvest losses using different estimation methods and propose methods for minimizing the losses
* Identify economically feasible animal product processing facilities and manage their efficient and effective utilization
* Monitor the implementation of safety measures and quality assurance procedures in transporting, storing, grading and standardization and marketing of livestock/animal products
* Apply the basic principles of processing livestock products to value added food commodities
* Explain the different processing methods for various livestock/animal products
* Apply different livestock/animal products preservation methods
* Assess the economic feasibility, social acceptability and environmental friendliness of different livestock/animal processing and preservation
* Analyse the role of women in livestock products handling, processing, preservation & marketing.

**Expected Competence**

* To identify
* To analyse
* To apply
* To monitor
* To manage
* To assess

**Course Content**

1. Roles of livestock in Ethiopian economy

2. Challenges and opportunities in commercializing livestock in Ethiopia

3. Supply chains of major livestock products

4. Characteristics of livestock/animal products

* Nutritional characteristics
* Safety and quality problems
* Post-harvest product losses

5. Handling and value addition of animal products

* Principles of Processing and Preservation of livestock Products
* Poultry and Poultry Products Handling & processing (Packaging, Transporting, chilling, preservation, Storage; Standardization, , Safety , Quality Control , Quality Standards)
* Milk and Milk Product Handling & processing (Straining/filtration, pasteurization, standardization, homogenization, cooling, Transporting, Packaging, Storage; Safety and Quality Control, Quality Standards)
* Meat and Meat Product Handling & processing (Chilling, Deboning, canning/sterilization, curing/salting, Transporting, Packaging, Storage; Safety and Quality Control, Quality Standards )
* Fish Handling & processing (Harvesting, chilling, preservation, Packaging, Transporting, Storage, Quality Control)
* Honey and Honey Product Handling & processing (Refining, Transporting, Packaging, Storage, Safety and Quality Control, Quality Standards )

6. Economic and biological benefits of value addition of livestock products

* Economic benefits of value addition/processing
* Biological benefits (quality and safety)
* Food security

7. Economic feasibility, social acceptability and environmental friendliness of processing and

preservation of animal/livestock products

8. Role of Gender in handling, processing, preservation and marketing of livestock products

**Mode of Course Delivery**

Interactive lecture, group discussion and presentations, term paper, field and company visits: students will visit different livestock farms, different livestock products processing industries and supermarkets and identify the possible loss types, factors affecting product quality, post harvest handling methods by chain actors.

**Assessment Methods**

Students will be assessed on continuous bases and summative exam. The continuous assessment consists of term paper writing, presentation, tests, and field reports. The minimum total weight for the elements in continuous assessment is 50%. The rest will be covered by final exam.

**References**

AGP-LMD (2013) Value chain analysis for Ethiopia: meat and live animal, dairy, hide, skin and leather products. Expanding livestock markets for small scale producers, USAID.

Cost benefit analysis of the dairy value chain in Ethiopia. USAID report.Available:http:/pdf.usaid.gov/pdf\_docs/pa00jp32.pdf.

Economic Commission for Africa (ECA). (2012). Report on livestock value chains in Eastern and Southern Africa: A regional perspective. Eighth Session of the Committee on Food Security and Sustainable Development and Regional Implementation Meeting for the Twentieth Session of the Commission on Sustainable Development, Addis Ababa, Ethiopia 19 - 21 November 2012.

FAO (2012) Designing and Implementing livestock value chain studies- A practical aid for highly pathogenic and emerging diseases control. FAO animal production and health guidelines No. 10. Rome.

FAO (2007) Meat processing technology for small to medium scale producers.FAO, regional office for Asia and the Pacfic.

Sahay, K.M. and Singh, K.K. (2001). Unit operation of agricultural processing 2nd Ed., Vikas

Publishing House Pvt. Ltd., New Delhi

[Sivasankar](http://www.amazon.com/s/ref=ntt_athr_dp_sr_1?_encoding=UTF8&field-author=B%20Sivasankar&ie=UTF8&search-alias=books&sort=relevancerank), B. (2004).Food Processing and Preservation, Prentice-Hall of India Pvt.Ltd.

<http://edepot.wur.nl/199075>

[http://www.beneluxshs.eu/wp](http://www.beneluxshs.eu/wp%0dcontent/uploads/2008/10/vandervorst_globalsourcing23november2007handout.pdf)

[content/uploads/2008/10/vandervorst\_globalsourcing23november2007handout.pdf](http://www.beneluxshs.eu/wp%0dcontent/uploads/2008/10/vandervorst_globalsourcing23november2007handout.pdf)

<http://ageconsearch.umn.edu/bitstream/121848/2/van%20der%20Vorst-ok.pdf>

<http://informs-sim.org/wsc05papers/204.pdf>

**Investment Analysis and Business Planning**

Course code: ABVM 522

Credit hour: 3

**Course Description:**

The course is aimed at equipping learners with the knowledge and skills that help in analyzing investment in agribusiness and develop business plan. The course generally covers the introductory concepts of investment, investment risk analysis, aspects of investment feasibility analysis, financial feasibility analysis of agribusiness investments, and development of business plans.

**Course Objectives**

At the end of this course, learners will be able to:

* Explain role and scope of investment
* Asses the investment environment
* Identify and measure investment risks
* Characterize the risk preference of investors
* Conduct risk diversification analysis
* Conceptualize of the steps of investment feasibility analysis
* Identify the aspects of investment feasibility analysis
* Conduct investment feasibility analysis using various methods
* Develop agribusiness plans

**Expected Competence**

* To plan
* To evaluate
* To analyze
* To develop
* To identify

[**1: Introduction**](#_Toc372061893)

* [Definition and Scope](#_Toc372061894)
* [Investment Environment](#_Toc372061895)
  + [Five forces of competition](#_Toc372061896)
  + [Investment vehicles and decisions](#_Toc372061897)
  + [Return on investment](#_Toc372061898)
  + [Breakeven analysis](#_Toc372061899)

**2:** [**Basics of Investment Feasibility**](#_Toc372061900) **Analysis**

* The Project Cycle
* [Steps in Investment Analysis](#_Toc372061901)
* [Financial Feasibility](#_Toc372061902)
* [Technical Feasibility](#_Toc372061903)
* [Marketing Feasibility](#_Toc372061904)
* Environmental feasibility
* [Socio-economic Aspect](#_Toc372061905)

**3:** [**Analysis of Risky**](#_Toc372061906) **Investments**

* [Measures of Return and Risk](#_Toc372061907)
* [Measures of expected return](#_Toc372061908)
* [Measures of risk](#_Toc372061909)
* [Probability distributions of returns](#_Toc372061910)
* [Decision rules for risk-return trade-off](#_Toc372061911)
* [Coefficient of variation](#_Toc372061912)
* [Highest lower bound (HLB)](#_Toc372061913)
* [Investors’ Utility Functions and Risk Preference](#_Toc372061915)
* [Risk-neutral utility functions](#_Toc372061916)
* [Risk-loving utility functions](#_Toc372061917)
* [Risk-averse utility functions](#_Toc372061918)
* [Indifference curves](#_Toc372061919)
* [Maximizing utility](#_Toc372061920)
* [Risk with Two Enterprises](#_Toc372061921)
* [Covariance](#_Toc372061922)
* [Correlation coefficient](#_Toc372061923)
* [Risk Diversification under Resource Constraints](#_Toc372061924)
* [Risk Diversification with More than Two Enterprises](#_Toc372061925)
* [Portfolio returns](#_Toc372061926)
* [Portfolio risk](#_Toc372061927)

**4**[**: Financial Feasibility and Investment Appraisal**](#_Toc372061928)

* [Time Value of Money](#_Toc372061929)
  + [Compounding and future values](#_Toc372061930)
  + [Discounting and present values](#_Toc372061931)
* [Methods of Investment Appraisal](#_Toc372061932)
  + [Basics](#_Toc372061933)
  + Non-discounted measures
    - [Cash flow method](#_Toc372061934)
    - [Payback method](#_Toc372061935)
    - [Accounting rate of return](#_Toc372061936)
  + [Discounted cash flow measures](#_Toc372061937)
    - [The NPV method](#_Toc372061938)
    - [Benefit-cost ratio](#_Toc372061939)
    - [The IRR method](#_Toc372061940)
  + [Profitability (or Excess NPV) index](#_Toc372061941)
* [Accounting for Risk in Investment Decisions](#_Toc372061942)
  + [Risk-adjusted cut-off rate](#_Toc372061943)
  + [Certainty equivalents approach](#_Toc372061944)
  + [Probability approach](#_Toc372061945)
  + [Sensitivity technique](#_Toc372061946)

**5**[**: Business Plan Development**](#_Toc372061947)

* [Meaning and Purposes of Business Planning](#_Toc372061948)
* [Elements of a Business Plan](#_Toc372061949)
  + [Business description](#_Toc372061950)
  + [Market analysis](#_Toc372061951)
  + [Competitor assessment](#_Toc372061952)
  + [Marketing plan](#_Toc372061953)
  + [Operating plan](#_Toc372061954)
  + [Financial plan](#_Toc372061955)
  + [Executive summary](#_Toc372061956)

**Mode of Course Delivery**

This course will be delivered through lectures, seminar papers and presentations, case studies and presentations, assignments, brainstorming sessions, and crossover discussions.

**Assessment Methods**

Continuous assessment will be employed. The assessment will be based on active participation in discussion of case-based tasks, presentations, seminars, assignments, and will account for at least 50% of the evaluation. The remaining goes for final exam.

[**References**](#_Toc372061957)

Belli, P., Anderson, J., Barnum, H., Dixon, J. and Tan, J-P. (2001). The Economic Analysis of Investment Operations: Analytical Tools and Practical Applications, Washington: The World Bank.

Berry, T., 2010. Start, Run and Grow Your business. Available at [www.bplans.com](http://www.bplans.com).

Ehmke, C., J. Fulton, J. Akridge, K. Erickson, S. Linton. Industry Analysis: The Five Forces. Availabl at http//:www.agecon.purdue.edu.nwventures.

GittingerJ.P.,1982.EconomicAnalysisofAgriculturalProjects.2nd edition,JohnsHopkinsUniversity Press.

Kirkpatrick, C. and Weiss, J. (eds.) (1996). Cost Benefit Analysis and Project Appraisal in Developing Countries, Cheltenham: Edward Elgar.

Levišauskait, K., 2010. Investment Analysis and Portfolio Management.Vytautas Magnus University Kaunas, Lithuania.

Potts, D. (2002). Project Planning and Analysis for Development, London: Lynne Rienner Publishers.

Schaper, M., Volery, T., Weber, P., & Lewis, K. (2010). Entrepreneurship and Small Business: 3rd Asia–Pacific Edition. Australia: John Wiley & Sons.

**International Trade**

Course Code: ABVM 532

Credit hours: 2

**Course Descriptions**:

Review of macroeconomic policy environment; the effects of economic policies on agribusiness and value chain management; Concepts of international trade and policy, classical and neo-classical theories of international trade, international patterns of trade and specializations, theory of trade protection, economic integration, and balance of payment foreign exchange market.

**Course objectives:**

Upon the completion of this course, student will able to:

* To Explain the meaning and nature of international trade
* To Analyze comparative advantage of a given country in the open economy
* To Identify global factors that affect local agribusiness and value chain management
* To Advice different stakeholders on how to be effective in international trade

**Expected Competence**

Upon the completion of this course, student will able to:

* To Explain the meaning and nature of international trade
* To Analyze comparative advantage of a given country in the open economy
* To Identify global factors that affect local agribusiness and value chain management
* To Advice different stakeholders on how to be effective in international trade

**Course contents:**

**1: Introduction**

* 1. Review of Macroeconomic policy environment
  2. Effects of economic policies on agribusiness and value chain management

1.3 Review of Concepts in international trade

1.4 Importance of agricultural trade to the economy.

1.5 Trends in agricultural trade

**2: The Theoretical Concepts Underlying International Trade**

2.1 Classical Theories of International Trade

2.2 Neoclassical Theories International Trade

**3: International Trade Policy Instruments**

3.1 Basic Trade Policy Instruments

3.2 Tariff and non tariff barriers to Trade

3.3 Trade Liberalization

3.3 Impact of Trade Policy Instruments

**4: International Trade and Developing Economy**

4.1 Importance and Implications of Foreign Trade for Developing Economy

4.2 Absolute and Comparative Advantages of Foreign Trade under Ethiopian condition

4.3 Composition of Ethiopia’s Foreign Trade Policy and Balance of Payments

4.4 Foreign exchange and world monetary systems

4.5 International institutions (UNCTAD, World Bank, IMF, GATT, WTO…) and their impact on the trade of developing countries.

4.5 Issues of access to WTO

**5: Emerging Issues in Agricultural Trade**

5.1 Global and Regional trade Integration and Implications

5.2 Foreign Demand, Supply and factor price Analysis

5.3 Market Entry Methods

5.4 Export Procedures & Documentations

5.5 Regulations Standards and Product Certification

5.6 Carbon Trade and other emerging issues in international trade

**Mode of course Delivery**

The course will be delivered through lectures, project works and assignments.

**Assessment Method**

Continuous assessment (Term paper, assignments and presentations) 50% and Final examination = 50%

**References:**

Corden, W. M. (1997) *Trade Policy and Economic Welfare.* Oxford University Press

Dixit, A. and Norman (1980).*Theory of International Trade,* Cambridge University Press: Cambridge.

Gandolfl, G (1987) *International Economics I: The pure Theory of International Trade*, Spinger-Verlag: Berlin

Krugman P.R and M. Obstfeld (2000) *International Economics: Theory and Policy.*MA: MA: Addison Wesley.

Markusen, J.R. and J.R. Melvin (1988) *The Theory of International Trade.* New York: Harper and Row.

Timmer (1986).*Getting Prices Right: The Scope and Limits of Agricultural Policy*. Ithaca, Cornell University Press

Tweeten, L. (1992). *Agricultural Trade: Principles and Policies.* Boulder: Westview Press.

Vousden, N. (1990) *The Economics of Trade Protection.* Cambridge University Press: Cambridge.

**Financial and Risk Management**

Course code: ABVM 542

Credit hour: 2

**Course Description**

The course covers issues in financial management; credit management; agricultural value chain finance; and agricultural risk assessment; and agricultural risk management.

**Course Objective**

After completion of this course, students will be able to:

* Analyze financial statements and interpret them
* Indentify the sources, roles, essentials of agribusiness credit, credit instruments and loan agreements
* Assess the basics of credit analysis and rating
* Evaluate information asymmetry and credit risk management
* Conceptualize the framework of value chain finance
* Compare the various innovations in value chain financing
* Indentify and assess the various risks and constraints in agribusiness
* Identify agribusiness risk management approaches and strategies.

**Expected Competence**

* To analyse
* To develop
* To manage
* To evaluate

**Course Content**

**1: Financial Management in Agribusiness**

* Basics of Financial Management
  + Meaning and dimension
  + Finance function
  + Objectives of financial management
  + Types of finance
* Techniques of Financial Analysis
* Analysis of Financial Structure
  + Liquidity
  + Solvency
* Financial Return Analysis
  + Structure
  + Earning performance

**2: Credit Management in Agribusiness**

* Roles and Essentials of Credit
* Sources of and Constraints in Agricultural Credit
* Advantages and Disadvantages of Credit
* Credit Instruments and Contracts
  + Credit instruments
  + Loan agreements
* Basics of Credit Analysis and Rating
  + Credit process
  + Credit analysis
  + Credit scoring and risk rating
* Information Asymmetry and Credit Risk Management

**3: Agricultural Value Chain Finance**

* Framework of Value Chain Finance
* Out grower Schemes
* Warehouse Receipt Finance
* Credit Guarantees
* Value Chain Intermediation
* Agricultural Factoring and Trade Receivables Finance
* Trade Credit
* Key Points in VCF

**4: Agribusiness Risk Assessment and management**

* Farm-level Risks and Constraints
* Supply Chain Risks
* Risk Assessment
  + Analyzing risky situations
  + Major risk variables
  + Dimensions of risk
* Risk Layering
* Approaches to Agribusiness Risk Management
* Agricultural risks and management strategies
* Agricultural insurance
  + Crop insurance products
  + Livestock insurance products
  + Risk layering in weather-related agricultural insurance
* Weather Index Insurance (WII)
  + Basics of WII
  + Weather parameters and payout structure
  + Advantages and disadvantages of index insurance
    - Advantages of index insurance
    - Challenges in index insurance

**Mode of Course Delivery**

This course will be delivered through lectures, seminar papers and presentations, case studies and presentations, assignments, brainstorming sessions, and crossover discussions.

**Assessment Methods**

Continuous assessment will be employed. The assessment will be based on active participation in discussion of case-based tasks, presentations, seminars, assignments, and will account for at least 50% of the evaluation. The remaining goes for final exam.

**References**

Berry, Ellinger, Hopkin and Baker, 2000.*Financial Management in Agriculture*,6th Edition Interstate Publishers.

Goodwillie, D., 2011. Comprehensive Guide to Farm Financial Management.Saskatchewan Ministry of Agriculture.

Jessop, R.,B. Diallo, M. Duursma, A. Mallek, J. Harms, and B. van Manen, 2012. Creating Access to Agricultural Finance Based on a Horizontal Study of Cambodia, Mali, Senegal, Tanzania, Thailand and Tunisia. AgenceFrançaise de Développement (AFD), France.

Lee, W.F., M.D. Boehlje, A.G. Nelson, and W.G. Murray, 1988.Agricultural Finance, 5th edition, Iowa State University Press, Ames, Iowa.

Rejda, J.E., 2003. Principles of Risk Management and Insurance, 8th edition, Pearson Education PLC, New Delhi.

WFP and IFAD, 2011. Weather Index-based Insurance in Agricultural Development: A Technical Guide. IFAD.

World Bank, 2011. Weather Index Insurance for Agriculture: Guidance for Development Practitioners. The World Bank, Washington, D.C.

**Research Methods in Agribusiness and Value Chains**

Course Code: ABVM 552

Credit Hours: 2

**Course Description**

The course provides students with advanced research techniques in Agri-business and value chain. It employs both quantitative and qualitative research techniques in Agri-business and value chain development. The course will cover areas of research problem identification, research design, methods of data collection & analysis, developing research proposal, scientific communication of research findings, and model applications.

**Course Objectives**

At the end of this course, learners will be able to:

* Apply skills of collecting, summarising and analyzing data
* Identify researchable problems in agribusiness and value chain
* Develop sound research proposal
* Conduct research
* Analyze data using appropriate quantitative techniques
* Communicate scientific findings in agribusiness and value chain

**Expected Competence**

* To develop
* To conduct
* To analyze
* To communicate
* To apply

**Course content**

**1: Concepts of Scientific Research**

* Types of Scientific Research
* Research in Agribusiness and Value Chains
* Systematic Process of Research

**2: Defining Research Problem**

* What is Research Problem?
* Defining and Formulating Research Problems
* Developing Research Questions, Hypotheses and Objectives

**3: Developing a Research Proposal**

* Research Proposals and Types
* Structure of Research Proposal

**4: Research Designs**

* Sampling
* Criteria for Selecting Sampling Procedures
* Types of Sample Designs (Probability and Non-probability sample designs)
* Determination of Sample Size
* Methods of Data Collection
* Methods and Tools of Data Collection
* Selection of Appropriate Methods for Data Collection

**5: Data Processing, Analysis, and Interpretation**

* Processing Operations (editing, coding, classification, tabulation)
* Selecting Variables and indicators
* Units of analysis (individual, households, groups, social artifacts)
* Consideration of Measurement Scales
* Types of Data Analysis
* Criteria for Selecting Analytical Tools

**6: Research Report Writing and Presentation**

* Types of Scientific Research Reports
* Characteristics of a good Report/Thesis
* Structure of Scientific Research Reports
* Publication and Authorship
* Presentations of Research Outputs
* Ethical Considerations in Research

**Mode of Course Delivery**

The mode of delivery for this course will mainly depend on lectures, presentations on scenario analysis, discussions and individual/group work on developing research proposal and writing reports.

**Assessment Methods**

The course evaluation will be both continuous assessment and final examination. At least 50 percent of the evaluation will be continuous assessment which includes assignments, tests, group work and presentations. The rest will be covered by final examination.

**References**

Alreck, P.L., Settle R. B. (2004). The Survey Research Handbook.Irwin Hill.Third Edition.

Angus Deaton (1998). The Analysis of Household Surveys: A Micro-econometric Approach to Development Policy. Baltimore: The Johns Hopkins University Press. (Chapters 1 and 2).

Anja, F., Ulrike G., Etti, W. 2009. Value Chain Analysis Methodologies in the Context of

Environment and Trade Research. Discussion Paper No. 429.

Babbies, E. (1989). The Practice of Social Research. New York: Wadsworth Publishing Company.

Brewerton, P. and Lynne M. (2001 ). Organizational Research Methods A Guide for Students and Researchers.London: Sage Publishers.

Casley, D.J., Lury, D. A., (1993). Data Collection in Developing Countries.Oxford: Oxford University Press.

Dennis J. C., and Krishma, K. (1988).Collection, Analysis and Use of Monitoring and Evaluation Data. Baltimore: John Hopkins University Press.

Dey, I. (1993).Qualitative Data Analysis.A User Friendly Guide for Social Scientists.

Environment and Trade Research. Discussion Paper No. 429

Ethridge, D. (1995**).** Research Methodology in Applied Economics: Organizing, Planning and Conducting Economic Research. Ames: Iowa State University Press.

Goode, W. J., and Paul K. H. (1981).Methods in Social Research.International Students Edition. Auckland: McGraw-Hill Book Company.

Malmfors, B., Phil G. and Michael G. (2004).Writing and Presenting Scientific Paper (2nd Ed.). Nottingham University.

Raphael, K. and Mike, M. (2003). A Handbook For Value Chain Research Prepared for the IDRC.

Raune, Janet. (2005). Essentials of Research Methods: A Guide to Social Science Research. Oxford: Blackwell Publishing

Sophie Laws (2003).Research for Rural Development: A Practical Guide. Sage Publications.

Verschuren, P. and Hans D. (1999).Designing a Research Project.Utrecht: LEMMA.

[www.advertisingadage.com](http://www.advertisingadage.com),

[www.ids.ac.uk/global](http://www.ids.ac.uk/global)

[www.kznbenchmarking.co.za](http://www.kznbenchmarking.co.za)

[www.nu.ac.za/csds](http://www.nu.ac.za/csds)

**Agribusiness Organization and Management**

Course Code: ABVM 562

Credit Hours: 2

**Course description**

The course is aimed at equipping learners with knowledge and skills in agribusiness organization and management. It covers introduction to agribusiness management; business types and forms; organizational behavior; strategic human resource management; consumer behavior; change management; farm business management; and resource mobilization and budgeting.

**Course Objectives:**

At the end of this course, learners will be able to:

* Explain agribusiness management
* Evaluate organizational behaviour
* Apply strategic human resource management
* Identify consumer behaviour
* Manage change
* Develop budget for agribusiness organization

**Expected Competence**

* To apply
* To analyse
* To explain
* To facilitate
* To develop
* To monitor
* To evaluate
* To negotiate

**Course Content**

1. Introduction to Agribusiness Management

* Concepts, Principles and Functions of agribusiness management
* Agribusiness Firms: Types, Characteristics and Development

1. Organizational Behavior

* Importance of Organizational Behaviour
* Models and Approaches of Organizational Behaviour
* Autocratic, Custodial, Supportive, and Collegial Models
* Bureaucracy and Scientific Management Approaches

1. Strategic Human Resource Management

* Job Analysis & Design
* Human Resource Management Functions

1. Change Management

* Change Management Process
* Conflict Management
* Roles of Gender in Change Management

1. Farm Business Management

* Physical Production Relationships
* Management Decisions
* Cost Relationships
* Risk and Uncertainty in Farm Business
* Consumer behaviour in Agri-business

1. Resource Mobilization and Budgeting

**Mode of Course Delivery**

This course relies on a variety of learning methods. Students-led discussions and presentations will be combined with instructor facilitated learning experiences and lectures. Some specific methods include lectures, reading assignments, group discussions, and case studies.

**Assessment Methods**

The assessment methods to be employed include continuous assessment (assignments, group work and presentations) at least 50% of the evaluation and the rest is final exam.

**References**

Cunningham, J. B. &Eberle, T. (1990).A Guide to Job Enrichment and redesign. Personnel, Feb 1990, p.57 in Newstrom, J. & Davis, K. (1993). [Organization Behavior: Human Behavior at Work](http://www.amazon.com/exec/obidos/tg/detail/-/007239675X/bigdogsbowlofbis/). New York: McGraw-Hill.

Davis , K. (1967). [Human relations at work: The dynamics of organizational behavior](http://www.amazon.com/HUMAN-RELATIONS-WORK-Organizational-Behavior/dp/B003BFNY0Y/). 9th ed., New York: McGraw-Hill

Knoster, T., Villa, R., & Thousand, J. (2000).A framework for thinking about systems change. In R. Villa & J. Thousand (Eds.), [Restructuring for caring and effective education: Piecing the puzzle together](http://www.amazon.com/Restructuring-Caring-Effective-Education-Together/dp/1557663866/bigdogsbowlofbis/) (pp. 93-128). Baltimore: Paul H. Brookes Publishing Co.

Koch, C. (2006). The New Science of Change. CIO Magazine, Sep 15, 2006 (pp 54-56). Also available on the web:<http://www.cio.com/archive/091506/change.html>

Newstrom, John W. & Davis, Keith (1993). [Organizational Behavior: Human Behavior at Work](http://www.amazon.com/exec/obidos/tg/detail/-/007239675X/bigdogsbowlofbis/). New York: McGraw-Hill.

Revans, R. W. (1982). [The Origin and Growth of Action Learning](http://www.amazon.com/Origins-Growth-Action-Learning/dp/9144990715/bigdogsbowlofbis/). Hunt, England: Chatwell-Bratt, Bickley.

Stephen PP. R. and Timothy A. J. (2012).Essentials of Organizational Behavior, 11thed.Umass ISOM MBA Custom Edition Edition.Pearson Prentice-Hall.

Stewart, J. (1991). [Managing Change Through Training and Development](http://www.amazon.com/Managing-Change-Through-Training-Development/dp/074941846X/bigdogsbowlofbis/). London: Kogan

John. M. Ivancevich, 1998. Human Resource Management, 7th ed.

Dessler, 1998. Human Resource Management , 9th ed.

Lioyd.L.Bayers and Leslie W.Rue, 1997.Human Resource Management.

Margaret Attwood and Stuart Dim Mock, 1999. Personnel management .

Margaret Foot Caroline Hook, 1998. Introducing Human Resource Management.

Wendell L. French, 1996. Human Resource Management.

Shaun Tyson and Alford york, 2001. An introduction to Human resource Management 1st ed.

**Economics of Climate Change**

Course Code: ABVM 572

Credit hour: 2

**Course Description**

This course covers concepts of climate change; climate change adaptation and mitigation; economic analysis of climate change and international agreements and climate policy instruments. It also gives emphasis on agribusiness value chains and climate change interaction, vulnerability, and resilience.

**Course Objectives**

After completing this course students will be able to:

* Apply concepts of economics in climate change
* Promote climate smart agribusiness value chains
* Analyze costs and benefits of climate change factors
* Advocate climate resilient policies and strategies

**Expected Competence**

* To analyse
* To facilitate
* To monitor
* To evaluate
* To advocate
* To promote

**Course content**

1: Introduction

* The Science of Climate Change &Variability
* Trends and Projections of Climate Variables
* Causes and Consequences of Climate Change
* Agriculture & climate change interactions
* Types of greenhouse gases and their effects

2: Climate change mitigation and adaptation

* Vulnerability to climate change in agribusiness value chains
* Mitigation and Adaptation: Emissions Control, Sequestration, Reengineering and related strategies
* Resilience to climate change

3: International Agreements and Climate Policy Instruments

* General Principles (Range of Policies, Widespread Participation, Unilateral Action, Cost Effective Institutions)
* Policy Responses to Climate Change: Carbon Taxes, Tradable Permits, Subsidies, incentives, Standards, R&D, and Technology Transfer
* International Policies and Agreements
* The Future of Climate Change Policy
* Ethiopian climate policy

4: Economic Analysis of Climate Change

* The Nature of Costs and Benefits (Timing of costs and Benefits, Uncertainties, Distribution of Benefits, Locational Considerations, additional benefits, Stringency Considerations)
* Costs of Greenhouse Gas Control: Cost Taxonomy, Bottom-up vs. Top-Down, Estimation of Control Costs
* Carbon stock assessment and trading
* Strategies to Consider Abatement Costs (Use of Economic Instruments, Use of Sinks, Reducing Distortionary taxes, Saving from Economic Approaches, Defining Emission Baselines, Narrow Agreements)
* Benefits of Greenhouse Gas Control: Scope of Benefits, Quantitative Estimates of Benefits
* Simple Models of Greenhouse Gas Emissions and Climate Change
* Integrated Assessment Models

**Mode of Course Delivery**

The mode of delivery for this course will mainly depend on lectures, presentations on scenario analysis, discussions and group work.

**Assessment Methods**

The course evaluation will be both continuous assessment and final examination. At least 50 percent of the evaluation will be continuous assessment which includes assignments, tests, group work and presentations. The rest will be covered by final examination.

**References**

Arnold J. Bloom, 2010, Global Climate Change: Convergence of Disciplines. University of California,Davis.

Council on Environmental Quality, 2010, *Interagency Climate Change Adaptation Task Force Progress Report*, Washington, DC: The White House.

E. A. Stanton and F. Ackerman, 2009, Climate and development economics: Balancing science, politics and equity, *Natural Resources Forum*, 33, 262-273.

J. Bicknell, D. Dodman, and D. Satterthwaite (eds), 2009, *Adapting Cities to Climate Change*, London: Earthscan.

OECD, 2010, *Adaptation to Climate Change* (includes various segments and links thereof for developing and developed country studies at [www.oecd.org](http://www.oecd.org))

P. K. Rao, 2011, Climate Change Adaptation: Economics, Policy, and Governance.

Perman et al. (2003), Natural Resource and Environmental Economics, Pearson Addison

S. Eriksen, et al, 2011, Why Not Every Response to Climate Change is a Good One: Identifying Principles for Sustainable Adaptation, *Climate and Development*, 3, 7-20.

UN Global Compact and Others, 2011, *Adapting for a Green Economy: Companies, Communities, and Climate Change*, report available at www. unglobalcompact.org

UNDP, 2010, *Adapting to Climate Change: Doing Development Differently*, UNDP Briefing Note, details and other links at [www.undp.org/climatechange/adapt/role.html](http://www.undp.org/climatechange/adapt/role.html)

Wesley.L. Berrang-Ford, et al, 2011, Are We Adapting to Climate Change, Global Environmental Change, 21, 25-33.

World Bank, 2010, *Economics of Adaptation to Climate Change*, Report of the World Bank, full report at [www.worldbank.org/eacc](http://www.worldbank.org/eacc)

World Bank, 2010, Mainstreaming Adaptation to Climate Change in Agriculture and Natural Resources Management Projects, available as Guidance Note 7 at www.worldbank.org/enr

**Operations Research**

Course Code: ABVM582

Credit hours: 2

**Course Description**

This course covers the origin, nature and impact of operational research, operational research modeling approach, introduction to linear programming, solving linear programming: graphic and simplex methods, revised simplex methods, duality theory and sensitivity analysis, nonlinear modeling, transportation and assignment problem, network models including project evaluation and review techniques (PERT) and critical path methods (CPM); software application at the end of each chapter.

**Course Objectives:** At the end of the course, students will be able to:

* Discuss the basic concepts of operations research and its applications
* Identify the various types of models in operations research
* Propose suitable decisions to resolve conflicts of interest among various sections of the organizations by seeking out optimal solution
* Apply linear programming model for analyzing operational problems in business (particularly in agricultural firms)
* Solve large system of linear equations using transportation problems model
* Apply the concept of transportation problem to allocate different resources to activities if the resource requires more than activity
* Apply the concept of assignment problem to assign different resources to activities on a one-to-one basis
* Apply the concept of sensitivity analysis to allocate scarce resources efficiently in agricultural firms
* Explain the basic Concepts of PERT/CPM techniques

**Course contents:**

**1: Introduction**

1.1. Development of operation research

1.2. Definitions and scope of operations research

1.3. Overview of the operations research modeling approach

1.4. Applications of operations research in Agribusiness and value chain management

**2: Linear Programming**

2.1. Basic Concepts and Assumptions of Linear Programming

2.2. Formulations of LPP

2.3. Methods of Solving LP

2.4. Tie Breaking in simplex method

2.5. The artificial variable (The Big M) technique

2.6. Minimization

2.7. Application of linear programming for agribusiness and value chain management

2.8 application of relevant programming software

**3: Duality theory and sensitivity analysis**

3.1. The essence of Duality theory

3.2. Economic interpretation of Duality

3.3. Primal-Dual relationship

3.4. The role of duality theory in sensitivity analysis

3.5. Sensitivity analysis

3.6. Duality theory and sensitivity analysis as applied in agribusiness and value chain management, practical examples

3.7 application of relevant programming software

**4: Transportation problem**

4.1. Formulation/construction of the model

4.2. Methods of solving Transportation problems

4.3. Special Cases in Transportation problem

**5: Assignment problem**

5.1 Formulation/construction of the model

5.2. Methods of solving assignment problems

5.3. Special cases in assignment problems

5.4. Practical examples for the applications of the transportation and assignment problems in agribusiness

**6: Network Analysis**

6.1. Basic concepts on net work

6.2. The critical path method (CPM)

6.3. Program evaluation and review technique (PERT)

6.4. Network analysis as applied in agribusiness and value chain management

**Mode of Course Delivery**

The course will be delivered through lectures, project works lab on software application and assignments.

**Assessment Method**

Continuous Assessment (Assignments, Test, and software Exercises) = 50% and Final examination = 50%

**References:**

J.K. Sharma, 1977. Operation Research, Theory and Application. Macmillan, New Delhi.

Hiller and Lieberman, 1986. Introduction to Operations Research, 4th ed.

Hamdy. A. Taha, 2007. Operation Research-An introduction, 8th ed. Prentice Hall, New Jersey

P.K Gupta and D.S Hira, 2007.Operations Research. Revised and enlarged edition 2007

F.S. Hiller and G.J. Lieberman: Introduction to Operations Research-Concepts and Cases, 9th Edition, Tata McGraw, 2010.

R.K. Ahuja, T.L.Magnati, B. Orlin: Network Flows-Theory, Algorithm and Applications, Prentice Hall, NJ, 1993.

J.D. Weist and F.K. Levy: A management guide to PERT/CPM, 2nd Edition, PHI,1967 (Reprint 2007).

Nesa Wu and Richard Coppins.Linear Programming and Extensions.McGraw Hill, Inc., 1981.

**Graduate Seminar in Agribusiness and Value Chain Management**

Course code: ABVM 592

Credit Hour: 1

**Course Description**

The course is expected to cover topics related to current issues and advances in agribusiness and value chain management such as policies, technologies, economic, social and environmental feasibilities as well as challenges and opportunities at local, national, regional and international levels.

**Course Objectives**

At the end of this course, students will be able to:

* Review and critically analyze scientific articles and papers related to advances in Agribusiness and value chain management
* Present scientific papers and with appropriate delivery methods using visual aids such as overheads, slides, posters and other computer generated techniques
* Prepare seminar paper on current issues of Agribusiness and value chain.
* Analyze emerging problems in agribusiness and value chain management and propose solutions

**Mode of Course Delivery**

Seminar coordinator gives orientation on seminar preparation and presentation procedures and gives other necessary supports.

**Assessment Methods**

Preparation and presentation of seminar paper on current issues of agribusiness and value chain; the presentation is evaluated by three relevant instructors and it accounts 100% (50% seminar document/paper, 50% presentation) of the evaluation. The seminar document has to follow proper seminar writing styles and stick to the research/scientific ethics and different from the M. Sc thesis topic.

**Master’s Thesis**

Course code: ABVM 602

Credit hour: 6

**Course Description**

Student selects a research topic related to agribusiness and value chain management, writes proposal, collects data (primary and/or secondary), analyze it and write thesis research report following the University graduate studies’ thesis guideline. The thesis should be original work of the student and usable for policy purposes. Both the proposal and the final thesis should be evaluated through open defense examinations.

**THE COLLABORATIVE MASTERS IN AGRICULTURAL AND APPLIED ECONOMICS**

**(CMAAE)**

**CORE COURSES**

**CAEC 501: Microeconomics**

**Classification:** Core **Number of Credits:** 3 **Semester:** 1

1. **Course Objectives**

This course provides a theoretical foundation in Economics and its application for almost all other courses in the programme. Specifically, the course is intended to enable students to:

* + Acquire a comprehensive understanding of the behaviour of individual economic agents (producers and consumers);
  + Understand microeconomics theory and tools needed for conceptualizing and modelling economic problems.
  + Apply microeconomic theories to problems of agriculture, rural development, and the environment; and
  + Acquire knowledge of the practical uses of microeconomics in research, management and policy.

1. **Expected Learning Outcomes**

By the end of the course, the students should be able to understand :

* + consumer theory and its applications
  + theory of the firm and its applications, and
  + the fundamental theorems of welfare economics and its applications.

1. **Prerequisites**

The students enrolled for this course are expected to have acquired competence in undergraduate Microeconomics and Mathematics. In Microeconomics, mastery up to the intermediate undergraduate level is expected. In Mathematics, students are expected to have a working knowledge of linear and matrix agebra, general calculus and differential calculus.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topics |  | Contact Hours | |  | Independent  Study | Total hrs |
| Lecture | Seminar | Practical | Subtotal |
| 1. Review of consumer theory | 2 | 1 |  | 3 | 12 | 15 |
| 2. Utility maximization | 3 |  | 1 | 4 | 12 | 16 |
| 3. Demand and Elasticity | 4 |  | 2 | 6 | 15 | 21 |
| 4. Income & Substitution  Effects | 3 | 1 | 1 | 5 | 15 | 20 |
| 5.Theory of revealed  Preference & applications | 3 |  | 1 | 4 | 12 | 16 |
| 6. Theory of the firm | 3 |  | 1 | 4 | 12 | 16 |
| 7. Choice under risk | 3 | 1 | 1 | 5 | 15 | 20 |
| 8. Consumption efficiency and gains from exchange | 3 |  | 1 | 4 | 12 | 16 |
| 9. Market Analysis | 3 |  | 2 | 5 | 15 | 20 |
| 10. Externalities & Public  Goods | 3 | 1 | 1 | 5 | 15 | 20 |
| Total | 30 | 4 | 11 | 45 | 135 | 180 |

**Course Description**

**Topic 1: Review of Consumer Theory**

 Consumer preference o The concept of utility

* + - * + Cardinal versus ordinal utility
        + Axioms of consumer preference
        + Mathematical form of the utility function o The difference between goods and bads o Indifference curves and marginal rate of substitution o The budget constraint set and the feasible set

o Homotheticity of preferences

 Four stylized types of utility functions o Perfect substitutes o Perfect complements

* + - * Cobb-Douglas
      * Constant elasticity of substitution (CES)
    - The concept of the individual and market demand function
    - Ordinary demand function o Derivation of ordinary demand function from indifference curves o Change in quantity demanded versus change in demand o Factors affecting change in demand
    - Inverse demand function

**Topic 2: Utility Maximization**

* + - Assumptions underlying the model of consumer optimisation
    - Utility maximization subject to the budget constraint
    - The Lagrangian technique for constrained optimisation o Mathematical procedure

o Economic interpretation of the Lagrangian multiplier

 Formal statement of the consumer’s problem o First-order condition for utility maximization

o Second-order condition for utility maximization (up to a case of 2 variables)

**Topic 3: Demand and Elasticity**

* + - Demand as a function of price of another good o Gross complements o Gross substitutes
    - Properties of demand function (Homogeneity, Adding up, Symmetry)
    - Derivation of demand functions o From Cobb-Douglas utility function o From CES utility function
    - Elasticity of demand (price, cross and income)
    - Engel function (demand as a function of income only) o Normal and inferior goods

o Income-consumption curve o Engel’s Law

* + - The indirect utility function
    - Market demand functions o Constructing market demand functions from individual demand functions

o Factors affecting shifts in market demand

 Elasticities for various types of demand functions o Linear demand functions

o Constant elasticity demand functions

* + - The relationship between price elasticity and total revenue for linear demand functions
    - Elasticity of substitution in consumption

**Topic 4: Income and Substitution Effects**

* + - Changes in the price of a normal good o For a luxury o For a necessity
    - Changes in the price of an inferior good o For inferior good o For Giffen good
    - Compensated and uncompensated demand functions o Derivation of compensated and uncompensated demand function o Comparison of uncompensated and compensated demand functions o Dual approach to the consumer’s problem contrasted with the primal approach

o The expenditure function

* + - * + Calculating the change in real income following a change in price
        + The concept of compensation and the optimal subsidy

 The Slutsky equation o Mathematical derivation

o Illustrated for normal and inferior goods

* + - Consumer surplus o Using compensated demand function to calculate consumer surplus o The relationship between compensation and consumer surplus o Comparison of consumer surplus estimated using uncompensated and compensated demand functions

**Topic 5: Theory of Revealed Preference and its Applications**

* + - Weak Axiom of revealed preference
    - Strong Axiom

**Topic 6: Theory of the Firm**

* + - Production Functions o Returns to scale

o Marginal rate of technical substitution o Elasticity of substitution in production

 Profit Maximization

o Derivation of factor demands and output supply

* + - Cost and Profit Functions
    - Cost Minimization
    - Relating Demand Functions to Profit Functions

**Topic 7: The Problem of Choice in Situations Involving Risk**

* + - The Axioms
    - Expected utility
    - Attitudes towards risk
    - Risk and insurance

**Topic 8: Consumption Efficiency and Gains from Exchange**

* + - Partial versus General equilibrium analysis
    - Edgeworth Box for an economy with consumption only o Assumptions o Initial endowments o Gains from exchange

o Pareto optimality and Pareto superiority o General competitive equilibrium

* + - First and second fundamental theorems of welfare economics for an economy with consumption only
    - Social welfare functions: income distribution and equity
    - The theory of the second best

**Topic 9: Market Analysis (Short and Long Run)**

* + - Perfect competition
    - Theory of contestable markets
    - Monopoly
    - Oligopoly
    - Game theory

**Topic 10: The Limits of the market (optional)**

* + - Externalities and efficiency effects
    - Public goods and free-rider problem
    - Role of information and property rights
    - Moral hazard and adverse selection, principal-agent problem

**Mode of Delivery**

The course materials will be delivered through lectures, reading and homework assignments. There will be 3 contact hours per week and a minimum of 9 hours of independent study per week for the 15-week semester.

**Assessment Methods**

|  |  |
| --- | --- |
| The following assessment methods will be used: |  |
|  Assignments & Continuous Assessment Tests (CATs) | 20% |
|  Midterm | 30% |
|  Final examination | 50% |

The assignments will consist of theoretical and applied microeconomic problems to be solved by the students. The CATs will be based on the lectures, readings, and homework assignments. The midterm and the final examinations will test the knowledge gained during the course.

**Course Materials**

***Recommended Textbooks***

* Nicholson, W., and Snyder 2008. *Microeconomic Theory: Basic Principles and Extensions, 10*th Edition. London: South-Western (Thomas Learning).
* Binger, Brian, and Elizabeth Hoffman. 1998. *Microeconomics with Calculus*, 2nd Edition. Reading, Massachusetts: Addison-Wesley.
* Hal, Varian. (2003). Intermediate Microeconomics, W.W. Norton & Co. New York.

**Further Readings**

* Baumol, William J. 1999. *Economic Theory and Operations Analysis*, 4th Edition. New Delhi: Prentice-Hall of India.
* \*Dowling, Edward T. 2001. *Schaum’s Outline: Introduction to Mathematical Economics*. 3rd Edition. New York: McGraw-Hill.
* Wetzstein, Michael. 2004. *Microeconomic Theory: Concepts and Connections with Economic Applications*. South-Western College Publishers.

**CAEC 502: Mathematics for Economists**

**Classification:** Core **Number of Credits:** 3 **Semester:** 1

1. **Course Objectives**

The general purpose of the course is to enable the students to understand the necessary mathematical concepts for Economics and apply them in economic models of the national and regional economy. The specific objectives are:

* + To equip the students with knowledge and skills to enable them apply mathematics in economic analyses;
  + To enable students use mathematics to understand the structure of economics;;
  + To facilitate the student to carry out quantitative analysis of economic systems;
  + To provide a framework for enabling the student to see the application of mathematical techniques to economics through examples.

1. **Expected Learning Outcomes**

At the end of the course, the student will be able to:

* + Learn to use and apply mathematics to develop new concepts and techniques in economics
  + Apply concepts of functions and linear algebra in developing and using basic economic models;
  + Apply calculus techniques (differential and integral) in maximization and minimization problems as well as marginal analysis and elasticity;
  + Apply differential and difference-based techniques in developing dynamic economic models;
  + Identify and solve optimisation problems in Agricultural Economics using various optimality criteria based on deterministic functions; and
  + Solve dynamic optimisation problems

1. **Prerequisites**

The student should have covered basic courses inclusive of the following aspects: (strong need for a bridging/preparatory course)

* + **Elementary matrix algebra and linear equations and inequalities:** Sets and set operations, basic matrix operations and inversions, properties of matrices, vectors and vector operations, input-output concept, graphical representation of equations, solutions to simultaneous linear equations, simple national income models, demand and supply curves, roots of the quadratic equation, break-even point, discontinuous functions.
  + **Series:** Arithmetic and geometric progressions, exponential series and logarithms, discounting, annuities and sinking funds, Taylor and MacLaurin series and theorems.
  + **Calculus:** Concept of derivatives as applied to elasticity of demand, maxima and minima, profit maximization, partial differentiation, basic integration techniques as related to consumer surplus and producer surplus.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topics** |  | Contact Hours | |  | Independe nt Study | Total Hrs |
| Lecture | Seminar | Practical | Sub-  total |
| 1. Application of Sets, functions and Linear Algebra in economic applications | 4 | - | 3 | **7** | 27 | **34** |
| 2. Differential & integral calculus applications in economics | 4 | - | 2 | **6** | 18 | **24** |
| 3. Differential & difference equations applications | 6 | - | 2 | **8** | 18 | **26** |
| 4. Elements of linear & non-linear programming | 9 | 2 | 4 | **15** | 45 | **60** |
| 5. Optimisation | 6 | - | 3 | **9** | 27 | **36** |
| **Total** | **29** | **2** | **14** | **45** | **135** | **180** |

1. **Course description**

**Topic 1: Application of Sets, Functions and Linear Algebra in Economic Applications**

* + - Review of matrix algebra and its applications, linear spaces and subspaces, convex and quasi-convex sets, interior and relative interior of convex sets, dimensions of convex sets, hyper-planes and extreme points of convex sets, review of series, continuity, differentiability and sub-differentiability of convex functions.
    - Linear systems and examples of linear models (linear models for production, Markov models of employment etc.), systems of linear equations, economic applications (budget sets in commodity space, the investment model etc.).
    - Portfolio analysis, activity analysis (for example, efficiency, Leontief models, feasibility analysis) and Taylor polynomials.

**Topic 2: Application of Differential and Integral Calculus in Economics**

* + - Review the rules of differentiation, implications of differentiation in economics, applications to cost and revenue analysis, profit maximization in several markets, maximization of tax revenue.
    - Review the rules of integration, implications of integration in economics, calculation of areas between curves, numerical methods of integration, producer and consumer surplus.
    - Review partial differentiation, total derivatives, implicit differentiation, maxima and minima, marginal analysis and elasticity of demand.

**Topic 3: Application of Differential and Difference Equations**

* + - Ordinary differential equations of the first and second order, homogeneous and non-homogeneous differential equations, existence and uniqueness of solutions of differential equations, concepts of partial differential equations and their applications, and systems of differential equations.
    - First- and second-order difference equations, systems of difference equations, economic models that emerge from difference equations such as cobweb model, compound interest and capital addition, consumption-investment models, and inflation unemployment models.
    - Concepts of stability and instability, stability and instability theorems, conditions for stability, stability tests, application to stability of price regulation process, indirect money metric utility functions and converse of Euler’s theorem.

**Topic 4: Elements of Linear and Non-Linear Programming**

* + - Application of convex set theory to programming, Lagrange function and its saddle points, duality and its implications, pairs of dual problems in Convex Programming (CP), Sleiter condition, Kuhn-Tucker theorem for CP, necessary and sufficient conditions for optimality for CP in differential form.
    - Application of quasi-convex functions to optimisation problems, necessary and sufficient conditions for optimality as applied to efficient resource use, utility maximization problems subject to budgetary constraints.
    - Linear programming and optimality conditions, general problems of linear and non-linear programming, local and global optimality, regularity conditions for constraints, Kuhn-Tucker theorem for smooth non-linear programming problems, theorems of marginal values for CP problems and their economic interpretation.
    - Differentiability of solutions and Lagrange multipliers of linear and non-linear programming problems, relations to marginal values.
    - Applications to the theory of demand using utility functions, demand functions and Slustky equation (decomposition of demand and supply), other economic models such as those based on dynamic programming.

**Topic 5: Optimisation and Dynamic Analysis**

* + - Constrained and unconstrained optimisations (first- and second-order conditions, global maxima and minima, economic applications such as profit maximization and cost minimization, discriminating monopolist, equality and inequality constraints, mixed constraints), constrained optimisation (multiplier, envelope theorems, bordered Hessian condition), homogeneous and homothetic functions.
    - Maximum principle as a necessary condition for optimality in finite interval for discrete and continuous time, example of model of planning with finite horizon, Ramsey’s model on infinite interval, model of optimal economic growth in discrete time, calculus of variations in continuous time, Euler equations as firstorder extremum condition, relationship between maximum principle and KuhnTucker theorem in discrete case, Pareto optimality and necessary and sufficient conditions.

1. **Mode of Delivery**

Each student will be expected to spend at least 3 hours of independent study for every contact hour on each topic. Practicals will focus on application of the techniques tospecific cases in agricultural and applied economics. Seminars will involve presentations of reviews and application on particular topics by each student for peer review.

The contact hours will be 3 lecture hours per week and 1 practical (math lab) hour per week for a total of 15 weeks.

1. **Assessment Method**

This will be through:

* + - Assignments and Seminar presentation (20%)
    - Mid-term examination (30%)
    - Final examination (50%)

1. **Course Materials**

**Recommended Textbooks** (check for updated versions)

* Simon, C. P., and L. Blume, 1994. *Mathematics for Economists*. W. W. Norton & Company.
* Mukras, M.S. 2008. *Mathematical Methods for Economics (Tools and Applications)*. Nairobi and Kampala: East African Educational Publishers Ltd.
* Chiang, A.C. 1984. *Fundamental Methods of Mathematical Economics*. 3rd ed., London:

McGraw-Hill Book Company.

**Further Readings**

* Silberberg, E. and W. Suer, 2001. *The Structure of Economics: a Mathematical Analysis* 3rd edition, McGraw-Hill Book Co.
* Samuelson, P. 1983. *Foundations of Economics Analysis.* London: Harvard University Press.  Timbrell, M. 1990. *Mathematics for Economists.* Oxford: Basil Blackwell.
* Weintraub, R. 1990. *Mathematics for Economists - An integrated Approach.* Cambridge: Cambridge University Press.
* Journal articles illustrating the use of mathematics in developing conceptual models which are then linked to empirical analyses.

**CAEC 505: Production Economics**

**Classification**: Core **Number of Credits**: 3 **Semester**: 2

1. **Course Objectives**

Specific goals of the course are for students to:

* + Develop a deeper understanding of the theories and methods of production economics
  + Apply the theory and methods of Production Economics to problems of agriculture, rural development, and the environment; and
  + Understand the practical use of Production Economics in research and management.

1. **Expected Learning Outcomes**

Students in this course are expected to gain knowledge and acquire the following competencies to:

* + Differentiate among technical , allocative and economic efficiencies and applications;
  + Understand & apply production, cost and profit functions in the short and long run;
  + Apply production theory to practical problems such as agricultural production response, risk and uncertainty in production
  + Understand and apply the household production model.

1. **Prerequisites**

Students enrolled for this course are expected to have completed MSc courses in Microeconomics and Mathematical Economics and to have fulfilled all prerequisites for those courses.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topics** |  | **Contact Hours** | |  | **Indepen dent study** | **Total hours** |
| **Lecture** | **Seminar** | **Practical** | **Sub-**  **total** |
| 1. Review of theory of the firm | 2 |  | 1 | 3 | 9 | **12** |
| 2. Technology | 3 | 2 | 4 | 9 | 27 | **36** |
| 3. Functional Forms | 3 |  | 1 | 4 | 16 | **20** |
| 4. Cost, Profit, and Supply  Functions of the Firm | 2 | 1 | 2 | 5 | 15 | **20** |
| 5. Cost Minimization and Profit  Maximization in the TwoInput Case | 4 |  | 4 | 8 | 24 | **32** |
| 6. Returns to Size and Returns to Scale | 1 |  | 1 | 2 | 6 | **8** |
| 7. Technical Efficiency andTechnology Adoption | 1 | 1 | 1 | 3 | 9 | **12** |
| 8. Risk & Uncertainty in  Production | 2 | 2 | 1 | 5 | 15 | **20** |
| 9. Household Production  Models for Smallholder  Agriculture | 2 | 2 | 2 | 6 | 18 | **24** |
| **Total** | **20** | **8** | **17** | **45** | **135** | **180** |

1. **Course Description**

**Topic 1: Review of Theory of the Firm**

* + - Production Functions
    - Returns to scale
    - Marginal rate of technical substitution
    - Elasticity of substitution in production

**Topic 2: Technology**

* + - Production sets and input requirement sets
    - Representing technology in one and two input cases
    - Production response surfaces
    - Isoquants o Marginal rate of substitution in production
      * Ridge lines
      * Relationship between marginal rate of substitution and marginal product o Using partial and total derivatives to derive the marginal rate of substitution

**Topic 3: Functional Forms**

* + - Linear functions
    - Cobb-Douglas function o Properties of the function o The dual cost function

o Constrained output or revenue maximization

* + - Cobb-Douglas function with variable input elasticities
    - Constant Elasticity of Substitution (CES) function o Properties

o Comparison with Cobb-Douglas function o Kuhn-Tucker conditions

* + - Flexible functional forms o Transcedental (Translog) function o Generalized Cobb Douglas function o Modified Cobb-Douglas function o Generalized Leontief function

**Topic 4: Cost, Profit, and Supply Functions of the Firm**

* + - Implicit (financial) versus economic (opportunity) costs
    - The cost function o Variable, fixed, and total costs
      * Average and marginal costs in the short and long run o Relationship between average and marginal costs
      * Properties of the cost function
    - The profit function o Hotellings Lemma
    - Duality in production o Relationship between cost and profit functions

o The cost function as the inverse of the production function

* + The supply function of the firm

**Topic 5: Profit Maximization and Cost Minimization in the Two-Input Case**

* + Unconstrained profit maximization
  + Constrained revenue maximization using the Lagrangian technique o The Lagrangian function o The Lagrangian multiplier o First- and second-order conditions o Interpretation of the Lagrangian multiplier
  + Profit functions and derived systems of output supply and factor demand
  + Comparative statistics
  + Isocost line
  + Isoclines and expansion path
  + Constrained cost minimization o Cost functions and associated systems of factor demands o Short-run versus long-run supply response

o Shephard's Lemma

* + Aggregate supply response

**Topic 6: Returns to Size and Returns to Scale**

* + Economies of size
  + Economies of scale
  + Homogeneous production functions
  + Euler’s Theorem and distribution
  + The relationship between returns to scale and production elasticities

**Topic 7: Efficiency Analysis**

* + Technical, allocative and economic efficiencies
  + Parametric and non parametric methods of efficiency analysis
  + The effect of farm-level management on productivity
  + Measuring the rate of technological adoption
  + Evaluating productivity gains from agricultural research

**Topic 8: Risk and Uncertainty in Production**

* + Farmer attitudes toward risk and uncertainty
  + Terminology: actions, states of nature, probability, consequences
  + Risk preference and utility
  + Marginal analysis under risk and uncertainty
  + Strategies for dealing with risk o Diversification o Multi-cropping o Low-risk crops o Government programs o Contracting o Insurance

**Topic 9: Household Production Model of Smallholder Agriculture**

* + Producer, consumer, and worker decisions in a household framework
  + Specification of the household model
  + Separable household model with perfect markets
  + Household model with market failures
  + When and how to use a household model

1. **Mode of Delivery**

The course material will be delivered through lectures, guided reading assignments, and homework assignments. The course will comprise of 3 credit hours. There will be 3 contact hours per week and a minimum 3 hours of independent study for each contact hour of a lecture.

1. **Assessment Methods**

The following assessment methods will be used:

* + Assignments and Continuous Assessment Tests (CATs) 20%
  + Midterm 30%
  + Final examination 50%

The assignments will consist of theoretical and applied problems of production economics to be solved by the student. The CATs will be based on the lectures, readings, and homework assignments. The mid-term and final examinations will test the knowledge gained throughout the course.

***8. Course Materials******Recommended Textbooks***

* Debertin, David L. 2004. *Agricultural Production Economics*. 3rd Edition. Privately published (similar to the 1st edition of Debertin published in 1986 by Macmillan).
* Beattie, B.R. and C. Robert Taylor, 1993. *The Economics of Production.* Krieger Publishing Co. Malabar, Florida.
* Chambers, Robert G. 1988. *Applied Production Analysis: A Dual Approach*. London: Cambridge University Press.

***Further Readings***

* Binger, Brian R., and Elizabeth Hoffman. 1998. *Microeconomics with Calculus*. 2nd Edition. Reading, Massachusetts: Addison-Wesley.
* Edriss, A. K. 2003. *The Dynamics of Groundnut Production: Efficiency, Profitability and Adoption of Technology in Sub-Saharan Africa*. International Publishers and Printer, Las Vegas and University of Malawi.
* Henderson, ? and ? Quandt, 1980. *Micro-Economic Theory: A Mathematical Approach*. 3rd edition. EC handbook series.
* Sadoulet, Elizabeth, and Alain de Janvry. 1995. *Quantitative Development Policy Analysis*. Baltimore: The Johns Hopkins University Press.
* Varian, R. H. 1984. *Microeconomics Analysis.* 2nd edition, W. W. Norton & Co. New York.
* Ali, Mubarak, and Derek Byerlee. 1991. “Economic Efficiency of Small Farmers in a

Changing World: A Survey of Recent Evidence.” *Journal of International*

*Development*, 3, 1-27.

* Alston, J.M., G.W. Norton, and P.G. Pardey. 1995. *Science under Scarcity: Principles and Practice of Agricultural Research Evaluation*. Chap 3. Ithaca, New York: Cornell University Press, 1995.
* Beattie, Bruce R. 1993. *The Economics of Production*. Melbourne, Florida: Krieger Publishing Co.
* Beneke, P.R., and R. Winterboer. 1973. *Linear Programming: Applications to Agriculture*. Ames: Iowa State University Press.
* Block, Steven A. 1994. “A New View of Agricultural Productivity in Sub-Saharan Africa.” *American Journal of Agricultural Economics*, Vol. 76, pp. 619-624.
* Cornia, Giovanni Andrea. 1985. “Farm Size, Land Yields, and the Agricultural

Production Function: An Analysis of Fifteen Developing Countries.” *World Development*, Vol. 13, No. 4, pp. 513-534.

* Dalton, T.J., W.A. Masters and K.A. Foster, "Production costs and input substitution in Zimbabwe’s smallholder agriculture,” *Agricultural Economics*, Vol 17,Issues 2-3, December 1997, Pages 201-209.
* Dawson, P.J., and J. Lingard. 1991. “Approaches to Measuring Technical Efficiency on Philippine Rice Farms.” *Journal of International Development*, Vol. 3, No. 3, pp. 211-228.
* Doll, John P., and Frank Orazem. 1992. *Production Economics: Theory with Applications*. Melbourne, Florida: Krieger Publishing Co.
* Feder, Gershon, Richard E. Just, and David Zilberman. 1985. “Adoption of

Agricultural Innovations in Developing Countries: A Survey.” *Economic*

*Development and Cultural Change*, Vol. 33, pp. 255-298.

* Frank, Michael D., Bruce R. Beattie, and Mary E. Embleton. 1990. “A Comparison of Alternative Crop Response Models.” *American Journal of Agricultural Economics*, Vol. 72, pp. 597-603.
* Griffin, Ronald C., John M. Montgomery, and M. Edward Rister. 1987. “Selecting Functional Form in Production Function Analysis.” *Western Journal of Agricultural Economics*, Vol. 12, pp. 216-227.
* Hattink, Wolter, Nico Heerink, and Geert Thijssen. 1998. “Supply Response of Cocoa in Ghana: A Farm-Level Profit Function Analysis.” *Journal of African Economies*, Vol. 7, No. 3, pp. 424-444.
* Hazell, P.B. and R.D. Norton. 1986. *Mathematical Programming for Economic Analysis in Agriculture.* New York: Macmillan Publishing Co. (Out of print but available free of charge on-line at www.ifpri.org)
* Heady, E. O. and J.L. Dillon. 1961. *Agricultural Production Functions*. Ames: Iowa State University Press.
* Henderson, J.M., and R.E. Quandt. 1980. *Microeconomic Theory: A Mathematical Approach*. 3rd Edition. London: MacGraw-Hill Book Company.
* Intrilligator, Michael D. 1978. “Applications to Firms: Production and Cost Functions.” Chapter 8 in *Econometric Models, Techniques and Applications*. Englewood Cliffs, New Jersey: Prentice-Hall.
* Jayne, T.S., Yougesh Khatri, Colin Thirtle, and Thomas Reardon. 1994. “Determinants of Productivity Change Using a Profit Function: Smallholder Agriculture in Zimbabwe.” *American Journal of Agricultural Economics*, Vol. 76, pp. 613-618.
* Junankar, P.N. 1989. “The Response of Peasant Farmers to Price Incentives: The Use and Misuse of Profit Functions.” *The Journal of Development Studies*, Vol. 25, No. 2, pp. 169-182.
* Koutsoyiannis, A. 1979. *Microeconomics*. 2nd Edition. London: Macmillan Press Ltd.
* Lau, Lawrence J. 1986. “Functional Forms in Econometric Model Building.” In Z. Griliches and M.D. Intrilligator, eds., *Handbook of Econometrics*, Vol. III. Amsterdam: Elsevier.
* Nkonya, Ephraim, Ted Schroeder, and David Norman. 1997. “Factors Affecting

Adoption of Improved Seed and Fertilizer in Northern Tanzania.” *Journal of Agricultural Economics*, Vol. 48, No. 1, pp. 1-13.

**CAEC 506: Macroeconomics**

**Classification:** Core **Number of Credits:** 3 **Semester:** 2

1. **Course Objectives**

The aim of this course is to expose students to different approaches in macroeconomics, develop critical perspective in theory and application of macroeconomic theory.

The objectives of the course are:

* + To develop a thorough knowledge of different approaches in macroeconomics;
  + Develop a critical perspective in macroeconomics theory and applications;
  + Expose students to the nature and importance of linkages between agriculture and the macroeconomy; and
  + Examine theories and methods applied in developing countries

1. **Expected Learning Outcomes**

At the end of the course students should be able to:

* + Demonstrate an understanding of the structure of a macroeconomic system and the underlying theoretical framework as well as controversies and debates;
  + Apply methodology and techniques used in conceptualizing macroeconomic

issues;

* + Analyse relevant macroeconomic policies and issues, especially those that relate to agriculture; and
  + Evaluate macroeconomic policies and their impacts in contemporary developing countries.

1. **Prerequisites**

Students are required to have completed at least intermediate macroeconomics at undergraduate level. In addition, students are required to have knowledge of mathematical economics, especially matrix algebra and differential calculus. Those not meeting these prerequisites will be required to take remedial courses.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topic** |  | **Contact Hours** | |  |  |  |
| **Theory** | **Seminar** | **Practical**  **/Tutorials** | **Sub-**  **total** | **Independent**  **Study** | **Total**  **Hours** |
| 1. Review of macroeconomics and Keynesian Economics | 3 |  | 0 | 3 | 15 | 18 |
| 2. IS-LM model, extension and microeconomic foundations of macroeconomics, | 5 |  | 2 | 7 | 24 | 31 |
| 3. Open macroeconomic theory | 5 |  | 1 | 6 | 15 | 21 |
| 4. Consumption, Savings, Investment Theories, and applications | 6 |  | 2 | 8 | 18 | 26 |
| 5. Growth models and  SAM | 6 | 0 | 3 | 9 | 27 | 36 |
| 6. Business cycle theories and application to agriculture | 5 |  | 1 | 6 | 18 | 24 |
|  |  |  |  |  |  |  |
| 7. Labour market, inflation and  unemployment | 5 | 0 | 1 | 6 | 18 | 24 |
| **Total** | **35** | **0** | **10** | **45** | **135** | **180** |

1. **Detailed Description of Topics**

**Topic 1: Review of Basic Macroeconomics (Comparative Statics) and Keynesian theory**

* + The development of macroeconomics, historical development.

o The success and failures of Keynesian economics; o The circular flow of income and national income determination; o Equilibrium analysis – market clearing, microeconomic foundations.

* + Keynesian Consumption and Savings functions and Multiplier o Keynesian treatment of labour markets o Liquid Preference Theory o Liquidity Trap and Monetary Policy o The economics of less than full employment.

**Topic 2: IS-LM Model, Extensions, and Foundations of Macroeconomics**

* + Endogenous investment and integration of goods market and money market o Endogenous investment o The IS curve and product market o The LM curve and the money market o Integrating goods and money market

o Determination of interest rates in the goods and money market

* + Fiscal and Monetary policy in IS-LM framework o Comparative static analysis – shifts in the IS function

o Comparative static analysis – shift in the LM function o Fiscal and monetary multipliers o Fiscal policy and crowding-out process o Effectiveness of monetary policy o Neo-Classical version of IS-LM model

* + The Lucas Critique and rational expectations o New Classical Macroeconomics o Static and rational expectations
    - * The Lucas Critique o Sticky wages and prices
      * Policy ineffectiveness with rational expectations
  + New Keynesian Economic Theory o Nominal and real rigidities
    - Capital market imperfections and asymmetric information

**Topic 3 : Open Macroeconomic Theories**

* + Contrast between closed and open economy IS-LM model o The BP line
  + The IS-LM-BP model of an open economy, floating and fixed exchange rates, the Mundell-Fleming model
    - Effect of changes in exchange rates on a country’s international transactions, and balance of payments
    - Balance of payments theories: elasticities, absorption and the monetary approaches.
    - The Dutch disease, two sector dependent model o Parallel foreign exchange markets and the unification problem o Trade liberalisation and the macroeconomy
  + The aggregate demand and supply model of an open economy o Features of international trade and borrowing

**Topic 4: Consumption, Savings, and Investment Theories and Application in Agriculture**

* + Keynesian Consumption Function o Factors affecting consumer spending o Factors affecting consumer savings
    - Functional relationship between desired consumption and saving
  + Permanent Income Hypothesis o Effect of temporary change in income o Effect of permanent change in income
  + Life Cycle Hypothesis (Modigliani), and the Role of Wealth-Kuznet’s Paradox o Relationship between income-consumption and age of a person o Relationship between savings and age of a person
  + Overlapping Generations Model o Relationship between a person’s accumulation of capital stock and age
  + Altruistic Motive and Bequests to Children Motives (Harry Becker and Robert Barrow) Deficit Financing and Saving, and Ricardian Equivalence o Fiscal Policy and features o Ricardian Equivalence proposition
  + Business Fixed Investment and Capital Stock Adjustment, Tobin’s ‘q’ ratio, the acceleration theory of investment
    - Determination of the desired stock of capital
    - Functional and graphical relationships between investment and capital stock, and marginal product of capital.
  + Deficit financing and crowding out process

**Topic 5: Growth Models and Social Accounting Matrix**

* + Background to economic growth analysis, the Harrod-Domar model
  + The neoclassical growth model o Changes in the saving rate
    - Population growth and technical progress o Application to performance of African Economies
  + The endogenous growth model o Application to African Economies
  + Social accounting Matrix framework and analysis o Income and asset distribution strategies

**Topic 6: Business Cycle Theories and Applications** o Measurement of business cycles o Theories of fluctuations

* + - Empirical applications

**Topic 7: The Labour Market, Inflation, and Unemployment**

* + Inflation and unemployment: the Phillips curve; rational expectations. o Efficiency wages
    - Wage rigidity and unemployment o Labour heterogeneity
    - Minimum wages and unemployment
  + Segmented labour markets in Developing countries
  + Unemployment and inflation in African economies

1. **Mode of Delivery**

The delivery methods will include lectures and tutorials.

1. **Assessment Method**

Assessment shall be a combination of a test, a term paper and two assignments. There will also be a final examination whose weight shall be 50% of the total assessment. The distribution of the rest of the 50 percent of the continuous assessment shall be, 20 percent for test and assignments and 30 percent for term paper. The timing of each assessment is left to the individual lecturer so as to maintain some flexibility.

1. **Course Materials**
2. **Required Textbooks**
   * Agenor, P. and P.J. Montiel. 2000. Development Macroeconomics, Princeton University Press.
   * Blanchard, O. 2003. *Macroeconomics* (Third Edition) Prentice Hall.
   * Branson, W.H. 1989. *Macroeconomic Theory and Policy*. Harper & Row Publishers, New York (Third Edition)
   * Romer, D. 2001. *Advanced Macroeconomics*, 2nd Ed. New York: McGraw Hill

1. **Further Readings**
   * -Andrew, Abel B. and Ben S. Bernanke. 2004. Macroeconomics 5th

Edition.Addison Wesley, Chapters 4 and 5.

* + -Branson, William H. 1989. *Macroeconomics: An Introduction to KeynesianNeoclassical Controversies*, English Language Book Society (ELBS and Macmillan). Chapter 2.
  + -Chowdhurry, A. and C. Kirkpatrick.. 1994. *Development Policy and Planning: An Introduction to Models and Techniques*, London and New York: Rutledge.
  + -Collier P. and ? Lal, 1986. *Labour and Poverty in Ken*ya 1980-1990 Clarendon Press
  + -Dixit, A and R. Pindyick. 1994. *Investment under Uncertainty New Jersey*, Princeton University Press.
  + -Deaton, A. 1989. Saving in Developing Countries: Theory and review.” *Proceedings of the World Bank Annual Conference on Development Economics*, pp. 61-96. Also at [www.worldbank.org.](http://www.worldbank.org/)
  + -Dornbush, R., S. Fisher and R. Startz. 2000. *Macroeconomics*, 8th Edition. Irwin:McGraw-Hill.
  + -Elbadawi, I. A. 1996. “Consolidating Macroeconomic Stabilization and Restoring
  + - Heijdra, B.J. and F. van der Ploeg. 2002. *The Foundations of Modern Microeconomics*. Oxford: University Press.
  + -Jha, Raghbendra. 1994. *Macroeconomics for Developing Countries*. London: Rutledge.
  + -Jones, C.I.(2002. *Introduction to Economic Growth.*2nd Ed. New York, WW Norton.
  + -Hugon, P.1990. *Economic Growth and Adjustment in Central Af*rica. Upper Monclair: Centre for Economic Research of Africa.
  + Huseyin, S. 1996. Social Accounting Matrix (SAM) and its applications for Macroeconomic Planning.Unpublished assessed article, Bradford University, DPPC, Bradford, UK.
  + IMF 1997. “Exchange Rate Arrangements and economic performance in developing countries” Chapter 4 in *IMF World Economic Outlook* Washington: IMF.

1. **Case studies** 
   * Chhibber, A. and N. Shafiq. 1992, “The Inflationary Consequences of devaluation with Parallel Markets: The Case of Ghana,” In Carbo, Stanley Fischer, and S. Webb, Eds. (1992), *Adjustment Lending Revisited*. Washington, D.C: The World Bank.
   * Kwanashie, M.; A-G. Garba and I. Ajilima. 1997. *Policy Modelling in Agriculture: testing the Response of Agriculture to Adjustment Policies in Nigeri*a. March
   * Jebuni C.D., N.K, Sowa and K.S. Tutu 1991. “Exchange Rate Policy and Macroeconomic Performance in Ghana” *AERC Research Paper* No. 6.
   * Mwase, N. 1998. Economic Liberalisation and Privatisation of Agricultural Marketing and Input Supply in Tanzania: A Case Study of Cashew Nuts. African

Economic Research Consortium

**CAEC 507: Econometrics**

**Classification:** Core **Number of Credits:**3 **Semester:**2

1. **Course Objectives**

This Econometric course is designed to bridge the gap between theory and policy analysis by providing insights on how amalgamation of economic theory, statistics and mathematics can be used to provide useful information to policy analysts and decision makers.

The specific objectives of the course are to:

* + Develop an understanding of the theory and application of Econometrics to quantifying economic relationships and testing economic theories;
  + Provide students a working knowledge to apply modelling, estimation, inference and forecasting in the context of real world economic problems;
  + Enable students to translate results from econometric analysis based on economic principles into useful and reliable policy reasoning;
  + Equip students to read, understand and evaluate empirical papers in professional journals

1. **Expected Learning Outcomes**

By the end of the course the students should:

* + Have solid understanding of various regression models, their underlying assumptions and the consequences of violating them;
  + Understand how to specify an econometric model and conduct the necessary diagnostic and specification tests;
  + Have an appreciation of emerging econometric techniques
  + Be able to conduct their own empirical investigations and critically evaluate econometric and other statistical estimations and inferences; and
  + Understand literature addressing economic issues and be able to critically review their methodology and interpretation of results.

1. **Prerequisites**

Students enrolled for this course are expected to have completed MSc courses in Microeconomics and Mathematical Economics and to have fulfilled all prerequisites for those courses, particularly Statistics for Economists.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topics** | **Contact Hours** | | |  | **Independent**  **Study** | **Total**  **Hrs** |
| **Lecture** | **Semin**  **ar** | **Practica**  **ls** | **Sub**  **-**  **tota**  **l** |  |  |
| 1. Review of concepts of  Econometrics | 3 | - | 1 | **4** | 12 | **16** |
| 2. Problems in modelling, specification and estimation, and their solutions | 8 | - | 3 | **11** | 27 | **38** |
| 3. Qualitative and  Limited Dependent  Variable Models | 8 | - | 3 | **11** | 27 | **38** |
| 4. Simultaneous  Equation Models | 6 | - | 2 | **8** | 21 | **29** |
| 5. Impact analysis methods | 5 | - | 3 | **8** | 24 | **32** |
| **Total** | **30** | **-** | **45** | **52** | **132** | **180** |

1. **Course Description**

**Topic 1: Review of concepts of Econometrics**

 The purpose and applications of Econometrics o Working definition

* + - * The kinds of problems handled by econometrics
      * What is econometrics? The link between economic theory, mathematics, and statistics and examples of the amalgamated concepts and their applications
    - Review of regression model essentials (assumptions, parameter estimates, ANOVA and Goodness-of-fit)
    - Review of Estimators o Ordinary Least Squares (OLS) o Generalized Least Squares (GLS) o Maximum Likelihood (ML)

o Instrumental Variables (IV)

**Topic 2: Problems in modelling, Specification, Estimation and their Solutions**

* + - Heteroskedasticity - nature, detecting, diagnosing and remedy
    - Autocorrelation **-**nature, detecting, diagnosing and remedy
    - Multicollinerity - nature, detecting, diagnosing and remedy
    - Non-normality - nature, detecting, diagnosing and remedy
    - Heteroskedasticity - nature, detecting, diagnosing and remedy
    - Specification Errors and Tests – the Hausman test for endogeneity and testing for instrument validity

**Topic 3: Qualitative and Limited-Dependent Variable Models**

* + - Applying qualitative variables: dummy independent and dummy dependent variables
    - Models with Binary Dependent variables: linear probability model, logit model, probit model and interpretations
    - Multinomial logit: multinomial logit choice probabilities, ordered logit/probit, maximum likelihood estimation and post-estimation analysis
    - Models for Count Data: Poisson regression model, test for over-dispersion, negative binomial model; and interpretation of Count data models
    - Limited Dependent Variables: Censored data; Truncated variables, The Tobit model and its interpretation
    - Sample selection: selection equation, selectivity problem, and Heckit (Heckman model)

**Topic 4: Simultaneous Equations Models**

* + - Endogenous and exogenous variables
    - The Reduced form equations
    - The identification problem
    - Estimation of simultaneous equations: maximum likelihood, two-stage and three stage least squares estimation
    - Recursive models (eg. Double Hurdle Models)

**Topic 5: Impact Analysis Method**

* + - Propensity Score Matching (PSM)
    - Difference-in-Difference (DID)
    - Reflexive Method
    - Triangulation Method
    - Pannel Data FE and RE Models

1. **Mode of Delivery**

The course aims to balance theory and hands-on experience while working with economic data. As such, the lectures will emphasize the practical uses of econometric theory, and students will have ample opportunity to put this to use in computerbased assignments, including a project paper. In addition, students will select articles of their choice from professional journals for critical review and presentation in class as a basis for discussion regarding application of econometrics in analysis of economic problems.

* + - **Lectures (Theory)**

There will be 2 lectures per week each lasting for 60 minutes (that is, 2 contact hours per week). Students will be expected to undertake a minimum of 3 hours of independent study for every 1 contact hour.

* + - **Practical Classes**

There will be 1 hour of practical class per week. Each practical class will be preceded by a computer tutorial where the relevant commands for performing that week’s exercise will be introduced. The course instructor will identify relevant data sets (cross-section and time-series) for use in the practical classes. It is recommended that students are exposed to the following free or open source data sets: Living Standards Measuremnet Survey data sets, FAO data sets and other relevant open source data. The textbook by Greene contains data sets and examples (including computer codes). Each student will subject his/her data set to various econometric tests and write a report.

* + - **Computer Tutorials**

As the course involves a considerable amount of computing, students will have to learn and use selected econometric software packages. Three econometric software packages that are highly recommended are SPSS, STATA, EVIEW and LIMDEP. The recommended packages are widely used and are window-based thus reducing the amount of programming until the user acquires sufficient experience[[1]](#footnote-1). ***7.* Assessment Methods**

The assessment criteria and their respective weights will be as follows:

* + - Assignments (20%)
    - Mid-term Examination (30%)
    - Final Examination (50%)

The examination will be held at the end of the semester.

**8. Course Materials**

**Recommended Textbooks**

* Johnston, J., and J. Dinardo. 2007, Econometric Methods. Fourth International Edition. The McGraw-Hill Companies, Inc.
* Maddala, G.S. 2002. Introduction to Econometrics, Prentice Hall International, 3rd ed.
* Greene, W. H. 2000. Econometric Analysis. Fourth Edition. Prentice Hall

International.

**Further Readings**

* Alderman, Harold. 1993. “International Price Transmission: Analysis of Food Markets in Ghana.” *Oxford Bulletin of Economics and Statistics* 55:pp 43-64.
* Barrett, C.B. 1997. Liberalization and Food Price Distributions ARCH-?M Evidence from Madagascar. *Food Policy* 22 (2), pp. 155-173.
* Benjamin, Dwayne, and Angus Deaton. 1993. “Household Welfare and the Pricing of Cocoa and Coffee in Côte d’Ivoìre: Lessons from the Living Standards Surveys.” *The World Bank Economic Review*, 7, 293-318.
* Bouis, Howarth E. 1994. “The Effect of Income on Demand for Food in Poor Countries: Are Our Databases Giving Us Reliable Estimates?” *Journal of Development Economics 44: pp. 199-226.*
* Box, G.E. and G Jenkins. 1976. Time Series Analysis: Forecasting and Control. Holden-Day, Inc. *(Time Series Analysis).*
* Budd, John W., 1993. “Changing Food Prices and Rural Welfare: A Non-parametric Examination of the Côte d’Ivoìre*. “Economic Development and Cultural Change*, 41, pp. 587-603.
* Cornia, Andrea. 1995. “Farm Size, Land Yields, and the Agricultural Production Function: An Analysis for Fifteen Developing Countries.” *World Development* 13: pp. 513-34.
* Deaton, Angus. 1997. *The Analysis of Household Surveys: A Micro-econometric Approach to Development Policy.* The Johns Hopkins University Press.
* Delgado, Christopher. 1988. “A Variance Components Approach to Food-Grain Markets Integration in Northern Nigeria.” *American Journal of Agricultural Economics* 68: pp. 970-79.
* Goetz, Stephan. 1992. “A Selectivity Model of Household Food Marketing Behavior in Sub-Saharan Africa.” *American Journal of Agricultural Economics* 74: pp. 444-52.
* Gujarati, D. (2001). *Basic Econometrics*. McGraw-Hill, Tokyo.
* Hassan R. M. 1996. Planting Strategies of Maize Farmers in Kenya: A Simultaneous Equations Analysis in The Presence of Discrete Dependent Variables. *Agricultural Economics* 15 (2), pp.137-149.
* Judge, G.G., W.E. Griffiths, R.C. Hil and T.C. Lee. 1980.. *Introduction to the Theory and Practice of Econometrics,* New York: John Wiley.
* Jutting, J. 2000. Transmission of Price Shifts in the Context of Structural Adjustment: An Empirical Analysis for Staple Food after the Devaluation of The Franc CFA in Ivory Coast. *Agricultural Economics* 22 (1), pp. 67-74.
* Lutz, C., Tilburg, A. van Kamp B. J. van der. 1995. The Process of Short- and LongTerm Price Integration in the Benin Maize Market. *European Review of Agricultural Economics* 22 (2), 191-212.
* Sadoulet, E. and Alain de Janvry. 1995. *Quantitative Development Policy Analysis,* The Johns Hopkins University Press.

**CAEC 508: Research Methods in Agricultural & Applied Economics**

**Classification:** Core **Number of credits:** 3 **Semester**2

1. **Course Objectives**

The objective of the course is to equip students with the tools and skills for proposal development and subsequently for thesis writing in agricultural and applied economics.

Specifically, the course aims at making students:

* 1. Understand how to identify a research problem;
  2. Generate appropriate objectives and hypotheses;
  3. Develop appropriate research methods to address the objectives;
  4. Acquire knowledge of relevant data collection methods and analytical skills;
  5. Apply principles of writing good reports; and
  6. Undertake policy-relevant research in Agriculture

1. **Expected Learning Outcomes**

At the end of the course, the student will:

* + Acquire an understanding of the role of effective research for development;
  + Be able to explain systematically and illustrate essential components of the scientific research process (defining the research focus, formulating questions and hypotheses, research design, data collection and analysis, report writing);
  + Develop skills in a range of research tools (qualitative and quantitative) relevant for agricultural economists engaged in a variety of research and development efforts;
  + Apply quantitative and qualitative data analysis techniques used to organize data into some meaningful form;
  + Appreciate the advantages, limitations and complementarities of different research approaches and methods according to context, purpose of research and type of data required;
  + Acquire skills required in the management and processing of data, including commonly used statistical packages such as SPSS and STATA;
  + Be exposed to important components of the process of research management; and  Be able to undertake a postgraduate research project for their thesis.

**3 Prerequisites**

In addition to the need to have acquired competence in basic statistics, it is desirable that students are exposed to selected topics in agricultural and applied economics prior to embarking on the research methods course.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topic** | **Suggested contact hours** | | |  |  |  |
| **Lecture** | **Seminar** | **Practical** | **Sub-**  **total** | **Independent study** | **Total hours** |
| 1. Research in perspective;Some frameworks of methods  for research for development work | 4 |  |  | 4 | 10 | 14 |
| 2. Selecting a research design | 2 |  |  | 2 | 9 | 11 |
| 3 . Planning and managing research for development | 5 | 3 | 3 | 11 | 14 | 25 |
| 4 . Types of data – using primary and secondary data sources | 2 |  |  | 2 | 9 | 11 |
|  |  |  |  |  |  |  |
| 5. Selecting variables and indicators: operationalizing hypotheses | 2 |  | 1 | 3 | 9 | 12 |
| 6. Data Collection  Methods | 2 |  |  | 2 | 12 | 14 |
| . |  |  |  |  |  |  |
| 7 . Choosing a sample | 1 |  |  | 1 | 3 | 4 |
| 8 . Questionnaire  Design | 2 |  | 1 | 3 | 9 | 12 |
| 9 . Conducting participatory research | 2 |  | 2 | 4 | 12 | 16 |
| 10 . Research data management | 3 |  | 3 | 6 | 12 | 18 |
| 11 . Data analysis and interpretation | 2 |  | 1 | 3 | 9 | 12 |
| 12 . How to write an effective research report/thesis | 2 |  | 2 | 4 | 12 | 16 |
| Total | 29 | 3 | 13 | 45 | 135 | 180 |

1. **Detail Description of Topics**

**Topic 1: Research in Perspective, Some Frameworks of Methods for Research for**

**Development Work**

* + Defining research: Research as a way of knowing/the scientific method/
  + Classification of research (basic, applied, disciplinary, subject matter, analytical, descriptive, multidisciplinary etc…)
  + How is research used in development work

How is research used in policy work

* + Research methods and research methodology
  + Research process
  + Role and qualities of researchers; they should: o pursue research, which will actually lead to solving substantive problems and improving the welfare of the people.
    - * see themselves as elements in a change process rather than providers of answers. Importance of recognizing and using local knowledge.
      * recognize and use local knowledge.
  + Action Research
  + Baseline studies
  + Case studies
  + Impact assessment
  + Participatory learning and action  Experimental data: o On-station o On-farm o Laboratory
  + Randomization in agricultural experiments
  + Farming systems
  + Typology techniques – risk mapping, zoning, adaptive research

Other frameworks for specific issues: sustainable livelihoods framework, poverty assessments, gender analysis etc.

**Topic 2: Selecting a Research Design**

* + The case study
  + The longitudinal study
  + The longitudinal comparison (panel and trends)
  + The cross-sectional study
  + The experiment
  + Designing and implementation of multi-topic household surveys: LSMS and LSMSISA
  + Controlling for influence in social science research

**Topic 3: Planning and Development of Research Proposal**

* + Defining a researchable problem and developing research hypotheses and objectives
  + Literature review: rationale and methods of literature review
  + Critique of research papers
  + Research methods and conceptual framework
  + Writing the research proposal – components of a typical research proposal o Introduction and background
    - * Research focus – statement of the research problem
      * Aims and objectives
      * Hypotheses
      * Justification (i.e. are the efforts worthwhile? / Who needs the output?) o Literature review o Methods and procedures o Conceptual framework o Analysis
      * Expected results / Outputs and dissemination plans
      * Accountability support and supervision o Time scale and budget
  + Ethical considerations in research
  + Preparing a grant proposal
  + Managing research tasks
  + Managing for impact – promoting research findings

**Topic 4: Types of Data – Using Secondary and Primary Data Sources**

* + Difference between primary and secondary data
  + Why and when to use primary / secondary data
  + Limitations of primary / secondary data
  + Sources / types of secondary data (time series, cross-sectional, panel)
  + Evaluating secondary data
  + Working with secondary data o Different ways research studies use secondary data o 1st stage thinking – exploration, discovery, generating ideas

o 2nd stage thinking – collating, sifting, organizing ideas into a robust structure

* + - * + Selecting categories in which the data can be summarized
        + Production of derived secondary data – new data sets
        + Conceptual models and diagramming
        + Analytical frameworks
  + Sources and types of primary data

**Topic 5: Selecting Variables and Indicators: Operationalizing Hypotheses**

* + Units of analysis (individual, groups, social artifacts)
  + Determining what data to collect and how to collect them o Clarify the problem by clearly defining concepts to be studied o Identify variables or indicators associated with each concept o Devise units of measurement for each variable

o Devise or select a measuring instrument or data collection method for each variable

* + Models, concepts and variables: introducing various analytical models and where they are likely to be applied
  + Finding variables for concepts and hypotheses testing
  + Finding a variable’s measurement

**Topic 6: Data Collection Methods**

* + Interviews
  + Focus groups
  + Observation
  + Questionnaire – single visit and multiple visit
  + Ranking and Scoring exercises
  + Visual methods –maps diagrams, and drawings
  + Participatory rural appraisal (PRA)
  + Triangulation

**Topic 7: Sampling Techniques**

* + Probability and non-probability sampling
  + Sampling, sampling methods and survey designs
  + Sampling and non-sampling errors

Basic sample statistics: sampling and estimation

**Topic 8: Questionnaire Design and Administration**

* + Types of questionnaires (structured, semi-structured)
  + When should you use a questionnaire for research
  + Composing clearly structured questions
  + Creating Effective Responses Scales
  + Building questionnaires
  + Sources of response bias
  + Pre testing and revision
  + Administration of questionnaires
  + Ethical considerations
  + Consent and confidentiality
  + Practical matters in carrying out a survey (timing, resource mobilization, training research assistants, language and cultural issues, interpretation, gender issues, political issues, etc.)

**Topic 9: Conducting Participatory Rural Appraisal**

* + Philosophy of PRA
  + The main ideas underlying RRA/PRA
  + PRA methods and techniques
  + Steps in carrying out PRA
  + Advantages and limitations of PRA
  + PRA versus other survey techniques
  + Issues in participatory research (degree of participation, participation in the analysis process)

**Topic 10: Research Data Management**

* + Data management o Organizing data o Checking and cleaning data o Verification, validation and fabrication

o Recoding data

* + - Data processing, use of code books, archiving and data ownership issues (with practical sessions in SPSS, STATA, analysis software e.g. LimDEP and GAMS etc)
    - Data analysis: the different aspects investigated
    - Ethical issues in data management (data fabrication, data mining)

**Topic 11: Results reporting and Interpretation**

* + - Content of the results
    - Components of the discussion

**Topic 12: How to write an effective Research Report/Thesis**

* + - Principles of good report/thesis writing
    - Components of research reports, publishing, authorship
    - Power of graphs and diagrams to communicate
    - Writing your thesis
    - Some guidelines for disseminating results in different dissemination media (writing for an academic thesis and dissertation, writing of peer reviewed journal papers, writing of policy briefs, research reports, working papers)
    - Introducing reference management or citation software such as Endnote, Refworks and Mendeley

1. **Mode of Delivery**

This course will be delivered using lectures, seminars and practical. The development of the thesis research proposal **MUST** involve at least one research advisor, other than the course lecturer

1. **Assessement Methods**

Students’ performance will be assessed using continuous assessment test, final examination, and an approved research proposal.

* Continuous assessments:
  + Two written assignments that cover the essential components of the research process (literature review, formulating research questions and hypotheses, research design,

research management) ……………………………………………………………(30%)

* + Two practical assignments that impart basic skills required in managing, processing and analyzing Quantitative and qualitative data and to familiarize students with commonly used computer software for statistical analysis {e.g. SPSS, STATA, spreadsheets, database packages) and reporting information (e.g. Microsoft Office) }

…………………………………………………………………………………………..(20%)

* Thesis research proposal, APPROVED by the research advisor(s): o Written 40 % o Oral presentation 10 %

**8. Course Materials**

**Required text books**

* Alreck, P.L. and R.B Settle. 2004. *The Survey Research Handbook.* Irwin Hill. Third Edition.
* American Psychological Association(APA). Date? Publication Manual. 6th Edition
* Ethridge Don, 2nd Ed. 2004. *Research Methodology in Applied Economics: Organizing,*

*Planning and Conducting Economic Research.* Wiley and Blackwell

* Sophie Laws. 2003 *Research for Rural Development: A Practical Guide*. Sage Publications.
* *Turabian Kate L 2007. A Manual. for Writers of Research Papers, Theses, and Dissertations*.

[University of Chicago Press.](http://en.wikipedia.org/wiki/University_of_Chicago_Press) (7th edition)

***Further readings***

* Babbies, E. 1989. *The Practice of Social Research*. Wadsworth Publishing Company  Bharati K. Patel, Kay Muir Lereshche. Richard Coe and Susan D. Hainsworth, Eds.

2004. *The Green Book: A guide to Effective Graduate Research in African Agriculture, Environment and Rural Development*. Published by The African Crop Science Society, Kampala, Uganda. (available in print and on CD).

* Bulmer M and D.P. Warwick, Eds. Date? *Social Research in Developing Countries*
* Bulmer, M. 1982. *The Use of Social Research: Social Investigation in Public Policy Making*. London: George Allen and Unwin
* Casley, D.J and D.A Lury. 1993. *Data Collection in Developing Countries.* Oxford University Press.
* Chambers, Robert. 1992. Principles, Methods and Discoveries of PRA. In: Rural Appraisal: Rapid Relaxed and Participatory Is something missing?, *Institute of Development Studies Discussion Paper* No 311.
* Chris O Andrew and P.E Hilderbrand. 1982. Orientation and Focus of Projects: Researchable Problems, Hypotheses, and Objectives in *Planning and Conducting Applied Research*. Westview Press Inc, pp 14-33
* Day, Robert A.. 1988. *Write and Publish a scientific paper.* 3rd edition. Oryx press.

Phoenix, USA

Dennis J. Casley and Krishma Kumar. 1988. *Collection, Analysis and Use of Monitoring and Evaluation Data*. John Hopkins Press.

* Denscombe, M. 1998. *The Good Research Guide for Small Scale Social Research Projects*. Open University.
* Dey, I 1993. *Qualitative Data Analysis. A User Friendly Guide for Social Scientists*
* D’Haese L and J Kirsten. 2006. *Rural Development: Focusing on Small Scale Agriculture in Southern Africa*. University of Pretoria. Chapter 20:Gender Sensitive Methodologies for Rural Development.
* Duflo, E., , R. Glennerster and M., Kremer. 2006. *Using randomization in development economics research: A toolkit. BREAD working paper 136.*
* Edriss, Abdi-Khalil. 2003. *A Passport to Research Methods: Research Skills-Building Approach.* . Capital Printing Press (CCP) for IPP ISBN 99908-902-3-4.
* Ellis F. and G. Bahiigwa. 2003. *Rural Livelihoods and Poverty Reduction in Tanzania* World Development. August*.*
* Etzold C., O. B.A Nyabundi and Olel. M. Ogot, Eds. 2003. *Toward Harmonization of Postgraduate Training through Improved student supervisor Relationships*: Workshop Proceedings, Maseno University (DAAD).
* Field Andy. 2000*. Discovering Statistics using SPSS for Windows*. Sage Publications.
* Grosh M and Paul Glewwe, Eds. 2002. Designing Household Survey Questionnaires: Lessons from Ten Years of LSMS Experience). World Bank.
* Krathwohl.R.D. 1988. How to prepare a research proposoal. 3rd Edition. Syracuse University Press, Syracuse.
* Leedy, Paul Dellinger, and Jeanne Ellis Ormrod. 2005."Practical research: Planning and design.".Publisher?
* Mettrick, H. 1993. *Development Orientated Research in Agriculture.* ICRA
* Mikkelsen, B. 1995. *Methods for Development Work and Research. A Guide for*

*Practitioners.* Sage Publications

* Moris Jon and James Copestake .1993. *Qualitative Enquiry for Rural Development*. 1993. Intermediate technology Group.
* Muraya, P., G. Garlick and R. Coe. 2003. Research Data Management. World Agroforestry Centre (ICRAF), Nairobi, Kenya. Appendix 9 on the CD of *The Green Book*
* Nachamias, D and C Nachamias 1981. *Research Methods in Social Sciences*: St. Martin’s Press, New York.

**COMPULSORY NON-CORE**

**CAEC 510: Institutional and Behavioural Economics**

**Classification:** Core **Credits:** 3 **Semester:** 2

***1.* Course Objectives**

The objectives of the course include:

* Familiarising students with agricultural and rural development challenges in Africa and particularly those that have not been addressed through applications of the Neoclassical Economics;
* Acquainting students with various concepts of the New Institutional Economics (NIE) and behavioural theories, while providing comparison with other theories and especially the neo-classical economics;
* Ensuring that students understand the Institutional and Behavioural Economics (NIE) paradigms and the application of the theories to solve problems constraining agricultural development in Africa; and
* Equipping students with skills useful for analyzing agricultural and rural development constraints through the application of the NIE and behavioural economic philosophies and thereby identifying the options/interventions for accelerating economic development in their countries.

**2. Expected Learning Outcomes**

At the end of this course students will :

* demonstrate knowledge of institutions-related problems facing agriculture and rural development in Africa;
* acquire knowledge on usefulness of NIE and behavioral economics in helping to answer the ‘how questions’ of agricultural policy and development; and
* be able to apply different NIE and behavioral concepts in their future research work and particularly in less empirically studied topics such as transaction costs and performance of institutions.

1. **Prerequisites**

Students can only be admitted to this course once they have successfully completed the core courses such as Microeconomics, and Agricultural Economics.

1. **Thematic Plan**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Topic** | **Contact Hours** | | | **Indep. Study hours** | **Total**  **Hours** |
| **Theory** | **Seminar** | **Sub-**  **total** |  |  |
| 1. The agricultural development challenge: stylized features | 4 |  | **4** | 6 | **10** |
| 2. NIE: distinctive features and overview of its concepts | 4 |  | **4** | 9 | **13** |
| 3. Analysis of institutions in development: evolution, functions and outcomes | 5 |  | **5** | 9 | **14** |
| 4. Property rights and other related theories | 4 | 1 | **5** | 21 | **26** |
| 5. Behavioural economics: review of concepts | 3 | 2 | **5** | 24 | **29** |
| 6. Collective action and social capital | 4 |  | **4** | 12 | **16** |
| 7. Transaction costs in agriculture and natural resource management | 4 | 1 | **5** | 18 | **23** |
| 8. NIE analysis of markets, market structure and market coordination | 5 | 2 | **7** | 21 | **28** |
| 9. The State: political and institutional determinants of development | 4 | 2 | **6** | 15 | **21** |
| **Total** | **37** | **8** | **45** | **135** | **180** |

1. **Detailed Description of Topics**

**Topic 1: The Agricultural Development Challenge: Stylised Features**

This will largely be a background section to familiarize students with the main problems and challenges facing African agriculture. The idea here is to illustrate the shortcomings of the current approaches in addressing African agricultural development challenges and emphasizing the need for an alternative economic paradigm to be able to find solutions and sustainable interventions.

**Topic 2: New Institutional Economics (NIE): Distinctive Features and Overview of its Concepts**

* + New Institutional Economics versus Neo-classical Economics
  + Emergence of New Institutional Economics
  + New Institutional Economics versus Old Institutionalism
  + Branches of New Institutional Economics

**Topic 3: Analysis of Institutions in Development: Evolution, Functions and Outcomes**

**(performance)**

* + Definition of Institutions and how they are Different from Organizations
  + Emergence of Institutions and Institutional Change
  + Theory of Induced Institutional Innovation
  + The Framework for Analysing Institutions
  + Assessing Performance of Institutions
  + Incomplete contract theory and principal-agent problems

**Topic 4: Property Rights and Related Theories:**

* + Property rights, Property Rules and Property Systems
  + Evolutionary Theory of Land Tenure,
  + Coase Bargaining Theorem (bargaining approach to handle externalities)
  + Application of Coase Bargaining Theorem in Agriculture and Natural Resource Management
  + Hardin’s Tragedy of the Commons and the Problem of Open Access
  + Case Studies of Application of Property Rights in Agriculture and Rural

**Topic 5: Behavioural Economics: Review of Relevant Concepts**

* + Linking Psychology to Behaviour of Economic Actors
  + Revisiting Theories of Bounded Rationality and Rational Choice (Behaviour)
  + Concepts of Unbounded Willpower and Unbounded Selfishness
  + Pure Altruism vs Reciprocal Altruism
  + Motivation Crowding Theory
  + Review of Game Theories (e.g., Prisoners’ Dilemma, Non-cooperative game Theory, Cooperative Game Theory, Evolutionary Game Theory, and Adaptive Learning Models) and their Application
  + Behavioural Gender Differences in Agriculture and Natural Resource Management
  + Case Studies of Application of Behavioural Economics in Agriculture and Rural Development

**Topic 6: Theories of Collective Action and Social Capital**

* + Definitions of Collective Action and Social Capital
  + Linking Collective Action to Social Capital
  + Empirical Measurement and Application of Collective Action and Social Capital
  + Collective Action in Natural Resource Management
  + Pervasive Social Capital
  + Case Studies of Application of Collective Action and Social Capital in Agriculture and Rural Development

**Topic 7: Transaction Costs in Smallholder Agriculture and Natural Resource**

**Management**

* + The Theory of Transaction Costs
  + Distinguishing Transaction Costs from Production Costs, Transport Costs and other Concepts
  + Applications of Transaction Costs Framework
  + Attributes of Transactions
  + Empirical Measurement of Transaction Costs and Case studies

**Topic 8: NIE Analysis of Markets, Market Structure and Market Coordination**

* + Commodity Characteristics: Asset Specificity, Frequency of Exchange,

Uncertainty, etc.

* + Market Failures and Missing Markets
  + Alternative Institutions to Counter Market Coordination Failures
  + Contracting in African Agriculture: Process, Failures and Enforcement
  + Horizontal and Vertical Coordination
  + Case Studies of Market Coordination

**Topic 9: The State: Political and Institutional Determinants of Development**

* + The Elements of Political Economy and Public Choice Theories
  + The Concepts of Rent-Seeking, Corruption and Rational bureaucracy
  + Lobbying Incentives
  + The Political Economy of Agricultural policy
  + Pathways to a Developmental State
  + Approaches of Analyzing the State
  + Case Studies of Application of Political Economics in different developing countries

1. **Mode of Delivery**

Delivery will be largely through lectures or classes where students will be expected to come prepared after reading the literature. This will largely involve elaboration of concepts, plenary and group discussions, and presentations of case studies. Additional presentation of case studies will be made in organized seminars.

1. **Assessment Methods**

Students will be graded on their class participation as well as with a series of continuous assessments that will involve written assignments and presentations of class tasks. There will also be a term paper and a written final examination. The marks will be distributed as follows:

* + - Class participation and continuous assessments ( 20%)
    - Term paper ( 30%)
    - Written final examination ( 50%)

1. **References**

**Required Textbooks**

* + - Eggertson, T (1990). *Economic behaviour and institutions*.Cambridge University Press, Cambridge, UK.
    - Harries J., J. Hunter and C. M. Lewis Eds., 1995. The New Institutional Economics and Third World Development. Routledge, New York, USA.
    - Gibbons R., 1992. Game Theory for Applied Economists*,* Princeton.
    - Kirsten, F. J., A. R. Dorward., C. P. Name? and N. Vink, Eds. 2009. Institutional Economics Perspectives on African Agricultural Development. Washington, DC. USA: International Policy Research Institute.
    - North D. C., 1990. Institutions, Institutional Change and Economic Performance. Cambridge University Press, Cambridge, UK.
    - Poulton C., A. J. Dorward, N. Kydd, Other names? Poole and L. Smith. 1998. A New Institutional Economics Perspective on Current Policy Debates. In: Dorward, A., Kydd, J. A. and Poulton, C. (Eds.). *Smallholder Cash Crop Production under Market Liberalisation: A New Institutional Economics Perspective.* Oxford: CAB International.
    - Wilkinson, [Nick.](http://www.goodreads.com/author/show/820086.Nick_Wilkinson) 2007. An Introduction to Behavioral Economics: A Guide for Students, Palgrave Macmillan

***Further Reading and Journals***

* Ariely,[Dan.](http://www.goodreads.com/author/show/788461.Dan_Ariely) 2008. Predictably Irrational: The Hidden Forces That Shape Our Decisions. HarperCollins Canada
* Kherallah, M. and J. Kirsten. 2001. The New Institutional Economics: Applications for Agricultural Policy Research in Developing Countries. *MSSD Discussion Paper No. 41.*
* North, D.C. 1998. Economic Performance through Time. In: Staatz, J.M. and Eicher, C.K. *International Agricultural Development.* Third Edition. Baltimore and London: The Johns Hopkins University Press.
* Williamson O. E. and S. E. Masten, Eds. 1999. The Economics of Transaction Costs. An Elgar Critical Writings Reader, Cheltenham, UK and Northampton, MA, USA.
* .Meinzen-Dick, R. and A. Knox Monica Di Gregorio Eds. 2001. Collective Action, Property Rights, and Devolution of Natural Resource Management: Exchange of Knowledge and Implications for Policy. Feldafing, Germany: ZentralstellefürErnährung und Landwirtschaft.
* Ostrom, E. 1990. *Governing the commons. The evolution of institutions for collective action.* Cambridge, UK, Cambridge University Press.
* Challen R., 2000. Institutions, Transaction Costs and Environmental Policy: Institutional Reform for Water Resources (New Horizons in Environmental Economics). Edward Elgar Publishing Limited, Cheltenham, UK.
* Baland J-M. andJ-P. Platteau. 1996. Halting degradation of natural resources: Is there a role for rural communities? Clarendon Press, Oxford, UK ( important text for application of Game theories).
* Hubbard, M. 1997. The New Institutional Economics in Agricultural Development: Insights and Challenges. *Journal of Agricultural Economics*. Vol. 48, No. 2: 239-250.
* Nabli, M.K. and J.B. Nugent 1989. The New Institutional Economics and its Applicability to Development. *World Development.* Vol.#17, No. 9: 1333-1347.
* Paarlberg, D. 1993**.** The Case for Institutional Economics. *American Journal of Agricultural Economics*. Vol. 75, August: 823-827.
* Hobbs J. E. 1997. Measuring the importance of transaction costs in cattle marketing. American *Journal of Agricultural economics*, 79: 1083-1095.
* Williamson, O.E. 1979. The Transaction Costs Economics: The Governance of Contractual Relations. *Journal of Law and Economics*. Vol. 22, October: 233-261.
* Coase, R. 1937. The Nature of the Firm, *Economica*, **4** (16): 386 – 405.
* Coase, R.H. 1960. The Problem of Social Cost. *Journal of Law and Economics* **3** (October): 1 –44.
* Coleman, J.S. 1988. Social Capital in the creation of human capital. *American Journal of Sociology*, 94(supplement): 95-120.

**FOUNDATION COURSES**

**CAEF 511: Environmental and Natural Resource Management**

**Classification:**Foundation **Number of Credits:** 3 **Semester:** 1

1. **Course Objectives** 
   * Introduce students to the basis of environmental management using some of the major issues which threaten the environment today locally and globally (soil erosion, deforestation, global warming, water pollution etc.);
   * Examine the main tools and techniques that have been developed to assess environmental problems and formulate sustainable management strategies; and Identify key economic, political and social factors that come together to influence decision-making regarding exploitation and development of natural and environmental resources
2. **Expected Learning Outcomes**

Students are expected to gain a broad introduction to and sufficient basis for more advanced courses in the specialization option in Environmental and Natural Resource Economics from this course. They are expected to acquire good understanding of the different approaches to the management of environment and natural resource systems and the limitations of the different approaches and how different management options can restore, mitigate or remediate impacts on ecological systems at local or global scales and within short to longtime scales.

1. **Prerequisites**

The prerequisites for this course should in principle be fully satisfied by the core courses of macroeconomics, microeconomics and quantitative methods at the masters’ level.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topic** |  | **Contact hours** | | | **Independent study** | **Total** |
| Lecture | Seminar | Practical | Subtotal | |
| 1. Introduction to environment and Natural resources | 2 |  |  | 2 | 6 | 8 |
| 2. Natural resource management gender, and sustainable development | 1 |  |  | 1 | 6 | 7 |
| 3. Biodiversity and Ecosystem  Function | 4 |  |  | 4 | 9 | 13 |
| 4. Land Resource Management | 5 | 1 |  | 6 | 12 | 18 |
| 5. Management of Water  Resources | 4 |  |  | 4 | 15 | 19 |
| 6. Management of fishery resources | 3 |  |  | 3 | 9 | 12 |
| 7. Management of Forests and  Wildlife | 4 | 1 |  | 5 | 9 | 14 |
| 8. Solid Waste Management | 3 |  |  | 3 | 9 | 12 |
| 9. Air Quality Management | 2 |  |  | 2 | 9 | 11 |
| 10. Management of Mineral and  Energy Resources | 4 | 1 |  | 5 | 15 | 20 |
| 11. Issues in Climate change | 3 | 1 |  | 4 | 9 | 13 |
| 12. Instruments for  Environmental Management and  Assessment | 5 | 1 |  | 6 | 9 | 15 |
| Total | 40 | 5 |  | 45 | 135 | 180? |

1. **Detailed Description of Topics**

**Topics 1: Introduction to environment and Natural resources**

1. The natural resource system

* Natural resources: occurrence, abundance, classification, distribution and measurement
* Ecosystems and their services to human society
* System behavior: basic concepts of thermodynamics, co evolution and systems interdependence; nonlinearities and chaotic dynamics, resilience, sustainability and their implications for natural resources management

**Topic 2: Natural resource management and sustainable development**

* The ecological limits to growth and consumption
* Tradeoffs between gains in economic wellbeing and environmental protection and conservation
* The rights of future generations and sustainable income and consumption
* Sustainability paradigms
* Poverty and environmental health
* Managing risk and uncertainty in NRM

**Topic 3: Biodiversity and Ecosystem Function**

* The ecological and economic importance of biodiversity
* The concept of habitat and its role in ecology
* Measures for reducing biodiversity loss
* Empirical evidence for biodiversity-function relationships and values of associated ecosystem services
* African experiences in managing species loss
* Measurement and assessment of the worldwide biodiversity loss and its implications

**Topic 3: Agriculture, Environment and Ecosystem Management**

* Agriculture as a managed ecosystem
* Natural resource inputs into agriculture production: soil nutrients, water
* Agricultural growth and expansion impacts on the environment: externalities of agriculture, erosion, pollution, etc. from intensification
* The multiple services of agro-ecosystems for human wellbeing and tradeoffs involved (food and fibre versus ecosystem functions and biodiversity conservation)

**Topic 4: Land Resource Management**

Types of Land use

Land tenure and property rights

* Land use policies
* Management of rangelands
* Principles of range management
* Grazing systems
* Land degradation and restoration

**Topic 5: Management of Water Resources**  Managing freshwater resources:

* Management of wetlands
* Management of underground water resources..
* Water pollution; Sources, effects and remediation
* Waste water management : Technology, processes, waste water recycling and

reuse

**Topic 6: Management of fishery resources**

* Managing freshwater and marine fisheries
* Ecological implications of overfishing; food fish introductions and intensive aquaculture

**Topic 7: Management of Forests and Wildlife**

* Principles of forest management
* Conversion of forestland and deforestation problems in Africa
* Principles of wildlife management; problems of wildlife management

**Topic 8: Solid Waste Management**

Municipal Solid Waste (MSW)

* Types
* Amounts
* Composition
* Technical methods in waste management and processes
* Landfill
* Composting
* Incineration, recycling

**Topic 9: Air Quality Management**

* The science of air pollution: Photochemical smog, temperature inversions  Benefits of air pollution control: Health, etc.
* Measures and policies for reducing air pollution: regulation, economic incentives and instruments
* Case studies

**Topic 10: Management of Mineral and Energy Resources**

Principles of Mineral resources management

* Types of energy sources and patterns of use in Africa (fossil fuels, renewable-hydro, wind, solar, biomass, nuclear)
* Options for low-energy development path for Africa
* Energy use, emissions and climate change mitigation

**Topic 11: Issues in Climate change**

* Concepts in climate change science
* Natural resource management and climate change
* Adaptation and mitigation strategies

**Topic 12: Instruments for Environmental Management and Assessment**

* Life Cycle Analysis (LCA)
* Integrated Environmental Impact Assessment (EIA) and audit;
* Environmental management systems
* Remote sensing techniques
* Ecological footprints
* Green accounting and sustainability indicators
* Carbon accounting
* Case studies

1. **Mode of Delivery**

The material of this course described above will be delivered through 40 hours of lectures and 5 hours of seminars plus mandatory readings listed below on which students are expected to spend at least 132 hours of independent study. The students will be exposed to a 2 days field excursion to appreciate the diversity and problems related to natural resources and the environment. A field report will be submitted at the end of the excursion for grading.

1. **Assessment Methods**

Students will be graded based on their performance in:

* + Home work Assignments
  + Project Paper
  + Final Examination

*Homework assignments:* Students will be required to do a minimum of two assignments, in which they are expected to work with resource and environmental management issues of relevance to Africa.

*Project Paper:* This will be a research-orientated paper of 10-15 typed double-spaced pages reflecting the student’s own effort and original thinking about modeling specific resource allocation problem. The goal of this paper is to have the students’ study in depth an environmental and natural resource management problem. Students will summarize all of the issues that motivate the problem, and then propose a solution (or solutions) to the problem, based on something that has been learnt in this course. For example, in controlling pollution of a large African city, a student might recommend that a transferable emissions permits program or a combination tax/subsidy program be established. The student would then briefly describe how the control program would actually work.

*Examination*: There will be a 3-hour final examination consisting of questions drawn from lectures and readings.

*Overall Performance in the Course:*

* Homework assignments (20%)
* Term Paper/Project (30%)
* Final Examination (50%)

**8. Course Materials**

**Required Textbooks**

* Daily, Gretchen C and Ellison Katharine. 2002 *The New Economy of Nature*.Island Press. Washington, DC.
* Daily, Gretchen C. 1997. *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press. Washington, DC.
* Costanza, R. et al., 1997. "The Value of the World’s Ecosystem Services and Natural Capital," Nature, Vol. 387.b. Further Readings
* Millennium Ecosystem Assessment (MEA) 2003. Ecosystems and Human Wellbeing: A framework for assessment, Island Press, Washington
* Millennium Ecosystem Assessment (MEA) 2005. Ecosystems and Human Wellbeing: Synthesis, Island Press, Washington

**Other Rading List**

* Hassan, R. 2010. Implications of Climate Change for Agricultural Sector Performance in Africa: Policy Challenges and Research Agenda, Journal of African Economies.
* Kurukulasuriya, Mendelsohn, Hassan, et al. 2006. Will African agriculture survive climate change? World Bank Economic Review-WBER Vol. 20 (3): 367-388
* Hassan, Dinar and Mendelsohn Eds.2008. Climate Change and African Agriculture, Special Issue of the African Journal of Agric. and Resource Economics
* Dinar, Hassan et al. 2008. Climate Change and Agriculture in Africa: Impact Assessment and Adaptation Strategies. Possing ham on habitat management. EarthScan, London –Hugh.
* Hassan, ? and ?Ngwenya 2006. Valuing forest services missing from the national accounts: Empirical assessment of the contribution of cultivated forests to wealth accumulation in Swaziland, Forest Policy and Economics 9: 249-260
* Lange, Hassan and ?Alfieri 2003. Using environmental Accounts to promote sustainable development: Experiences in Southern Africa.Natural Resources Forum 27: 19-3
* Hassan, ? and ?Farolfi 2005. Water value, resource rent recovery and economic welfare cost of environmental protection: a water sector model for the Steelpoort sub-basin in SouthAfrica, *Water SA, Vol. 31, n. 1, 2005, p. 9-18.*
* Foley, G. 1992. *The Energy Question.*Penguin.-Gilpin, A. (1995). Environmental Impact Assessment (EIA): Cutting Edge for the 21st Century. Cambridge University Press, Cambridge.
* Glasson, J., R. Therivev, and A. Chadwick 1994). *An Introduction to Environmental Impact Assessment.Publisher?*
* Harrison, R.M. 2001. *Pollution: Causes, Effects and Control*. The Royal Society of Chemistry, Cambridge.
* Hartwick, ? and ?Olewiler (1986). *The Economics of Natural Resource Use*.Chapter 2.
* Hessen, O.L. 1999. “Catchment Properties and the Transport of Major Elements to Estuaries”.*Advances in Ecological Research* 29: 1-42.
* Lange, ? and ?Hassan Eds.2006. The Economics of Water Management in Southern Africa: An Environmental Accounting Approach. Edward Elgar, UK.
* Benhin, ? and ?Hassan 2008. A Dynamic analysis of trade and biodiversity loss in semi-arid Southern Africa: The role of grazing activities, Int. Journal of Ecological Economics and Statistics, Vol. 11, No. S08: 31-48.
* Manchester, ? et al. 1999. The Cost and Practicality of Techniques for the Reversion of

Arable Land to Lowland Wet Grassland – An Experimental Study and

Review.*Journal of Environmental Management* 55 (2): 91-109.

* Newman, E.I. 2000. *Applied Ecology and Environmental Management*. Blackwell Scientific Publications, Oxford.Chapter 4.
* O’Callaghan, J.R. Ed. 1996. *Land Use: The Interaction of Economics, Ecology and Hydrology*.

**CAEF 512: Agricultural Policy Analysis**

**Classification:** Foundation **Credit:** 3 **Semester:**3

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1. **Course Objectives**

The course aims at analyzing how the agricultural sector changes over time, interacting with government policies on a global and farm economy basis. ThIs will be done through the application of economic theory, measures of policy impacts and likely response of food and farm sectors.

Governments’ engagement in the agricultural sector is usually guided by agricultural policy which in reality is a complex web of interventions covering output markets, input markets, trade, public good investments, natural resources, regulation of externalities, education and the marketing and distribution of products. Since these programmes always involve huge budgetary costs it is very important to make sure that the interventions, mechanisms, instruments do in actual fact correct for market imperfections, lower transaction costs, effectively regulate externalities and enhance productivity. In many cases however the choice of policy is the result of manipulation by powerful commodity or agricultural interest groups actively engage in rent-seeking. It is true to say public and special interests are always in conflict when government policy in agriculture is designed and implemented.

The purpose of agricultural policy analysis is narrow and one dimensional in nature - usually to assist in policy choice, design and impact with the aim of increasing social welfare or to achieve certain other objectives. In this course we will unpack different analytical frameworks that try to explain and prescribe public policy. The course therefore deals with the four dimensions on which different policy frameworks focus on: incidence; policy choice and instrument design; political economy and governance structures. We hope to show by the end of this course that any conceptual framework that attempts to explain or prescribe public policy only emphasizing public or alternatively special interests are doomed to fail. In addition we will show that any framework that neglects political forces and role of special interest groups will have little explanatory power. After discussing all the dimensions of analytical frameworks for agricultural policy analysis and recognizing the merits of each of these dimensions it is possible to design and implement agricultural policies that are sustainable and robust to an evolving economy.

**Specifically the course will:**

* Expose learners to the basic concepts and frameworks used in agricultural policy analysis and to identify short comings;
* Provide learners with clear understanding of the political economy of agricultural policy to illustrate the limitations of our standard economic tools to analyze agricultural policy;
* Equip the learners with skills for analyzing agricultural and trade policies, and monitoring and evaluation of their impacts;
* Impart to the learners the art of rationalizing conflicting policy objectives;
* Expose learners to literature and data sets for Agricultural Policy Analysis  Develop policy briefs

1. **Expected Outcomes**

By the end of the course, the learner will be able to:



* + Understand the main elements of the major challenges facing agricultural policymakers in Africa;
  + Identify and define the various dimensions of analytical frameworks for agricultural policy analysis
  + Understand major policy issues and drivers of change in the food and agricultural sector of the world;
  + Interpret and critique the most important literature in each of the key dimensions
  + Apply any of the dimensions in a practical case study of policy analysis
  + Have an appreciation of the limitation of the neo-classical framework by also understanding the politics of agricultural policy;
  + Have an appreciation of the most recent work on the political economy of agricultural policy in developed as well as developing countries.
  + Understand the nature of the ‘farm problem’ and how this links to domestic and international trade policy; and
  + To effectively participate in contemporary agricultural policy debates. 

1. **Prerequisites**

Basic undergraduate course in agricultural policy analysis and graduate courses in microeconomics and macroeconomics

1. Thematic Plan

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic | Contact Hour(s) | |  |  |  | Total |
|  | Lecture | Seminar | Practicals /Tutorial | Sub-  total | Indep endent Study |  |
| Introduction, importance and place of agricultural policy | 4 | 2 | - | 6 | 20 | 26 |
| Policy incidence | 3 | 2 | - | 5 | 10 | 15 |
| Normative Approaches to Agricultural  Policy Analysis: Theory and Shortcoming. | 3 | 3 | - | 6 | 20 | 26 |
| Design of Agricultural Policy Instruments | 6 | 2 | - | 8 | 20 | 28 |
| Public choice and agricultural policy: Concepts and Framework for Agricultural Policy analysis. | 6 | 2 | - | 8 | 15 | 23 |
| Indicators and Measures for Assessment of Policy Interventions, using imaging datasets and literature. | 4 |  | 2 | 6 | 10 | 16 |
| Impact of political institutions ideology and inequality on agricultural policy outcomes. | 3 | 2 | - | 5 | 15 | 20 |
| Impact of Political institutions, and ideology on agricultural policy implementation, Monitoring and impact assessment. | 4 | - | 2 | 6 | 20 | 26 |
| Total | 33 | 13 | 4 | 50 | 130 | 180 |

1. **Detailed Description**

**Topic 1.Introduction, importance and place of agricultural policy.**

The topic is aimed at acquinting students with agricultural growth and immerging food problems worldwide and help them appreciate the strategic economic significance of the agriculture sector in the overall economic development process. Special reference will be made of the predominant role the sector plays in the economic development of the majority of developing countries. The topic will be explored under the following sub-topics:

* + - A review of agricultural policy
    - Principles and objectives of agricultural policy
    - Agricultural and food problems around the world
    - Taxonomy of agricultural policies
    - Farms, food and the development paradox
    - Structural adjustment policies and the agricultural sector
    - Role of agriculture in poverty reduction
    - Role of agriculture in economic development of developing countries

**Required textbooks**

* + - Roger Norton. 2004. *Agricultural Development Policy: Concepts and Experiences*. Wiley/FAO, Rome (Chapters 1 and 2)
    - Bresciani, F. and Alberto Valdes 2007, Beyond *Food Production: The role of agriculture in poverty reduction*. Edgar Elgar/FAO.

**Further readings**

* + - Abbott, Philip C. 2009, *Development Dimensions of High Food Prices*Paris: OECD, May 2009.
    - Masters, W.A. 2008, *Beyond the Food Crisis in Africa.* African Technology Development Forum, 5(1-2): 3-13.
    - Norton, G.W., J. Alwang and W.A. Masters. 2006, “Economic Transformation and Growth”, chapter 6 in *Economics of Agricultural Development* (Abingdon: Routledge), 20 pages.
    - Tomich, Thomas P., Peter Kilby and Bruce F. Johnston 1995, "Poverty and the Rural Economy" and "Structural Transformation" (excerpts), in *Transforming Agrarian Economies* (Ithaca, NY: Cornell University Press), pp. 9-19 and 35-48.

**Topic 2. Policy Incidence**

* + - Policy instruments and mechanisms
    - Partial equilibrium analysis and social welfare impacts
    - Empirical analyses on policy incidence
    - Assumptions in policy incidence analysis (normative policy analysis)
    - Main shortcomings of the theory and assumptions on normative analyses

* + - **Prescribed literature:** Please format these refs

= Alston, J.M and J.S. James. 2002. The incidence of agricultural policy. Chapter 33 in *Handbook of Agricultural Economics*, Volume 2, B. Gardner and G. Rausser (eds).Elsevier Science : pp1690-1700

= Bullock, D.S and K. Salhofer. 2003. Judging agricultural policies: a survey.*Agricultural Economics* Vol. 28: pp225-235.

- Bromley, D.W. 1990. The ideology of efficiency: Searching for a Theory of Policy Analysis. *Journal of Environmental Economics and Management* Vol. 19 July: 86 -106.

Topic 3: **Normative Approaches to Agricultural Policy Analysis: Theory and Shortcomings** The topic is aimed at developing the students understanding on the theory and general equilibrium framework of policy analysis and principles informing government intervention in agriculture. Essentially, how far or not the ‘invisible hand’ has been able to produce desirable results will be elicited from the following topics:

* Key assumptions of the GE framework: free entry to markets, zero transaction costs, profit maximization, and the *ceteris paribus* assumptions on technology and institutions;
* Incomplete and missing markets as results from public goods, externalities, transactions costs and asymmetric information, scale economies;
* Partial equilibrium analysis and social welfare impacts
* What the theory says about income and wealth distribution and the economics of second best; and-Mechanism design of policy analysis
* Recognition of market failure, externalities and transaction costs.
* Incentive compatibility, adverse selection and moral hazard
* Criticisms of efficiency assessments and the role of normative analyses in judging agricultural policies.

**Required textbooks**

* Alston, J.M and J.S. James. 2002. The incidence of agricultural policy. Chapter 33 in *Handbook of Agricultural Economics*, Volume 2, y B. Gardner and G. Rausser (eds), Elsevier Science : pp1690-1700
* Roger Norton. 2004, *Agricultural Development Policy: Concepts and Experiences*. Wiley/FAO, Rome.
* Griffin, Ronald C. 1995. On the meaning of economic efficiency in Policy Analysis. *Land Economics*. Vol. 71 (1): 1 -15.
* Bullock, D.S and K. Salhofer. 2003. Judging agricultural policies: a survey. *Agricultural Economics* Vol. 28: pp225-235.
* Bromley, D.W. 1990. The ideology of efficiency: Searching for a Theory of Policy Analysis. *Journal of Environmental Economics and Management* Vol. 19 July: 86 -106.

**Further readings**

* + Zilberman, David and Michele Marra. 1993, "Agricultural Externalities," chapter 6 in Gerald A. Carlson, David Zilberman and John A. Miranowski (eds)., *Agricultural and Environmental Resource Economics*. New York: OxfordUniversity Press, pp. 221-267. - Bullock, D.S and K. Salhofer. 2003. Judging agricultural policies: a survey. Agricultural Economics Vol. 28: 225-243.
  + Schmid A.A. (1987). *Property, Power, and Public Choice*. New York: Prager.

Topic 3. **Design of Agricultural Policy Instruments and Review ofPolitical Economy of Agricultural Policy**

The topic aims at providing and exposing students to the process and approaches of policy-making from an institutional economic point of view, by illustrating the role of various interest groups, politicians and voters in the making of agricultural policy with particular reference to Africa. Aspects such as game theory and a range of models to explain the decision-making on agricultural policy will be presented. Key topics to cover in this regard include the following:

* Mechanism design of policy analysis
* Recognition of market failure, externalities and transaction costs.
* Incentive compatibility, adverse selection and moral hazard
* Considering practical cases such as: food subsidies via vouchers; input vouchers; land control measures
* Determinants of policy: demanders and suppliers of policy changes;
* The legislative process; the role of lobbyists, multilateral institutions and exogenous forces.
* Rent-seeking and government failure and the elements of public choice theory; and
* Changing theories of political economy and its implication for agricultural policy analysis
* Relationships between electoral systems and agricultural policy  Media effects in agricultural and food policies

**Required textbooks**

* -Chambers, R. 2002. Information, incentives, and the design of agricultural policies, Chapter 34in *Handbook of Agricultural Economics*, Volume 2, B. Gardner and G. Rausser (eds). Elsevier Science: pp 1753 - 1788
* -Innes, R. 2002. Market failures and second-best analysis with a focus on nutrition, credit, and Incomplete markets, Chapter 35 in *Handbook of Agricultural Economics*, Volume 2, B. Gardner and G. Rausser (eds).. Elsevier Science: pp 1829-1846
* -Chambers, R.G. 1992, "On the design of agricultural policy mechanisms", *American Journal of Agricultural Economics* 74:646-554.
* Van Tongeren, F. 2008, "Agricultural Policy Design and Implementation: A Synthesis", OECD Food, Agriculture and Fisheries Working Papers, No. 7, OECD publishing.  ***A***nderson, Kym 1995, "Lobbying Incentives and the Pattern of Protection in Rich and Poor Countries." *Economic Development and Cultural Change* 43(2, January): 401-424.
* McCluskey, Jill J. and Johan F.M. Swinnen, (2004). "[Political Economy of the Media and Consumer Perceptions of Biotechnology,](http://ideas.repec.org/a/bla/ajagec/v86y2004i5p1230-1237.html)" [American Journal of Agricultural Economics,](http://ideas.repec.org/s/bla/ajagec.html) American Agricultural Economics Association, vol. 86(5), pages 1230-1237, December.
* Olper A., J Falkowski and J. (Swinnes. 2009. Political Reforms and Public Policies: Evidence from Agricultural Protection (November 2009). LICOS Discussion Paper 251/2009
* Swinnen J., J McCluskey and N, Francken. 2005. Food safety, the media, and the information market, *Agricultural Economics*, vol. 32, no. s1, pp. 175 - 188.

**Further readings**

* Bullock, D.S and K. Salhofer. 2003. Judging agricultural Policies: a survey. Agricultural Economics Vol.28; 225-243
* Becker, G. 1983 A Theory of Competition among pressure groups for political Influence. Quarterly Journal of Economics 98 (3) 371-400
* Masters, William A. and Andres Garcia. 2009. (forthcoming), “Price Distortion and Stabilization: Stylized Facts and Hypothesis Tests,” in K. Anderso (ed)., *The Political Economy of Agricultural Distortions*. Washington, DC: The World Bank, 2009.
* Beghin, John C. and Mylene Kherallah. 1994. Political Institutions and International Patterns of Agricultural Protection. Review of Economics and Statistics 76 (3 August) 482-489.

Topic 4.**Public choice and agricultural policy: Concepts and Frameworks**

This topic aims at providing the students with working definitions of policy-related concepts, context and a theoretical framework for agricultural policy analysis. The following will be covered:

* + Changing theories of political economy and its implication for agricultural policy analysis.
  + Political and institutional determinants of agricultural policy  The elements of public choice theory.
  + The concept of "rent-seeking".
  + Lobbying incentives
  + Markets, policy and state; (Land, Financial and labour)
  + State versus market (identifying failures and objectives for interventions);  Instruments of agricultural policy (tax, subsidies, regulations); and
  + Constraints to agricultural policy formulation and implementation.

**Required textbooks**

* + Brooks, Jonathan 1996, "Agricultural Policies in OECD Countries: What Can We Learn from Political Economy Models?" *Journal of Agricultural Economics* 43(3): 366-389.
  + Becker, G. 1983. A theory of competition among pressure groups for political influence.*Quarterly Journal of Economics* 98 (3):371-400.
  + De Gorter, H and Swinnen, J 2002.The Political Economy of Agricultural Policies. In: B. Gardner and G. Rausser (eds) *The Handbook of Agricultural Economics*, Vol. 2: 2073-2123
  + -Gardner, B.L. 1987. Causes of US Farm Commodity Programs. Journal of Political Economy; 95 (2), pp. 290-310.
  + Grossman, G. M. and E. Helpman. 1994. Protection for Sale, *Amer. Econ. Rev*. 84:4, pp. 833– 50  .

**Further readings**

* + Helfand, Steven M. 200?, “Interest groups and economic Policy: Explaining the pattern of protection in the Brazilian Agricultural Sector”, Contemporary Economic Policy 18 (2 October): 462-476.
  + de Gorter, H and Swinnen J 1994. Political and institutional determinants of agricultural policy. Invited paper prepared for the XXII International Conference of Agricultural Economists August 22-30, 1994 in Harare, Zimbabwe.
  + North, D. C. 1991: Institutions. *Journal of Economic Perspectives*, Vol. 5 No. 1:97-112.
  + Scrimgeour, F.G. and E.C. Pasour. 1996. A Public Choice Perspective on Agricultural Policy Reform: Implications of the New Zealand Experience. *American Journal of Agricultural Economics*, Vol. 78: 257-267.
  + Sender, J. and D. Johnston 2003. Searching for a Weapon of Mass Production in Rural

Topic 5**. Indicators and Measures for Assessment of Policy Interventions, using imaging datasets and literature.**

This topic aims at acquainting the learners with the basic tools and concepts that are used by economists to assess the impacts of proposed policy interventions. The topic covers the following:

* + The role of quantitative policy analysis
  + Scope and tasks of policy analysis;
  + Demand and supply elasticities and projections;
  + Producer and consumer surplus;
  + Compensation and equivalent variation; and
  + Socio-economic indicators including poverty measures (levels and alleviation), the Gini Coefficient as a measure of equity/inequality

***Exercises****: Elasticities, projections and policy analysis*

The exercises are aimed at furthering understanding of demand and supply elasticities and projections in the context of policy analysis.

***Exercises:*** *Applying producer and consumer surplus*

These exercises give practice on how the concepts of producer and consumer surplus are used to assess the effects of various policy interventions. **Required textbooks**

* + Ellis, F. 1992: Agricultural policies in developing countries. CambridgeUniversity Press.
  + Sadoulet, E and de Janvry A. 1995: Quantitative development policy analysis. The JohnsHopkinsUniversity Press, Baltimore, London.
  + Dastagiri, M.B. 2004. Demand and supply projections for livestock products in India. Policy paper 21. National Centre For Agricultural Economics and Policy Research (ICAR), New Delhi, India. **Further readings**
  + Okounmadewa, F 1999. Overview of the measurement of poverty and inequality. Graduate studies capacity building programme, Centre for Economic and Allied Research (CEAR), University of Ibadan
  + Kimalu P, N, Nafula, D. M. Manda, G Mwabu and M. S. Kimenyi. 2002. A situational analysis of poverty in Kenya. The Kenya Institute for Public Policy Research and Analysis (KIPPRA). WP/6/2002
  + Bellù, Lorenzo Giovanni and Paolo Liberati *(2005).*Social Welfare Analysis of Income Distributions: Ranking Income Distributions with Generalised Lorenz Curves. *http://www.fao.org/tc/easypol.*

**Topic 6. Empirical Tools of Policy Analysis**

This topic provides learners with an introductory overview of the main empirical tools used for policy evaluation, illustrating the assumptions, objectives and purpose of the tools. The application of these will be dealt with in detail in the course: “Quantitative analysis of Agricultural policies”. The emphasis here is to make students know for which purpose the different tools should be applied and the limitations of each technique. The topic covers the following:

* + Common empirical policy tools
  + The Partial Equilibrium Framework (illustration with the BFAP model)
  + Country and economy wide models (General Equilibrium Framework and Social Accounting Matrix)
  + Household models
  + Transport and storage models
  + Common measures policy distortions: Nominal and Effective Protection; Aggregate Measurement of support, Nominal Rate of Assistance; Domestic Resource cost and Policy Analysis Matrix (PAM)
  + Using economic arguments to explain global patterns of agricultural policies.
  + Empirical studies provide three patterns:

o development pattern o anti-trade pattern o relative income pattern

* The role of political economy theories to explain these patterns (Role of structural factors and development paradox)

**Required textbooks**

* Sadoulet, E and A. de Janvry. 1995. *Quantitative Development Policy Analysis*. Johns Hopkins University Press, Baltimore.
* Anderson, Kym.1995, "Lobbying Incentives and the Pattern of Protection in Rich and Poor Countries." *Economic Development and Cultural Change* 43(2, January): 401-424.
* Binswanger, Hans P. and Klaus Deininger 1997, "Explaining Agricultural and Agrarian Policies in Developing Countries." *Journal of Economic Literature* 35(December): 1958-2005.
* De Gorter, H and J. Swinnen. 2002. The Political Economy of Agricultural Policies. In: B. Gardner and G. Rausser (eds) *The Handbook of Agricultural Economics*, Vol. 2: 20732123.
* Gawande, K., and U. Bandopadhyay 2000. Is Protection for Sale? Evidence on the

Grossman-Helpman Theory of Endogenous Protection. *Review of Economics and*

*Statistics* 82, 139-152.

* Lopez, Rigoberto and Ibrahima Hathie. 2000, The Structure of Government

Intervention in African Agriculture. *Journal of Development Studies* 37(1, Oct.): 57-72. Swinnen, J. 1994. A positive theory of Agricultural Protection. *American Journal of Agricultural Economics* 76 (1): 1-14.

**Recommended additional references:**

* Swinnen, J.F.M., H. de Gorter, G.C. Rausser and A.N. Banerjee 2000, "The Political Economy of Public Research Investment and Commodity Policies in Agriculture: An Empirical Study."
* Masters, William A. and Ernst-August Nuppenau. 1993, "Panterritorial versus Regional Pricing for Maize in Zimbabwe." *World Development* 21(10): 1647-58.
* Omamo, Steven Were (1998), "Transport Costs and Smallholder Cropping Choices: An Application to Siaya District, Kenya." *American Journal of Agricultural Economics* 80 (1, February): 116-123.
* Krueger, Anne O., Maurice Schiff and Alberto Valdes. 1988. "Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economywide

Policies," *World Bank Economic Review*, Oxford University Press, vol. 2(3), pages 25571, September.

* Reutlinger, S. 1976. A simulation model for evaluating worldwide buffer stocks of wheat. *American Journal of Agricultural Economics,* February 1976: 1-12
* Tweeten, L. ed. 1989. *Agricultural Policy Analysis Tools for Economic Development*. Boulder: Westview Press. Place?

**Topic 7.Impact of political institutions, Mass Media and ideology on agricultural policy Design, implementation, Monitoring and Impact Assessment**

The topic aims at equipping learners with the art of rationalizing conflicting policy objectives and also providing them with the skills for monitoring and evaluating the impacts of policies. The topic covers the following key points:

* Relationships between electoral systems and agricultural policy
* Impact of ideology on policy-making
* The role of civil servants, administrations in the implementation process
* Role of Mass Media on agricultural and food policies
* Bias created by the media in the process of policy making
* Media coverage of food safety and the influence on consumer behaviour
* Policy instruments
* Policy objectives and evaluation criteria (Design matrix)
* Monitoring and evaluation

***Exercise****: Policy Design Impact Matrix*

The exercise gives learners practice on designing policy and thinking about the relationship between policy instruments and policy objectives.

***Exercise:*** *Monitoring policy impacts*

The aim of this exercise is to deepen the learners understanding of the concepts, methods and tools used in monitoring the impacts of policies.

Case studies from Cornell Series: Vol. II and III  *Discussion and presentations.*

**Required textbooks**

* -Acemoglu, D., S. Johnson and J.A. Robinson. 2001, “The Colonial Origins of Comparative Development: An Empirical Investigation”, *American Economic Review* 91(5): 1369–1401.
* -Aghion, P.; A. Alesina, F. Trebbi. 2004. Endogenous Political Institutions.*Quarterly Journal of Economics* May 2004, Vol. 119, No. 2, Pages 565-611
* -Bates, R. H. and S. Block, 2009. [Political Economy of Agricultural Trade Interventions in Africa,](http://ideas.repec.org/p/ags/wbadwp/50302.html) [Agricultural Distortions Working Paper](http://ideas.repec.org/s/ags/wbadwp.html) 50302, World Bank
* -Dutt, P. and D. Mitra. 2009, Impacts of Ideology, Inequality and Democracy on Agricultural Distortion Patterns. [Agricultural Distortions Working Paper](http://ideas.repec.org/s/ags/wbadwp.html) no 84, World Bank
* -Olper, A. 2001, Determinants of Agricultural Protection: The Role of Democracy and Institutional Setting, *Journal of Agricultural Economics* 52 (2): 75–92.
* -Olper, A. 2007, Land Inequality, Government Ideology and Agricultural Protection, *Food Policy* 32(1): 67-83.
* -Rausser G. C. and G Roland 2009. Special interests versus the public interest in policy determination. Agricultural Distortions Working Paper 78, May 2009 **Further readings**
* Latacz-Lohmann, U 2000. A policy decision making framework for devising optimal implementation strategies for good agricultural and environmental policy practices. Directorate for Food, Agriculture and Fisheries; Organization for Economic Cooperation, 2 rue Andre-Pascal, 75775, Paris Cedex 16,

France.COM/AGR/CA/ENV/EPOC 56/Final.

* Kirsten, J.F. and N. Vink. 1999. Agricultural Policy in South Africa in the 1990s.

Unpublished memo, University of Pretoria. [*http://www.up.ac.za/academic/ecoagric/books/deregula.htm.*](http://www.up.ac.za/academic/ecoagric/books/deregula.htm)

* Jaime Ortiz 1999. The role of interest groups in agricultural policy design: Chile 19601988 [*Journal of International Development*Volume 11 Issue 2,](http://www3.interscience.wiley.com/journal/5102/home) Pages 241 – 258.
* FAO 2005. Monitoring policy impacts (MPI): The role of MPI in policy formulation and implementation. EASYPO Model 056-On-line resource materials for policy making.

[*www.fao.org/tc/easypol.*](http://www.fao.org/tc/easypol)

1. **Mode of Delivery**

The course will use the mode of class lectures, class seminars, reading assignment and exercises.

1. **Overall Assessment Method**
   * Coursework (Mid-term exams, Take home assignments): ( 20%)
   * Term paper (30%)
   * Final examination (50%)

**References**

* + Norton Roger. 2004, Agricultural *Development Policy: Concepts and Experiences*. Wiley/FAO, Rome.
  + Bresciani F. and Alberto Valdes. 2007, Beyond *Food Production: The role of agriculture in poverty reduction*. Edgar Elgar/FAO.
  + Norton Roger. 2004, *Agricultural Development Policy: Concepts and Experiences*. Wiley/FAO, Rome.
  + Griffin, Ronald C. 1995. On the meaning of economic efficiency in Policy Analysis. *Land Economics*. Vol. 71 (1): 1 -15.
  + Abbott, Philip C., 2009, *Development Dimensions of High Food Prices* Paris: OECD, May 2009
  + Masters, W.A. 2008, *Beyond the Food Crisis in Africa.* African Technology Development Forum, 5(1-2): 3-13.
  + Norton, G.W., J. Alwang and W.A. Masters 2006, “Economic Transformation and Growth”, chapter 6 in *Economics of Agricultural Development* (Abingdon: Routledge), 20 pages.
  + Tomich, Thomas P., Peter Kilby and Bruce F. Johnston 1995, "Poverty and the Rural Economy" and "Structural Transformation" (excerpts), in *Transforming Agrarian Economies* (Ithaca, NY: Cornell University Press), pp. 9-19 and 35-48.
  + Zilberman, David and Michele Marra 1993, "Agricultural Externalities," chapter 6 in Gerald A. Carlson, David Zilberman and John A. Miranowski, eds., *Agricultural and Environmental Resource Economics*. New York: Oxford University Press, pp. 221-267.
  + Bullock, D.S and K. Salhofer 2003. Judging agricultural policies: a survey. Agricultural Economics Vol. 28: 225-243.
  + Schmid, A.A. 1987. *Property, Power, and Public Choice*. New York: Prager.
  + Anderson, Kym. 1995, "Lobbying Incentives and the Pattern of Protection in Rich and Poor Countries." *Economic Development and Cultural Change* 43(2, January): 401-424.
  + Binswangr, H. P and Deininger, K. 1997: Explaining agricultural and agrarian policies in developing countries. *Journal of Economic Literature*, Vol. XXXV. 1958-2005.
  + Brooks, Jonathan 1996, "Agricultural Policies in OECD Countries: What Can We Learn from Political Economy Models?" *Journal of Agricultural Economics* 43(3): 366-389.
  + De Gorter H and J. Swinnen 1995. The economic polity of farm policy: Reply (to Brooks).

*Journal of Agricultural Economics*. Vol. 46, No. 3, September 1995: 403-414.

* + Hillman, A., 2003, “Political Behavior and Public Policy” and “Public Policy and RentSeeking Behavior,” ch. 6.2 and 6.3 in *Public Finance and Public Policy: Responsibilities and Limitations of Government* (New York: Cambridge University Press, 2003), pages 416-460.

Becker, G. 1983. A Theory of Competition among pressure groups for political Influence. Quarterly Journal of Economics 98 (3) 371-400

* + Masters, William A. and Andres Garcia 2009. (forthcoming), “Price Distortion and Stabilization: Stylized Facts and Hypothesis Tests,” in K. Anderson, ed., *The Political Economy of Agricultural Distortions*. Washington, DC: The World Bank,
  + Beghin, John C. and Mylene Kherallah 1994. Political Institutions and International Patterns of Agricultural Protection. Review of Economics and Statistics 76 (3 August) 482-489.
  + Pasour, E.C. 1990. *Agriculture and the state: Market Processes and Bureaucracy*. Holmes and Meier, New York. (Chapters 3 and 4)
  + Wright, P.D. and Nieuwoudt, W.L. 1993a. The political economy of the South African dairy industry: A public choice analysis. *Agrekon*, Vol. 32 no 1, March 1993.
  + Hagedorn, K. 1992. The impact of institutional particularities on agricultural policy. In: Csaki, C. et al (eds) (1992) Agricultural restructuring in Southern Africa, Proceedings of a IAAE conference, Swakopmund, 1990.
  + Tullock, G. and Hillman, J. 1989. Public choice and Agriculture: An American example. In Dasgupta (ed) *Issues in Contemporary economics*. Proceedings of the 9th World congress of the International Economic Association, Athens, Greece.
  + Mueller, C.M. 1979. *Public choice*. Cambridge University Press, Cambridge.
  + Kreuger, Ann O. 1974. The political economy of the rent seeking society. *American Economic Review*, Vol. 64, No 3: 291-303.
  + Just, R.E. 1988. Making economic welfare analysis useful in the policy process: Implications of the public choice literature. *American Journal of Agricultural Economics*, Vol. 70 no. 2 May 1988.
  + Gardner, B.L. 1989. Economic Theory and farm politics. *American Journal of Agricultural Economics*. Vol. 71 no. 5 December 1989.
  + Swinnen, Johan 1994, "A Positive Theory of Agricultural Protection." *American Journal of Agricultural Economics* 76(1, February): 1-14.
  + Zuzman?
  + Ellis, F. 1992: Agricultural policies in developing countries. Cambridge University Press.
  + Sadoulet, E and A. de Janvry. 1995: Quantitative development policy analysis. The Johns Hopkins University Press, Baltimore, London.
  + Pasour, E.C. 1990. *Agriculture and the state: Market Processes and Bureaucracy*. Holmes and Meier, New York.
  + Haggard, S and Webb, S. B. 1993: What do we know about the political economy of economic policy reforms? *The World Bank Research Observer*, Vol. 8, No. 2. 143-168.
  + de Gorter, H and J Swinnen. 1994. Political and institutional determinants of agricultural policy. Invited paper prepared for the XXII International Conference of Agricultural Economists August 22-30, 1994 in Harare, Zimbabwe.
  + North, D. C. 1991: Institutions. *Journal of Economic Perspectives*, Vol. 5 No. 1:97-112.
  + Scrimgeour, F.G. and E.C. Pasour 1996. A Public Choice Perspective on Agricultural Policy Reform: Implications of the New Zealand Experience. *American Journal of Agricultural Economics*, Vol. 78: 257-267.
  + Sender, J. and D. Johnston. 2003. Searching for a Weapon of Mass Production in Rural Africa: Unconvincing Arguments for Land Reform. Paper read at the IAAE Conference, Durban.
  + Stiglitz, J.E. 198). Some Theoretical Aspects of Agricultural Policies. *World Bank Research Observer*, Vol. 2 No.1: 43-60.

Ellis, F. 1992: Agricultural policies in developing countries. Cambridge University Press, UK>

* + Sadoulet, E and A. de Janvry. 1995: Quantitative development policy analysis. The Johns Hopkins University Press, Baltimore, London.
  + Dastagiri, M.B. 2004 Demand and supply projections for livestock products in India. Policy paper 21. National Centre for Agricultural Economics and Policy Research (ICAR), New Delhi, India.
  + Okounmadewa, F 1999: Overview of the measurement of poverty and inequality. Graduate studies capacity building programme, Centre for Economic and Allied Research (CEAR), University of Ibadan, Nigeria.
  + Kimalu P, N, Nafula, D. M. , Manda G Mwabu and M. S. Kimenyi. 2002 A situational analysis of poverty in Kenya. The Kenya Institute for Public Policy Research and Analysis (KIPPRA). WP/6/2002
  + Bellù, Lorenzo Giovanni and Paolo Liberati. *2005.*Social Welfare Analysis of Income Distributions: Ranking Income Distributions with Generalised Lorenz Curves. *http://www.fao.org/tc/easypol.*
  + Sadoulet, E and A. de Janvry 1995. *Quantitative Development Policy Analysis*. Johns Hopkins University Press, Baltimore.

**Further readings:**

* + Masters, William A. and Ernst-August Nuppenau 1993, "Panterritorial versus Regional Pricing for Maize in Zimbabwe." *World Development* 21(10): 1647-58.
  + Omamo, Steven Were 1998, "Transport Costs and Smallholder Cropping Choices: An Application to Siaya District, Kenya." *American Journal of Agricultural Economics* 80 (1, February): 116-123.
  + Krueger, Anne O., , Maurice Schiff and Alberto Valdes. 1988. "Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economywide Policies," *World Bank Economic Review*, Oxford University Press, vol. 2(3), pages 25571, September.
  + Reutlinger, S. 1976. A simulation model for evaluating worldwide buffer stocks of wheat. *American Journal of Agricultural Economics,* February 1976: 1-12.
  + Tweeten, L. ed. 1989. *Agricultural Policy Analysis Tools for Economic Development*. Boulder: Westview Press.Where?
  + Monke, L and R. Pearson, 1989. The Policy Analysis Matrix for agricultural Policy Analysis Cornell University.
  + Tsakok, I. (1990). *Agricultural price policy*. Cornell University Press, Ithaca.
  + Kirsten, J., L. Edwards and N. Vink. 2009, “South Africa”, Ch. 5 in K. Anderson and W. Masters eds., *Distortions to Agricultural Incentives in Africa*, Washington DC: World Bank.
  + Omamo. Steven Were. 1998. “Building Institutional Links between Research and PolicyChange: Experiences and Lessons from the Kenya Agricultural Research Institute.” In*Closing the Loop: From Research on Natural Resources to Policy Change*.

Maastricht: European Centre for Development Policy and Management.

* + Ferris, J., 1988. Agricultural Prices and Commodity Market Analysis. WCB McGrawHill. Where?

**CAEF 513: Agricultural and Rural Development**

**Classification:** Foundation Course in the Field of Specialisation

**Credits:** 3 **Semester:** 3

1. **Course Objectives** 
   * + To provide students with an understanding of the theoretical approaches and perspectives of Rural and Agricultural Development
     + To provide students with knowledge on issues , challenges and options facing the contemporary agricultural and rural development sector
     + To expose students to analytical skills for the analysis of the d? agricultural and rural development issues and problems in Africa and other developing countries.
2. **Expected Learning Outcomes**

At the end of the course, the students are expected to be:

* + - Conversant with the theoretical approaches and perspectives of Rural and Agricultural Development
    - Be knowledgeable on issues, challenges and options facing the contemporary agricultural and rural development sector
    - Undertake analysis of the agricultural and rural development issues and problems in Africa and other developing country context.

1. **Prerequisites**

Students should have taken core courses in Microeconomics, and Macroeconomics

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topics** | **Contact Hours** | |  |  | **Independent**  **Study hours** | **Total hours** |
| **Lecture**  **s** | **Semi**  **nar** | **Practicals /Tutorial**  **s** | **Sub-**  **total** |  |  |
| 1. Review of theories and  principles of  growth and development | 2 | 1 |  | 3 | 9 | 12 |
| 2. Role of agriculture in  rural  and economic development | 4 | 2 |  | 6 | 18 | 24 |
| 3. The economic nature of  Smallholder agriculture | 4 | 2 | 2 | 8 | 24 | 32 |
| 4. Problems and policies in agricultural and rural development | 6 | 2 |  | 8 | 24 | 32 |
| 5. Strategies to modernizing  Agriculture | 6 | 2 |  | 8 | 24 | 32 |
| 6.Poverty dynamics, food, and the environmental nexus | 9 | 3 |  | 12 | 36 | 48 |
| Total | 31 | 12 | 2 | 45 | 135 | 180 |

1. **Detailed Description of Topics**

**Topic 1: Review of Theories and Principles of Growth and Development**

* + - * The scope and nature of agricultural and rural development: agricultural development from a world history perspective; institutional, social and economic variables; the goals of development; politics and agricultural and rural development.
      * Economic development: concept and measurement; sustainable development; models of growth; growth accounting.
      * Policy, markets and public action (scope and limitations, actors and conflicts of interest, government intervention, role of markets and institutions).

**Topic 2: The Role of Agriculture in Rural and Economic Development**

* + - * Agricultural contributions to development
      * Growth stage theories
      * Theories or Analytical Models of growth and development in the agricultural context: Classical, Dualistic, Institutional/Structural
      * Capital transfer link between agriculture and other sectors
      * Structural change: characteristics, causes, and policy implications
      * Globalization and its implications of rural and economic development

**Topic 3: The Economic Nature of Smallholder Agriculture**

* + - * Subsistence agriculture: concepts and scope
      * Household production and consumption decisions
      * Supply response and allocative efficiency
      * Marginal productivity conditions and disguised unemployment
      * Capital and savings conditions, and credit
      * Technology adoption
      * Decision-making under risk and uncertainty
      * Economics of share tenancy and land reform
      * Transformation of subsistence agriculture

**Topic 4: Problems and Policies in Agricultural and Rural Development Issues Options and Challenges**

* + - * Rural industrialization, income diversification and livelihoods: poverty and inequality
      * Labour abundance and absorption problem
      * Rural-urban migration
      * Human capital formation
      * Water development and management
      * Infrastructure Challenges
      * Investments and national incentives for rural and agricultural development  Emerging issues: o Gender dimension o HIV and AIDS o Urban Agriculture o Environment, Environmental degradation and Climate Change Conflicts: Sources and resolutions.

**Topic 5: Strategies for Modernizing Agriculture (Lessons from Experience)**

* + - * Institutions and Institutional change
      * Role of institutions, institutional change and stakeholders’ participation
      * Rural markets, price policy and incentives
      * Role of natural resources in development
      * Rural farm and non-farm labour markets

* + - * Technology and Technical Change
      * Development pathways
      * The green revolution: economic impacts and lessons
      * The potential for agricultural biotechnology
      * Technological change and agricultural intensification: the high-payoff input model
      * The nature and economics of agricultural research
      * Agricultural productivity: theory and measurement
      * Productivity decomposition: scale impacts and efficiency changes

**Topic 6: Poverty Dynamics, Food and the Environmental Nexus**

* + - * Characterisation of the poor
      * Measurement of Poverty
      * Poverty traps
      * Poverty reduction strategies

1. **Mode of Delivery** 
   * + - Lectures,
       - Reading assignments,
       - Term papersand take-home assignments  Individual and group/presentations in class.
       - Excursions/field visits

1. **Assessment Methods** 
   * + Continuous assessment 20%
     + Term paper 30%
     + Final examination 50%

1. **Course Materials** ***Required Texts***
   * CA. Clunies-Ross, D. Forsyth and M. Huq. 2009. Development Economics. London:
   * McGraw-Hill.A.P. Thirlwall. 2006. Growth and Development (8th ed). Basingstoke: Palgrave Macmillan.
   * Christopher B. Barret and Michael R. Carter. 2012. The Economics of Poverty traps and Persistent Poverty: Policy and Empirical Implications.
   * Gershon Feder. 1985. The relation between farm size and labour productivity: the role of family labour, supervion and credit constraints. Journal of development Economics Vol 18, p297-313.
   * Todaro M.P. and S.C. Smith. 2008. Economic Development (10th ed). Harlow:

Addison Wesley Pearson.

* + Norton G.W. J Alwang and W.A. Masters 2001. The Economics of Agricultural

Development: World Food Systems and Resource Use, Routlidge Taylor and Francis Group, New York and London Inc

* + FAO, 2012. The State of Food and Agriculture: Investing in agriculture for a better future [(http://www.fao.org/publications/sofa/2012/en/)](http://www.fao.org/publications/sofa/2012/en/)
  + HLPE. 2013. Investing in smallholder agriculture for food security. A report by the

High Level Panel of Experts on Food Security and Nutrition of the Committee on

World Food Security, Rome

[(http://www.fao.org/fileadmin/user\_upload/hlpe/hlpe\_documents/HLPE\_Reports/H](http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-6_Investing_in_smallholder_agriculture.pdf)

[LPE-Report-6\_Investing\_in\_smallholder\_agriculture.pdf)](http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-6_Investing_in_smallholder_agriculture.pdf)

**Further Readings**

* + Gabriel, Abebe H., 2003. *Development Strategies and the Ethiopian Peasantry: Supply Response and Rural Differentiation****.*** Shaker Publishing BV: Maastricht.
  + Ashley, C and S Maxwell. 2001. Rethinking Rural Development. *Development Policy Review*, 19(4): 395-425.
  + Alexander, P., P. Boomgaard, and B. White. 1991. In: “The Shadow of Agriculture: NonFarm Activities in, The Javanese Economy, Past and Present.” Amsterdam: Royal Tropical Institute.
  + Boserup, Ester 1981. *Population and Technological Change: A Study of Long- Term Trends*. Chicago: University of Chicago Press.
  + Boserup, Ester 1990. *Economic and Demographic Relationships*. Baltimore and London: The Johns Hopkins University Press.
  + Byres, T. 1979. ‘Of Neo-Populist Pipe Dreams: Daedalus in The Third World and the Myth of Urban Bias’. *Journal of Peasant Studies*. 6 (2): 210- 244.
  + Cernea, Michael M. Ed. 1991. *Putting People First: Sociological variables in rural development* (Second revised and expanded edition). New York: Oxford University Press (a World Bank publication).
  + Chambers, Robert, Arnold Pacey, and Lori Ann Thrupp. 1993. *Farmer First: Farmer Innovation and Agricultural Research*. London: Intermediate Technology Publications.
  + Chibber, A. and J. Wilton. 1986. ‘Macroeconomic Policies and Agricultural Performance in Developing Countries’. *Finance and Development*, 23 (3): 6-9.
  + Cleaver, Kevin M. and Gotz A. Schreiber. 1994. Reversing the Spiral: The Population, Agriculture, and Environmental Nexus in Sub-Saharan Africa. Washington, DC: World Bank.
  + Coelli, T.J., Prasada Rao, D.S., and Battesse, G.E. 1997. *An Introduction to Efficiency and Productivity Analysis*. Kluver.
  + Delgado, Christopher L. 1995. Africa’s Changing Agricultural Development Strategies: Past and Present Paradigms as a Guide to The Future. *Food, Agriculture and the Environment Discussion Paper* 3. Washington DC: International Food Policy Research

Institute.

* + Delgado, Christopher, Jane Hopkins and Valerie Kelly. 1998. Agricultural Growth Linkages in Sub-Saharan Africa. Research Report, 107. Washington DC: International Food Policy Research Institute.

**CAEF 514. Agribusiness Management**

**Classification: Foundation Number of Credits: 3 Semester:** 3

**Course Objectives** The modern agribusiness industry includes commercial farmers, businesses providing them with supplies and services, businesses adding value to farm products and those businesses that facilitate the marketing of agricultural products to an ever-growing marketplace. This sector is continuously facing new challenges including technological developments in production and manufacturing processes, heightened environmental concerns and increased nutritional awareness throughout the community.

The overall objective of this course is to generate students’ understanding of the management of food and agribusiness firms from a managerial perspective and the importance of strategic management in agribusiness. The course will enable students to actively use the principles and techniques explained to them during the course in a global, ever changing, competitive and even hostile environment.

The specific objectives of the course will be to give students:

. • Review certain managerial aspects of agribusiness management . • A critical understanding of agro-industrialization and the relationships between producers, processors, manufacturers and consumers of commodities involved in the agribusiness sector;

. • An insight into international trends in agribusiness, mega factors, institutional economics etc.;

. • A sound knowledge of the theory, techniques and analytical skills

needed to address a range of strategic and managerial problems in agribusinesses;

. • A sound knowledge of applying competitor analysis

. • Apply the life cycle concept in agribusiness strategies

. • A sound knowledge the dynamics of agribusinesses, business concepts and strategic management;

. • The ability to implement strategy for agribusiness;

. • Manage change in an agribusiness environment

. • Create insight in understanding strategic management concepts in the global marketplace

1. **Expected Learning Outcomes**

At the end of this course, the student should be able to:

|  |  |  |
| --- | --- | --- |
| . | • | Understand the international trends, agribusiness issues, etc.; |
| . | • | Conduct external and internal environmental analysis; |
| . | • | Understand and apply competitor analysis; |
| . | • | Make strategic choices for an agribusiness; |
| . | • | Evaluate the feasibility of a proposed venture in the agricultural sector; |
| . | • | Understand the theoretical concepts of managing an agribusiness and |

relate; these concepts to the operational environment of the agribusiness;

. • Understand strategies in the global market place

. • Assimilate business information and present it verbally and in written form; and

. • Harness entrepreneurial opportunities.

1. **Pre-Requisites**

Exposure and background knowledge and skills required in:

Microeconomics

Production Economics

Management and Business studies

Basic Financial Management

Principles of Marketing

Computer skills

1. **Thenatic Plan and Course Description**

This course comprises of two parts. In the first part, an overview to agribusiness management and its dynamics is presented during the first lectures. The second part of the course focuses on agribusiness strategic management.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Contact hours** | | | |  | |  | |  |
| **Topic** | **Lecture** | **Seminar** | **Practicals** | | **Sub-**  **total** | | **Suggested** | | **Total** |
|  |  |  |  | |  | | **Hours**   **Hours** | | |
| **Review** |  |  |  | |  | |  | |  |
| 1. Review of agribusiness | 1 |  | 1 | | 2 | | 4 | | 6 |
| management |  |  |  | |  | |  | |  |
| 2. Dynamics of the agribusiness | 2 | 1 |  | | 3 | | 7 | | 10 |
| environment |  |  |  | |  | |  | |  |
| 3. Organisation & contents | 2 |  | 1 | | 3 | | 6 | | 9 |
|  |  |  |  | |  | |  | | 0 |
| **Sub-Total** | **5** | **1** | **2** | | **8** | | **17** | | **25** |
|  |  |  |  | |  | |  | |  |
| **Strategic Management** |  |  |  | |  | |  | |  |
| 1. The strategic  management | 1 |  | 2 | | 3 | | 7 | | 10 |
| process |  |  |  | |  | |  | |  |
| 2. Strategic direction | 2 |  |  | | 2 | | 8 | | 10 |
| 3. Corporate governance  & strategy | 2 |  |  | | 2 | | 8 | | 10 |
| 4. Internal  environmental analysis | 2 |  | 1 | | 3 | | 8 | | 11 |
| 5. External  environemtnal analysis | 2 |  | 2 | | 4 | | 8 | | 12 |
| 6. Strategy formulation:  long-term | 1 | 1 |  | 2 | | 8 | | 10 | |
| goals and generic strategies |  |  |  |  | |  | |  | |
| 7. Strategy formulation:  grand & | 2 |  |  | 2 | | 8 | | 10 | |
| functional strategies |  |  |  |  | |  | |  | |
| 8. Aligning strategy with industry | 1 | 1 |  | 2 | | 8 | | 10 | |
| life cycle |  |  |  |  | |  | |  | |
| 9. Strategic analysis and choice | 2 |  |  | 2 | | 8 | | 10 | |
| 10. Strategy implementation & | 2 |  | 2 | 4 | | 8 | | 12 | |
| change managemet |  |  |  |  | |  | |  | |
| 11. The drivers of strategy | 2 |  |  | 2 | | 8 | | 10 | |
| implementation |  |  |  |  | |  | |  | |
| 12. The structural drivers  & | 2 | 1 |  | 3 | | 8 | | 11 | |
| instruments for strategy implementation |  |  |  |  | |  | |  | |
| 13. Continuous improvement through | 2 |  |  | 2 | | 8 | | 10 | |
| strategic control & evaluation |  |  |  |  | |  | |  | |
| 14. Strategic management in not-for-profit | 1 |  |  | 1 | | 8 | | 9 | |
| organisations |  |  |  |  | |  | |  | |
| 15. Strategic management concepts in | 1 |  | 2 | 3 | | 7 | | 10 | |
| the global marketplace |  |  |  |  | |  | |  | |
| **Sub-total** | **25** | **3** | **9** | **37** | | **118** | | **155** | |
| **Total** | **30** | **4** | **11** | **45** | | **135** | | **180** | |

1. **Detailed description of the topics**

**Topic 1. Review of Agribusiness Management**

. • Functions of management

. • Overview of agribusiness management

**Topic 2. Dynamics of the Agribusiness Environment**  . • Overview of the food & agribusiness industry

. • Importance of the food & fibre system in the World and African economy

. • Emerging trends & challenges in the food & agribusiness industry . • Agro-industrialization, international trends, strategic management and issues in agribusiness management.

. • Functional tasks of agribusiness managers: planning, organizing, directing and control

. • Description of the input supply, production, processing and distribution sectors

**Topic 3. Starting and Financing an Agribusiness Enterprise**

The topic will introduce students on steps to start an agribusiness enterprise even under financial constraints. The topic will introduce them on how to apply for credit based on a feasibility study and a business plan.

**5.2 Strategic Management in Agribusiness**

**Topic 1. Strategic Management process in Agribusiness Learning outcomes:**

Understand the definition & explanation of strategic management. Identify the people involved in strategic management and explain what strategy planning champions are.

Differentiate between qualitative and quantitative decisions. Understand the strategic management process as well as strategic visualisation.

. • What is strategic management?

. • The strategic management process

. • Strategic issues and concepts leading us into the future

**Topic 2. Strategic direction & Leadership in Agribusiness Learning outcomes:**

* Distinguish between the great leader view and the great groups view of strategy.

Know the components of strategic leadership.

Discuss the six leadership tasks that are emerging as priorities. Understand and apply strategic intelligence.

. • Strategic leadership

. • Setting strategic direction: vision, strategic intent and mission

. • Vision, strategic intent and mission

**Topic 3. Corporate governance and strategy Learning outcomes:**

* Define the terms “responsible leadership”, “sustainability” and “corporate citizenship”.
* Define “corporate governance.”
* Explain how corporate governance related to corporate citizenship, sustainability and  responsible leadership.
* Explain what the agency problem is and how it relates to corporate governance.
  + Responsible leadership o What is corporate governance?

**Topic 4. Internal environmental analysis for Agribusiness Strategy Learning outcomes:**

* Discuss the importance and challenge of internal environmental analysis.
* Apply SWOT analysis and explain its importance in environmental analysis
* Identify all the important resources and capabilities in an organisation and discuss their importance in the resource-based view with regard to internal environmental analysis.
* Describe value chain analysis as a method for performing internal environmental analysis.
* The importance and challenge of internal analysis o SWOT analysis
  + Internal analysis for effective strategy development

**Topic 5. External environmental analysis for an gribusiness Learning outcomes:**

* Describe all the elements of the external environment.
* Apply all the elements of the macro environment in the environmental analysis of an organisation.
* Describe and identify what an industry is and how to do an industry-competitive analysis by using Porter’s model.
* Analyse the importance of key success factors for an organisation.

. • The external environment

. • The macro environment

. • Industry or market environment

. • The external Factor Evaluation Matrix

**Topic 6: Competitor Analysis for an Agribusiness**

* ™Identifying competitors
* ™Competitive forces
* ™Competitive position

**Topic 7. Strategy formulation: long-term goals and generic strategies Learning outcomes:**

* Define long-term goals and discuss the requirements that they should meet in order to be used effectively in the strategic management process.
* Explain what competitive advantage is.
* Understand how capabilities contribute to competitive advantage. Discuss the generic strategies identified by Michael Porter and illustrate with practical
* examples how these strategies can contribute to the attainment of competitive advantage for an organisation.

. • Long term goals

. • Competitive advantage

. • Classifying strategies

. • Generic competitive strategies

. • Criticism against the generic strategy framework

**Topic 8. Strategy formulation: grand and functional strategies for an Agribusiness Learning outcomes:**

* Explain the relationship between Porter’s generic strategies and grand strategies.
* Discuss the grand strategies that organisations can pursue to achieve their long-term objectives, with specific reference to the circumstances under which each strategy would be appropriate.
* Illustrate with practical examples how each of the grand strategies is implemented by organisational environment.
* Explain what a combination of strategies entails.

. • Grand strategies

. • Combination of grand strategies

. • Functional strategies

**Topic 9. Aligning strategy with industry life cycle in Agribusiness Learning outcomes:**

* Understand the importance of the industry life cycle when doing an external environmental analysis.
* Identify the strategies applicable to organisations in emerging markets.
* Apply your knowledge in the identification of strategic options for competing in turbulent high-velocity markets. 9

Understand the strategies for competing in mature markets.

|  |  |  |
| --- | --- | --- |
| . | • | The industry life cycle |
| . | • | Strategies for competing in emerging industries of the future |
| . | • | Strategies for competing in turbulent, high-velocity markets |
| . | • | Strategies for competing in maturing industries |
| . | • | Strategies for firms in stagnant or declining industries |
| . | • | Strategies for industry leaders |

**Topic 10. Strategic analysis and choice in Agribusiness Learning outcomes:**

* Discuss the strategy analysis framework.
* Implement the SWOT Matrix
* Implement the SPACE Matrix
* Implement the Grand Strategy Matrix

. Implement the Quantitative Strategic Planning Matrix (QSPM)

. • Strategy analysis framework

. • The three strategic analysis matrixes

. • Final strategic choice/decision

**Topic 11. Strategy implementation and change management Learning outcomes:**

* Understand the significance of strategy implementation.
* Differentiate between strategy formulation and strategy implementation.
* Assess strategy implementation as a component of the strategic management process.
* Examine the problem of and barriers to successful stratergy implementation
* The significance of successful strategy implementation

• Change – a fundamental implementation issue

**Topic 12. The drivers of strategy implementation in Agribusiness Learning outcomes:**

* Evaluate leadership, organisational culture and reward systems as drivers for strategy implementation.
* Describe the relationship between corporate governance, leadership, organisational culture and reward systems.
  + Leadership as a driver of strategy implementation
  + Organisational culture as a driver for strategy implementation
  + Reward systems as a driver for strategy implementation

**Topic 13. The structural drivers and instruments for strategy implementation Learning outcomes:**

* Analyse and discuss the use of organisational design s a driver for strategy implementation.
* Realise and evaluate the importance of resource allocation as a driver for strategy implementation.
* Apply and discuss the role of short term goals, functional tactics and policies as instruments for strategy implementation.

. • Organisational design as a driver of strategy implementation

. • Resource allocation as a driver of strategy implementation

. • Short tem goals as an instrument for strategy implementation

. • Functional tactics as an instrument for strategy implementation

. • Policies as an instrument for strategy implementation

. • Conclusion

**Topic 14. Continuous improvement through strategic control and evaluation Learning outcomes:**

* Understand and discuss strategic control as a component of the strategic management process.
* Describe the different types of strategic control.

Design a strategic control system.

* Comment on the value of the role of the balanced scorecard in strategy

* implementation and control.

. • Strategic control

. • The balanced scorecard in strategy implementation and control

. • Evaluation strategic success

. • Sustaining competitive advantage through continuous improvement

**Topic 15. Strategic management in not-for-profit organisations Learning outcomes:**

* Discuss the usefulness of strategic management concepts and techniques for nonprofit or non-forprofit organisations.
  + Explain the difference between revenue sources for profit-seeking and not-forprofit organisations.
  + Identify the constraints on strategic management for not-for-profit organisations.

. • The benefits of strategic management concepts and techniques

. • Revenue sources for not-for-profit organisations

. • Constraints on strategic management for NFP organisations

. • Some useful strategies

**Topic 16. Strategic management concepts for Agribusiness in the global marketplace Learning outcomes:**

* Understand the scope and dynamics of the global business arena.
  + Distinguish between globalisation and “glocalisation”. o Identify the various strategic orientations of a global firm. o Global Competitiveness & the Cost of Doing Business o Understand the strategy and organisation on international business.

. • The scope and dynamics of global business

. • Strategic orientations of global organisations

. • The strategic choices of the global business

1. **Mode of Delivery**
   * **Teaching method**

A problem and solutions driven approach to learning will be followed. Student-centered and co-operative learning and teaching methods will be applied during lectures. Case studies will be used as well as high level senior managers of established agribusinesses. Field visits are also conducted to agribusinesses.

* + **Practical and key transferable skills**

Agribusiness Management will provide students with the skills necessary to successfully manage an agribusiness enterprise through the exposure obtained as set out above. Assignments on relevant topics are also given and presented to the class. It will also stimulate the development of communication and interpersonal skills and group dynamics.

1. **Assessment Methods**

In order to achieve the objectives, attendance of and meaningful participation during lectures is essential. Furthermore, students are advised to embark on a well-structured and systematic study program, in which the module material is studied in a probing, scientific and innovative manner, rather than by simple and passive memorizing.

The course consists of three components:

.

|  |  |  |  |
| --- | --- | --- | --- |
| . | • Continuous test/ assignments/case studies |  | 20% |
| . | • Term paper |  | 30% |
| . | • Final exam |  | 50% |

1. **References**

**Required text books**

-Ehlers, M.B, Lazenby, J.A.A. (2010). *Strategic Management: Southern African*

rd *concepts and cases* 3 ed, Van Schaiks, Pretoria.

-Van Rooyen, C J., OT Doyer, F Bostyn, & D’Haese, L. (2002) *Agribusiness : A Source Book for Agribusiness Training : Graduate Readings Volume 4 Agribusiness*

*I.* University of Pretoria (Available at the Department) **Further selected Reading List**

th

* -Aaker, D. A. *Strategic Market Management*. 7 edition. Wiley, New York, 2005.
* -*Grant, Robert ( ) Contemporary Strategy Analysis*
* -Manning, A.D. (2001) *Making sense of strategy*. Zebra Press, Cape Town.
* -Manning, A.D. (2002) *Discovering the essence of leadership*. Zebra Press.
* -Porter, M. *Competitive Strategy*. New York Press, 1985.
* -Thompson, A.A & Strickland, A.J (2008). *Strategic Management: Concepts and Cases*. Irwin: McGraw Hill.
* -Arbage A P, Padula A D (2006). Governance and vertical coordination structures in agri-food companies: insights into the impact of transaction costs. *Paper presented at the 7th International Conference on Management in AgriFood Chains and Networks, Ede, The Netherlands, 31 May – 2 June, 2006.*
* -Barry Peter, Cook Michael. (2004). Organizational Economics in Food, Agribusiness and Agricultural Sector. Organizational Economic Analysis in the Global Food, Agribusiness and Agricultural Sector. *American Journal of Agricultural Economics* 86(3) August 2004: 740 -743.
* -Boehlje, Michael: Gray, Allan. W; Detre, Joshua. D. (2005). Strategy Development in a turbulent business climate: concepts and methods.
* *International food & Agribusiness Management Review*, Volume 8 (2): 21-40.
* -Camps, T; Dideren, P; Hofstede, G.J & Vos, B. (2004). The Emerging World of Chains and Networks: Bridging Theory and Practice: Chapter 2: (In: Verhallen, T; Wiegerinck, V; Gaakeer, C & Poisez, T. *Demand driven chains and networks*.
* -Cardemil-Katuaric, Gustavo; Shadbolt, Incola. (2004). The Balanced Scorecard as a spontaneous framework in an agricultural hybrid cooperative under strategic change: A case study in the New Zealand kiwifruit industry. *Massey University, Palmerston North. New Zealand*.
* -Carlberg, Jared. G; Ward, Clement. E; Holcomb; Rodney, B. (2006). Success Factors for new generation cooperatives *International food & Agri-business Management Review*, Volume 9 (2): 33-52.
* -Culley, F; Coates, K & Haines, H. (2006). How can we make our agri-food supply chains work better? A case study from Victoria, Australia. *Department of primary Industries, Australia*: 1-7.
* -Helmut Albert (Section 4555), Henckes Christian (Section 4556), Elfring Wilhelm (consultant) (2001) - Services for Market and consumer oriented Agrifood systems - S*ervices for market and consumer oriented agrifood systems - GTZ agribusiness approach -(Conceptual aspects and practical examples).*
* -Graffham A, Public and Private Standards Information Sheet (2007). *Trends in the horticulture export sector from Sub-Saharan Africa.*
* -Hagen M. James. (2003). Agri-food innovation in developing countries: The role of retailer. *Department of applied economics and management*. Cornell University, Ithaca. New York, 14853-7801 USA. Submitted for IAMA. Cancun*.*
* -Henderson J, Dooley F, Akridge J and Carerre A (2005) Adoption of Internet Strategies by Agribusiness Firms -*International Food and Agribusiness Management Review, Volume 8, Issue 4, 2005.*
* -Hingley, M.K; Custance P.R & Walley, K.E. (2006). Co-opetition within United Kingdom agri-food chain. *Harper Adams University College, Newport, Shropshire.*  United Kingdom: 1-14.
* -Hsiao, H.I; Van der Vorst, J.G.A.J & Omta, S.W.F. (2006). Logistics outsourcing in Food Supply chain networks: Theory and Practices. *Management studies group, Wageningen.* University of Wageningen: 1-16.
* -King D J, Botha M (2007) The State of Logistics in South Africa: A review of the past five years.
* -Kirsten J F, Abdulrahman (2007). The impact of market power and dominance of supermarkets on agricultural producers in South Africa.. A *report commissioned by the National Agricultural Marketing Council.*

**COMMON AND ELECTIVE COURSES**

**CAEE 5102: Gender and Economic Development**

**Classification:**Elective **Credits:**3 **Semester:**3

**1. COURSE OBJECTIVES:**

* To provide students with knowledge of and insight into the connections between gender and economic development.
* To introduce students to the relevance and applicability of the concept of gender to development thinking and practice.
* To expose students to analytical skills for analysis of gender and development issues and approaches.
* To provide students an understanding of theoretical approaches and perspectives of gender and development.
* Expose students to the issues of gender and development.



**2. EXPECTED LEARNING OUTCOMES**

By the end of the course students should be able to:

* Identify gender roles in the economic development process of African countries.
* Critically apply gender concepts and theories and methodologies to address problems related to development studies and agencies that tackle poverty and global inequalities.
* Demonstrate substantive knowledge of contemporary debates relating to gender

1. **Prerequisites**

The course requires that students should have taken core courses of Microeconomics, Macroeconomics, undergraduate course in Gender and Development and Sociology or Anthropology.

1. **Thematic Plan**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Topic** |  | **Contact Hours** | | |  | **Independ ent study** | **Total**  **Hrs** |
| **Lecture** | | **Sem** | **Practi cal** | **Sub-**  **total** |
| 1. Evolution of gender theories | 5 | | 1 |  | 6 | 18 | 24 |
| 2. Gender and access to  productive resources | 6 | | 1 |  | 7 | 21 | 28 |
| 3. Gender, *poverty* and the household’s economy | 5 | | 1 |  | 6 | 18 | 24 |
| 4. Gender roles and relations in agricultural production | 4 | | 1 |  | 5 | 15 | 20 |
| 5. Gender and agricultural technological development | 5 | | 1 |  | 6 | 18 | 24 |
| 6. Mainstreaming gender in economic development | 8 | | 1 |  | 9 | 27 | 36 |
| 7. Case studies | 5 | | 1 |  | 6 | 18 | 24 |
| Total | 38 | | 7 |  | 45 | 135 | 180 |

1. **Detailed Description of Topics**

**Topic 1: Evolution of Gender Theory**

* + - * *Theoretical approaches and perspectives*
      * Women in development (WID)
      * Women and development (WAD)
      * Gender and development (GAD)
      * *Paradigm shifts from WID to GAD*
      * Engendering development

**Topic 2: Gender and Access to Productive Resources**

* + - * Gender and land tenure system
      * Gender, power and control over use of rural credit programmes
      * Women, wages, and intra-household power relations
      * Microfinance and women’s empowerment in Africa
      * Gender relations and armed conflicts

**Topic 3: Gender, Poverty and the Household Economy**

* + - * Women and food production in Africa
      * Gendered differentials in resources on productivity
      * Effects of single-parent families on household economy
      * Gender relations to food crisis
      * Gender relations to nutrition, health and consumption  Women and trade in Africa.
      * Gender dimensions of rural poverty

**Topic 4: Gender Roles and Relations in Agricultural Production**

* + - * Review of Agricultural Production Systems o Land ownership/allocation of resources for optimum growth o Land degradation o Cash crop production o Costs of production/prices o Dual sector development model.

o Entrepreneurship/returns o Development trap o Malthusian trap o Inequality

**Topic 5: Gender and Agricultural Technological Development**

* + - Exclusion from technology
    - Technological and welfare models
    - Appropriate technology
    - Post harvest technology

**Topic 6: Mainstreaming Gender in Economic Development**

* + - Elements of gender mainstreaming
    - Levels of gender mainstreaming
    - Gender analysis framework
    - Action plan for economic development
    - How to develop activity, access and control profile in an economic enterprise
    - Patterns of resource allocation
    - Institutional arrangements for gender mainstreaming
    - Why is targeting gender parity and gender equality a current policy concern*?* **Topic 7: Case Studies**

This requires guided reading and study to enable students understand topics in greater depth. Students will be required to give presentations on assigned case study themes and participate in discussions. Areas to be covered or included in case studies are:

* + - Gender and rural production
    - Gender policies and economic development  Gender equality reforms and their impact  Methodological approaches to gender studies.
    - Economic models of the household
    - Theoretical premises and feminist perspectives.

1. **Mode of Delivery**

The course will be offered on fulltime attendance. Curriculum will be delivered through lecture talk, exchange of ideas and discussion of aspects of a topic. Student presentation, guided reading and study seminars and discussion form part of case studies.

1. **Assessment Methods**

Progress will be evaluated through continuous assessments and the assessment of term papers.

* + - Case study/seminar and class participation account for 20%,
    - term paper 30% and
    - Final written examination will make up the balance of 50% of the final grade.

1. **Course Materials Required Texts** 
   * Feldstein, H. S.; and V.P. Susan. 1989. Working Together: Gender Analysis in Agriculture. Volume 1: Case Studies. Connecticut, USA, Kumarian Press, Inc.
   * Molyneux M. and S. Razavi, eds. 2005. Gender Justice, Development and Rights Oxford University Press: Oxford.

**Further Readings**

* + Gender and Food Security FAO 2011. Report.
  + World Development Report 2012. World Bank
  + Bannon, I. and M. Correia 2006. ‘The other half of gender’, World Bank Publications.
  + Chant, S., and M. Gutmann 2000. ‘Mainstreaming men into gender and development:

Debates, reflections and experiences’, Oxfam Working Papers, Oxfam: Oxford.

* + Derné, S. 2002. ‘Globalization and the reconstitution of local gender arrangements.*Men and Masculinities* 5 (2): 144-164.
  + Cook J, Roberts, J & Waylen, G. 2000. Towards a Gendered Political Economy. Macmillan: Basingstoke.
  + Datta, R. and Kornberg, J. eds. 2003. Women in Developing Countries: Addressing Strategies for Empowerment, Boulder.
  + Elson, D. ed. 1995. Male Bias in the Development Process (Manchester University Press: Manchester).
  + Friedrich, M. and A. Jellema 2003 ‘Literacy, gender and social agency: Adventures in empowerment’ DFID Education Papers No. 53, DFID: London
  + Global Campaign for Education. 2003. A fair chance: Attaining gender equality in basic education by 2005, Global Campaign for Education: London
  + Jackson, C and R. Pearso., eds. 1998. Feminist Visions of Development: Gender Analysis and Policy (Routledge: London).
  + Jackson, S, and, J. Scott.2002. Gender: A Sociological Reader, Routledge: London and New York.
  + Kabeer, N. 1994. Reversed Realities: Gender Hierarchies in Development Thought Verso: London.
  + Kabeer, N. 2003. Approaches to poverty analysis and its gender dimensions (chap 4), Gender Mainstreaming in Poverty Eradication and the Millennium Development Goals, Ottawa, Commonwealth Secretariat.
  + Herz, B. and G. Sperling. 2004. What Works in Girls’ Education: Evidence and Policies from the Developing World. (New York: Council on Foreign Relations) <http://www.cfr.org/pdf/Girls_Education_full.pdf>
  + Leach, F. 2003.Practising Gender Analysis in Education Oxfam: Oxford.
  + Moser, C. 1993. Gender Planning and Development: Theory, Practice and Training. Routledge: London.
  + Pearson, R. 2005. ‘The rise and rise of gender and development’, in Kothari, U (ed), 2005, A Radical history of Development Studies: Individuals, Institutions and Ideologies, London: Zed Books.
  + Reeves, H. and Baden, S. 2000. Gender and Development: Concepts and Definitions, IDS: Brighton.
  + Razavi, S. and Miller, C. 1995. From WID to GAD: Conceptual shifts in the Women in Development Discourse. UNRISD Occasional paper for the Fourth Conference on Women in Beijing, 1995.
  + Saunders, K. (ed) .2002. Feminist post-development Thought: Rethinking modernity, post-colonialism and representations. Zed Books: London.
  + Subrahmanian, R. 2005. Gender equality in education: Definitions and Measurements. *International Journal of Educational Development*24 (4): 395-407.
  + Visvanathan, N, L Duggan, L Nissoff and N. Wiegersma, eds. .1997. The Women, Gender and Development Reader. Zed: London.
  + Adepoju, A.; and C. Oppong 1994. Gender, Work and Population in Sub-Saharan Africa. ILO, Geneva. Heinemann.
  + Agrawal, Bina, 1992. “The Gender and Environment Debate: Lessons from India”, *Feminist Studies*, 18, 1. Pp. 119-158.
  + Babalola, S. O.;, C., 1 Dennis. 988. Returns to Women’s Labour in Cash Crop Production: Tobacco in Igboho, Oyo State, Nigeria. *Agriculture, Women, and Land: The African Experience*. P. 79-89.
  + Baud, I.S.A., and G.A., de Bruijne eds. 1993. Gender, Small-Scale Industry and Development Policy. Intermediate Technology Publications, London, UK.
  + Bina, A., 1994. Gender and Command Over Property: A Critical Gap in Economic Analysis and Policy in South Asia. *World Development,* 22, 10, pp. 1455-1478*.*
  + Boserup, E., 1970. *Woman’s Role in Economic Development*. London Earthscan Publications Ltd.
  + Chambers, R. and Jiggins, J., 1987. Agricultural Research for Resource-Poor Farmers: Transfer of Technology and Farming Systems Research. The University of Sussex, Brighton, England. Agricultural Administration No. 27.
  + Davison, J. 1988. Land and Women’s Agricultural Production: The Context.
  + Davison, J. 1988. Land Redistribution in Mozambique and its Effects on Women’s Collective Production: Case Studies from Sofala Province. *Agriculture, Women, and Land: The African Experience*. p. 228-249.
  + Gerson, R.T. 1989. Home Gardening of Indigenous Vegetables: The Role of Women. *Acta Hortic:* (270): p 331-336*.*

**CAEE 5103: Agricultural Project Planning and Management**

**Classification:** Elective **Number of Credits:** 3 **Semester:**  3

1. **Course Objectives**

The course seeks to provide a practical overview on Agricultural Investment Planning at strategic level, as well as planning and management of Agricultural projects. Although projects are virtually in every sector of the economy, it is expected that there will be a bias on agricultural projects. The concepts and skills taught to the students will however, be applicable to any project in any sector. Specifically, the course will aim to:

* + - Expose students to important concepts and skills critical to the Investment planning process and management of Agriculturalprojects
    - Guide students on how to plan, evaluate and manage investment plans and projects.
    - Understand scope management, the project life cycle, project risks, etc
    - Expose students on how to develop and effectively apply various concepts e.g. CPM and PERT in project management.
    - Expose and enhance application of logical framework in project planning
    - Understand the importance of quality management in project management.

1. **Expexted Learning Outcomes**

After completing the course, the learner should be able to:

* + Define the role of an agricultural investment plan in the sector/country
  + Relate agricultural investments to the strategic goals of the organization
  + Initiate a project, identify stakeholders and define the project scope
  + Manage scope changes
  + Define major agricultural project phases, deliverables and decision gates
  + Allocate resources to work packages and manage the workload on resources
  + Identify roles and responsibilities of team members and other stakeholders
  + Explain a model for managing multiple farm projects
  + Use network techniques to develop practical, realistic project schedules
  + Use techniques to ensure timely completion of the project
  + Use Gantt charts for project monitoring and for reporting
  + Estimate project costs and prepare a project budget
  + Plan project cash flow
  + Control project costs, progress and the quality of deliverables
  + Assess agricultutal projects as a financial investment (including the use of IRR and NPV)

1. **Prerequisites**

Basic knowledge in project analysis, statistics and Excel

Some background in project management

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topic** | **Time (in Hours)** | | |  | **Independent**  **Study** | **Total** |
| **Lectures** | **Seminar** | **Practical** | **Sub-**  **Total** |
| 1. Introduction to the agrocultural investment planning and management | 2 |  |  | 2 | 0 | 2 |
| 2. Strategic Planning | 2 |  |  | 2 | 5 | 7 |
| 3. The Project  Concept | 2 |  | 1 | 3 | 5 | 8 |
| 4. The Logical  Framework  Approach to Project  Planning | 4 | 2 |  | 6 | 15 | 21 |
| 5. Agricultural  Research Planning | 3 |  |  | 3 | 5 | 8 |
| ? |  |  |  |  |  |  |
| 6. Economic Analysis of Agricultural  Development  Projects through  CBA | 5 | 2 | 1 | 8 | 25 | 33 |
| 7. Welfare  Economics/Political  Economy of Project  Analysis and  Appraisal | 4 |  |  | 4 | 15 | 19 |
| 8.Monitoring,  Evaluation and  Impacts Assessment | 4 | 1 | 1 | 6 | 25 | 31 |
| 9. Project scheduling techniques | 5 | 1 |  | 6 | 20 | 26 |
| 10. Agricultural Project Management | 5 |  |  | 5 | 20 | 25 |
| **Total** | **36** | **6** | **3** | **45** | **135** | **180** |

1. **Detailed Description of the Topics**

**1. Introduction to Investment Planning and Management in Agriculture**

* Definitions and terminologies
* Characteristics of agricultural projects

**2. Strategic Planning**

* The process of strategic planning
* Scenario planning, evidence-based analysis (incl. monitoring and analysis of public expenditures and policies)
* Components of a strategic plan
* Formulating strategic plans
* Objective setting
* Setting up a Result-Framework for the Plan
* Reflections on CAADP and good practices in investment plan development
* Implementation arrangements (Projects, Budget support, other)

**3. The Project Concept and Tratergic Planning**

* Attributes of successful project management
* Project lifecycles and phases
* Phases and milestones
* Phases risks and uncertainties
* S-curve of project progress

**4. The Logical Framework Approach to Project Planning**

* Introduction to Logical framework
* Analysis stage of Logframe
* Planning stage of Logframe

**5. Agricultural Research Planning**

* Levels of planning
* Program planning
* Planning socio-economic types of projects
* Setting priorities
* Approaches to priority setting
* Difficulties in priority setting

**6. Investment Appraisal: Financial Analyses**

* The Time Value of Money
* Compounding and Discounting
* Measures of Project Worth o Net Present Value (NPV) o Annuities o Sinking Fund

o Behaviour and Treatment of some Variables in the Process of Discounting o Internal Rate of Return (IRR) Criterion

* Conflict between NPV and IRR o Decision on Ranking Mutually Exclusive Projects o Decision on the Ranking of Independent Projects o Decision on the choice of Discount Rate
* Other Investment Criteria o Proceeds per unit of outlay o Payback Period, D

o Benefit- cost ratio ( B/C)

 Problem sets

**7. Investment Appraisal: Economic Appraisal**

 Projects requiring economic appraisal  The Rationale for Economic Appraisal  Economic Efficiency: o Pareto optimality o Compensation Tests

* Efficiency and distribution considerations
* Market Failures o Government Failures o Economic Considerations  Divergences between Market Prices and Social Values  Social Prices for Goods: o Non-traded goods and Conversion factors o Shadow Prices of Traded Goods o Shadow Prices for Factors of Production  Social Analysis

1. **Monitoring, Evaluation and Impacts Assessment** 
   * Process monitoring
   * Strategic (plan) and operational (projects) monitoring
   * Types of evaluation
   * Purpose of impact assessment
   * Types of impact assessment
   * Overview of impact assessment methods
   * Strategies for impact assessment
2. **Project Scheduling Techniques** 
   * Work breakdown structures
   * Gantt Charts
   * Network Analysis o CPM method o PERT Analysis
   * Project crashing

1. **Project Management** 
   * Process of project management: o What makes a project successful?

* Scope management o Cost estimating techniques
* Project life cycle o Project Risk management o Resources
* Procurement schedule

 Human Factor in project management o Quality management o Project meetings

**8. Overall Assessment Criteria**

 Expose students to important concepts and skills critical to strategic planning as well as the planning and management of projects

* Guide students on how to plan, evaluate and manage projects.
* To understand scope management, the project life cycle, project risks, etc
* Expose students on how to develop and effectively apply various concepts e.g. CPM and PERT in project management.
* Expose and enhance application of logical framework in project planning o Understand the importance of quality management in project management  Understand logic of project management and planning

1. **Mode of Delivery**

Formal lectures and extensive computer based exercises, assignments, etc

1. **Assessment Methods**

This will be through continuous assessment tests and home assignments (20%), case study/term paper (30%), semester test (50%) (All = 50%) and final exam (50%). These do not add up to 100%!

1. **Course Materials** 
   1. **Main resource Book**

 Van Rooyen, CJ, P. Anandajayasekeram, M. Rukuni, C, D. Marassas, M. Haese and L. D’Haese. 2001*. Agricultural Project Planning and Analysis: A*

*Sourcebook.Publisher and plac?..*

* 1. **Further readings including journals**
* Curry, S. and J. Weiss. 2000. *Project analysis in developing countries.* Revised 2nd Edition. London: Macmillan.
* Author? Agriculture Investment Plans – selected resources from the Investment Centre of the Food and Agriculture Organization (in course of finalization)
* CIMMYT. 1988. *From agronomic data to farmer recommendations: An economic training manual.*Revised edition.Mexico: CIMMYT.
* Gittinger J. P 1982. *Economic analysis of agricultural projects.* 2nd Edition. Baltimore: The Johns Hopkins University Press.
* Anandajayasekeram A, D. R. Martella and M (1996). *A.* Rukuni. Date? *Ttraining manual for biological scientists on impact assessment of investments in agricultural and natural resources research.*
* Casley D.J. and Kumar K. 1989. *The collection, analysis and use of monitoring and evaluation data.* Washington DC: The World Bank.
* *European Commision. 2002. Project Management Cycle Handbook, PARTICIP GmbH and FTP.*
* Hulme, D. 1995. Projects, politics and professionals: Alternative approaches for project identification and project planning, *Agricultural Systems*, 47(2): 211-233.
* Wiggins S and D. Shields 1995. Clarifying the ‘Logical Framework’ as a Tool for Planning and Managing Development Projects. *Project Appraisal*, 10 (1): 2-12.
* Ward W,A. and B. J. Deren. 1991. Project Analysis versus? Policy Analysis*.* In *The Economics of Project Analysis: A Practitioners Guide, EDI, World Bank.*

**8.3 Internet sourses**

* *Asian Development Bank (ADB). 1997.* Guidelines for Economic Analysis of Projects. *Available online on:*http://www.adb.org/Documents/Guidelines /Eco\_Analysi[s/ default.asp#contents](http://www.adb.org/Documents/Guidelines%20/Eco_Analysis/%20default.asp#contents)
* ICRA Agricultural Research for the Development (ARD) Learning modules, web site:

[*http://www.icra-edu.org*](http://www.icra-edu.org/)

**CAEE 5111: Environmental Valuation and Policy**

**Classification**: Elective **Number of Credits**: 3 Hours **Semester**: 2

1. **Course Objectives**

This course is designed to prepare students for a research career in environmental and natural resource economics. Since this is a course specifically designed for students of agricultural economics, there is a specific bias to applying the concepts and principles gathered to environment and natural resources management problems in the agriculture sector. Many environmental and natural resources goods and services are non-marketed. Without knowledge of the value society places on such goods, allocating them in a manner that maximizes society’s welfare becomes a policy challenge. The course is designed to provide students with a blend of theory, methods, computer applications and case studies.

1. **Expected Learning Outcomes** 
   * The rationale behind environmental valuation and the concept of value in welfare economics, including the different categories of value and how they relate to valuation methods
   * The concepts of market (and government) failure, public goods and externalities
   * The interrelationships between market failure, externalities and economic efficiency
   * The theoretical basis and application of cost-benefit-analysis (CBA) to project/policy appraisal in the environment
   * Theoretical framework of environmental valuation and how it relates to measures of economic welfare
   * The application of travel cost methods and how to estimate travel cost models and interpret the results
   * The application of hedonic price methods and how to estimate hedonic price models and interpret the results
   * The design and implementation of contingent valuation (CV) method and how to analyse and interpret the results of a CV study
   * The design and implementation of the choice experiment method (CE) and how to analyse and interpret the results of CE study
2. **Prerequisites**:

Familiarity with mathematical economics, microeconomics, econometrics and computer skills (especially working with a spreadsheet program) are required. Since the course has a strong micro component, an understanding of the following topics in Microeconomics is particularly desired: theory of the consumer and the firm, welfare economics, general equilibrium and constrained optimization.

**4.Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic |  | Contact hours | |  | Independen  t study | Tota l |
| Lectur e | Semina  r | Practica  l |  |  |
| 1. Introduction to environmental valuation | 3 |  |  | 3 | 5 | 8 |
| 2. Theory of Welfare Measurement | 3 |  |  | 3 | 15 | 21 |
| 3. Introduction to the Economic  Theory of Valuation | 3 |  |  | 3 | 10 | 13 |
| 4. Cost-benefit Analysis (CBA) | 3 |  | 2 | 5 | 15 | 21 |
| 5. Environmental Valuation  Methods: Revealed Preferences | 8 |  | 5 | 1  3 | 20 | 34 |
| 6. Environmental Valuation  Methods: Stated Preferences | 8 |  | 5 | 1  3 | 20 | 34 |
| 7:  CombiningStatedandRevealedPreferenc es | 3 |  | 2 | 5 |  |  |
| **Total** | **31** |  | **14** | **4**  **5** | **135** | **180** |

**5. Detailed Description of Topics**

**Topic 1: Introduction to environmental valuation**

* Overview of environmental and resource management (ERM) problems
* Market failure, public goods and externalities
* Basic steps in evaluation
* Basic concepts in welfare economics and economic valuation
* Defining economic/environmental values
* The concept of total economic value (TEV)
* Introduction to environmental valuation methods

**Topic 2: Introduction to the Economic Theory of Valuation**

* Intrinsic value
* Instrumental value: (i) direct consumptive use value, (ii) direct non-consumptive use value, (iii) indirect use value, (iv) non-use value (option and existence values)
* Resource-environment systems, changes in human welfare, economic valuation
* Classification of valuation methods based on data sources: (i) revealed preference, (ii) production function, and (iii) stated preference methods of valuation.

**Topic 3: Theory of Welfare Measurement**

* **Basic tools**: (i) direct utility functions, (ii) Marshallian demands, (iii) indirect utility functions, (iv) Hicksian demands, (v) the expenditure function
* Welfare measures for price changes: (i) consumer surplus, (ii) compensating variation,
* Equivalent variation, (i) the problems of CS as a welfare measure
* Welfare measurement under quantity constrained regimes: (i) compensating surplus, (ii) equivalent surplus
* Theoretical model of non-market goods (NMGs)
* Duality and Expenditure Function
* Welfare measures for a change in price
* Welfare measure for a change in non-market good
* Willingness to pay (WTP) versus Willingness to accept (WTA) compensation
* Implicit Markets for Environmental Goods
* Price Changes and Environmental Values
* The concept of weak complementarily
* The Hedonic price concept

**Topic 4: Cost-benefit Analysis (CBA)**

* The rationale of CBA
* The Kaldor-Hicks test
* Steps in conducting CBA o Defining the project/policy
* Identify the physical impacts of the project/policy
* Value impacts
* Discount the cost and benefit flows o Apply the net present value (NPV) test o Sensitivity analysis
* Aggregation and distributional Issues
* Challenges of CBA
* Sustainability and CBA

**Topic 5: Environmental Valuation Methods: Revealed Preferences**

**Topic 5.1: Recreational Demand Models**

**5.1.1 Travel Cost Models (TCM)**

* Zonal travel cost approach
* Individual travel cost approach
* Random utility TC approach
* TCM limitations
* Applications o TheBasicModel:Studentswillbeexposedtothegenerictravelcostproblemandestimation.Conting ent Valuationestimationwill alsobecovered.

o SinglesiteModels:EstimationofcensoredmodelsincludingTobit,Count models o Truncationandstratificationincludingwelfaremeasurement.

5.1.2 Extension of recreational demand

MultipleSiteModels:Conditionallogit,nestedmodels,logit/IIA,Twostage(LIML)modelestimation,Kuhn-

TuckerModels.WelfarecalculationandstatisticalpropertiesofWTP.

* DemandSystems
* CornerSolutionsModels
* IssuesinMultipleSitesModels: DefiningtheChoiceSet, MattersofTime:

**Topic 5.2: Hedonic price Models**

* Economic rationale and links to consumer theory
* Hedonic price functions and data considerations  Issues in estimating hedonic price functions  EquilibriumSortingModels:
* Case study applications

**Topic 6: Environmental Valuation Methods: Stated Preferences**

**Topic 6.1: Contingent Valuation Method**

* Introduction
* Designing a CV questionnaire
* Validation of CV data
* Controversies and biases
* Benefit Transfer
* Modelling CV data: Case Studies (Labs)

**Topic 6.2: Choice Experiments**

* Introduction
* Theoretical basis
* Designing a choice experiment  Modelling CE data: Case Studies (Labs) o Conditional logit model

o Modelling preference heterogeneity: (i) Random parameters logit (ii) Latent class model

* Applications (Labs)

**Topic 7: CombiningStatedandRevealedPreferences**

* Limitations of stated and revealed preference methods
* The value of combining stated and revealed preference methods
* Methods of combing stated and revealed preferences
* Case studies

**7. Assessment Criteria**

Students will be graded based on their performance in:

* One Mid-semester test (20%)
* Home assignment (30%)
* A final examination (50%)

The assessment consist of a mid-semester test (20%), home assignment probably based on computer lab exercises or Lab reports (30%) which assess students’ understanding of practical applications of the valuation methods and appreciate the challenges of empirical research. Then a three-hour end of semester final examination (50%). Ideally, all examination questions will be compulsory since there are no optional sections of the course. Consequently students are expected to understand the course in its entirety.

1. **Mode of delivery:**

This course offers 45 teaching hours, which will include “learn by doing” computer Lab or practical sessions in which students work with datasets to implement the environmental valuation models introduced in the lectures. There will be 5 hours of **lab work** where the lecturer will introduce students to various methods of environmental valuation based on the case-study approach. The case-study approach is preferred considering that it helps the student appreciate that environmental valuation is a decision making tool: the student will appreciate the relationship between knowing how to implement an environmental valuation technique in computer and using the results to solve specific environmental/natural resource management problems. The lecturer will introduce the lab to the students who will then be expected to implement it using statistical software e.g. EXCEL, STATA and/or LIMDEP. There will be 135 hours of **independent study**, through which students are expected to spend a lot of self-study time understanding theoretical and applied material covered in valuation.

1. **Course Materials**  ***Books:*** 
   * Perman, R., Y. Ma, M. Common, D. Maddison and J. Mcgilvray. 2011 Natural Resource and Environmental Economics (4th Edition), Pearson Education, UK.
   * Freeman III, Myrick A. 2003. *The Measurement of Environmental and Resource Values:*

*Theory and Methods* , 2nd edition, Resources for the Future Press

* + Nick Hanley and E Barbier. 2009: *Pricing Nature: Cost-Benefit Analysis and*

*Environmental Policy*, Cheltenham: Edward Elgar

* + Haab, Timothy C. and Kenneth E. McConnell. 2003, *Valuing Environmental and Natural Resources: The Econometrics of Non-market Valuation*, Edward Elgar Publishing Ltd, UK.
  + Champ, Patricia A., Kevin J. Boyle and Thomas C. Brown Eds. 2003. *A Primer on NonMarket Valuation*, Kluwer Academic Publishers, Boston/
  + Bateman, Ian J. Richard T. Carson, et al. 2004, *Economic Valuation with Stated Preference Techniques: A Manual*, Edward Elgar Publishing Ltd, UK.
  + Dixon John A and Maynard M. Mufschmidt Eds. 1986. *Economic valuation techniques for the Environment: a case study workbook*, the John Hopkins University Press.
  + Garrod, G.D. and K.G. Willis. 1999. Economic valuation of the environment, methods and case studies. Cheltenham: Edward Elgar.
  + Hensher, David A., John M. Rose, and William H. Greene. 2005, *Applied Choice Analysis: A Primer,* Cambridge University Press.
  + Louviere, J. J., D. A. Hensher and J. D. Swait. 2000, Stated Choice Methods: Analysis and Applications, Cambridge University Press, Cambridge.
  + Train, K. 2002, *Discrete choice methods with simulation*, Cambridge University Press, Cambridge.
  + Mitchell, R. C. and R. T. Carson 1989, *Using Surveys to Value Public Goods: The Contingent Valuation method*, Resources for the Future, John Hopkins University Press, Washington D.C.
  + Bennett, ? and ?Blamey Eds. Date? *The Choice Modelling Approach to Environmental Valuation*, Edward Elgar, Cheltenham.
  + Ben-Akiva, M. and S. R. Lerman. 1985, Discrete Choice Analysis: Theory and Application to Travel Demand, MIT Press, Massachusetts.

***Publications:***

* + Lancaster, K. J. 1966, 'A New Approach to Consumer Theory', *Journal of Political Economy*, **74**: 132-157.
  + Rosen, S. 1974, 'Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition', *Journal of Political economy*, 82: 34 - 55.
  + McFadden, D. 1974, 'Conditional logit analysis of qualitative choice behaviour', in P. E. Zarembka (ed.), Frontiers of Econometrics, Academic Press, New York.
  + Ronal Coase 1960: The problem of social cost, *Journal of Law and Economics*, 3: 1-44.
  + Bator, F. M., 1958. The Anatomy of Market Failure. Quarterly Journal of Economics 72, 351-379.

**CAEE 5112: Quantitative Methods in Environmental Economics**

**Classification: Elective Number of Credits: 3 Semester: 1**

1. **Course Objectives**

This course is concerned with the application of econometric techniques and quantitative economy-wide methods to studying natural resource and environmental economics phenomena and problems. Econometric subjects covered emphasize the use of choice models, which include estimation with limited dependent variables, dichotomous choice, duration models and panel data analysis as applied to environmental economics. The course also deals with the methodology of multi-sector economy-wide modelling for the environment at an introductory level. Several methods are covered under this section, such as environmental input output and computable general equilibrium modelling. The course will stimulate participants to plan several tentative research agendas for possible subsequent work in this field (e.g. dissertation methodology chapters). By its nature, the course will use computers intensively.

1. **Expected Learning Outcomes:**

The course is designed to suit students with a primary interest in undertaking empirical work in environmental economics. Students are expected to acquire through this course skills required for assessing the impact of environmental policies on the joint environment/economic system and be able to develop models of economic-environment interactions. They should have needed skills to collect relevant data, choose the appropriate mathematical, statistical or econometric technique and use the appropriate software package to address substantive environmental issues.

1. **Prerequisites:**

The prerequisites for this course should in principle be fully satisfied by the core courses of macroeconomics, microeconomics and quantitative methods at the masters’ level. The econometrics module covers very advanced material usually not attempted until students have a thorough understanding of how biases in OLS can be corrected in analysis of continuous (as opposed to discrete) choice models through use of maximum likelihood and multi regression models. This requires a full year of econometric study.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic | Contact hours | | | | Independent study | Total |
| Lecture | Seminar | Practical | Sub  Total |
| 1. Regression models for categorical and limited dependent variables | 8 |  | 6 | 14 | 22 | 36 |
| 2. Econometric analysis of duration data | 6 |  | 6 | 12 | 20 | 32 |
| 3. Introduction to econometric analysis of panel data | 5 |  | 6 | 11 | 25 | 36 |
| 4. Environmental inputoutput models | 7 |  | 6 | 13 | 25 | 38 |
| 5. Environmental SAM and  CGE models | 7 |  | 6 | 13 | 20 | 33 |
| **Total** | **33** |  | 27 | **60** | **112** | **175** |

1. **Detailed Description of Topics**

**Topic 1: Regression models for categorical and limited dependent variables**

*This topic covers the following sub-topics:*

* + Binary Outcomes: Linear Probability, Probit and Logit Models
  + Hypothesis Testing and Goodness of Fit
  + Ordinal Outcomes
  + Ordered Logit Analysis
  + Ordered Probit Analysis
  + Nominal Outcomes
  + Multinomial Logit Model
  + Conditional Logit Model
  + Nested Logit Model
  + Limited Outcomes
  + Truncated and Censored Distributions
  + Tobit Model
  + Sample Selectivity Model
  + Practical – Model estimation (STATA/Limdep)

**Topic 2: Econometric analysis of duration data**

*This topic covers the following sub-topics:*

* + Features of Duration Data (Stock Sample, Flow Sample, Censored and Truncated Data)  The Rationale for Distinctive Econometric Method Survival Function and Hazard: Definitions and Key Relationships
  + Non-Parametric Estimation of the Hazard Rate and Survival Function
  + Functional Forms of the Hazard Rates and Duration Dependence (Exponential, Weibull, Log Logistics etc)
  + Parametric Estimation of the Hazard Rate
  + Estimation of the Parameters of the Distribution
  + Proportional Hazard Model (Introduction of Covariates)
  + Cox Proportional Hazard Model
  + Other Specifications and Specification Checks.
  + Practical - Estimation

**Topic 3: Introduction to analysis of panel data**  *This topic covers the following sub-topics:*

* + Advantages of Using Panel Data
  + Rationale for Distinctive Econometric Approach
  + Estimation of Panel Data Model
  + One Way and Two Ways Fixed Effect Model
  + One Way and Two Ways Random Effect Model
  + Choosing Between Pooled, Fixed Effects and Random Effects Models and Other Specification Tests.
  + Practical – Panel estimation, Environmental Kuznets Curve

**Topic 4: Environmental input-output models**

* + Input-output accounting
  + Matrix algebra
  + Introduction to input-output analysis
  + Relative prices in input-output models
  + Environmental issues in input-output models
  + Strengths and weaknesses of input output models
  + Practical – Solving IO Model using GAMS

**Topic 5: Environmental SAM and CGE modeling**   This topic covers the following sub-topics:

* + Social accounting matrices
  + Introduction to computable general equilibrium modeling  The building blocks of CGEs.
  + Empirics
  + Environmental aspects in CGEs
  + Trade and the environment
  + The time dimension
  + Strengths and weaknesses of CGEs
  + Practical – Implementation in GAMS

1. **Mode of delivery:**

This course will be delivered in 33 hours of lectures and 12 hours of computer lab exercises plus mandatory readings listed below on which students are expected to spend at least 90 hours of independent study.

1. **Assessment Methods**

Students will be graded based on their performance in:

. • Home work Assignments

. • Term Paper/Project

. • Final Examination

*Homework assignments:* Students will be provided with assignments each week, reflecting some of the material they will be tested on in the final examination as well as examples of types of analysis they might want to use for their project term paper.

***Project Paper****:* This will be a research-orientated paper (i.e. the paper should include the student’s own original thinking about the issue from an environmental economic perspective) of 10-15 typed double-spaced pages. The goal of this paper is to have students study in depth a relevant environmental problem applying the methodologies taught in the course. Students will first choose a country and topic on any of the issues falling under Environmental and Resource Management courses. They will find relevant data (or data sets are provided) and then initiate quantitative analysis (e.g., regression analysis, estimation of IO multipliers, CGE analysis etc) using this data. The final paper should have an introduction of chosen country, literature reviews, methodology and data description, data analysis and estimation and a discussion of results and summary. If insurmountable data availability problems are encountered synthetic data sets may be used instead. The due date for this paper is ideally the final week of class.

*Examination*: There will be a 3-hour final examination consisting of short-answer problems primarily patterned after your homework assignments. There will also be questions drawn from lectures and readings.

*Overall Performance in the Course:*

* Homework assignments (40% )
* Term Paper/Project (30%)
* Final Examination (30%)

*Software and Teaching Aids*

The recommended computer software for this course is as follows:  *Spreadsheet analysis*: Excel

* *Econometric and Statistical analysis:* STATA or LIMDEP/SPSS
* *Economy-wide Modeling:* GAMS

The following teaching aids are required:

* *Equipment:* Computers, Power-Point data projector, Overhead Projector, Black/White

Boards, Internet Access, Flip Charts and accessories, Recommended software

* *Infrastructure:* Computer laboratory, Class room, Library **8. Course Materials**

*Required readings for Topic 1:*

* Long, J Scott, 1997, *Regression Models for Categorical and Limited Dependent Variables*, SAGE.
* Publications. Greene, W.H. 2003, *Econometric Analysis*, Maxwell-MacMillan: New York Haab.
* Timothy C. and Kenneth E. McConnell. 2002. Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation, Edward Elger. ??
* Mekonnen, A., 2000. “Valuation of community forestry in Ethiopia: A contingent valuation study of rural households”, *Environment and Development Economics,* Vol. 5, 2000, pp. 289-308.
* Whittington, D. 1988, Adminstering contingent valuation surveys in developing countries. World Development, Vol 26, No. 1.
* Whittington, D. 2002, Improving the Performance of Contingent Valuation Studies in

Developing Countries, Env & Res Econ, Vol. 22

* Carson1/, Richard T., Nicholas E. Flores2? and Norman F. Meade. 2001, Contingent

Valuation: Controversies and Evidence, Env & Res Econ, Vol. 19

* Carlsson, Fredrick. 1997, Stated Preferences methods (Chapters 3, 5, 6 & 7) Publisher?
* Carlsson, Fredrik, Peter Frykblom and T, Carl Johan Lagerkvist. 2005, Using cheap talk as a test of validity in choice experiments, Econ Letters, Vol. 89 *Required readings for Topic 2:*
* Long, J Scott, 1997, *Regression Models for Categorical and Limited Dependent Variables*, SAGE Publications. Jenkins,
* Stephen, P. 2004. *Survival Analysis*. Unpublished manuscript, Institute for Social and ? Economic Research, University of Essex, Colchester, UK.

Downloadable:http://www.iser.essex.ac.uk/teaching/stephenj/ec968/pdfs/ec968lnotes v5.pdf

* Kiefer, N.M 1988. “Economic Duration Data and Hazard Functions”. *Journal of Economic Literature.*, Vol. XXVI (June), pp. 646-679.
* Smith M.D. 2004. “Limited-Entry Licensing: Insights from a Duration Model” *American Journal of Agricultural Economics*, August, Vol. 86. No 3, pp. 605-618.
* Abou-Ali Hala 2003. *Water and Health in Egypt: An Empirical Analysis*, PhD Thesis, Department of Economics, University of Gothenburg. Downloadable online from: http://www.handels.gu.se/epc/archive/00003482/01/Thesis\_Hala\_Abou-Ali.pdf
* Greene, W.H. 2003, *Econometric Analysis*, Maxwell-MacMillan: New York
* Lancaster, Tony 1990. *Econometric Analysis of Transition Data*. Cambridge University Press.
* Wooldridge, J.M. 2002, *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, Massachusetts.

*Required readings for Topic 3*

* Baltagi, B.H. 2001, Econometric Analysis of Panel Data, 2nd edition, Wiley, Chichester.
* Hsiao, C. (1986), Analysis of Panel Data, Cambridge University Press, Cambridge.
* Wooldridge, J.M. 2002, Econometric Analysis of Cross Section and Panel Data, MIT Press, Cambridge, Massachusetts.
* Wooldridge, J.M. 2001, *Introductory Econometrics: A Modern Approach*, South-Western College Publishing.
* de Bruyn S.M., J.C.J.M. van den Bergh and J.B. Opschoor. 1998 “Economic growth and emissions: reconsidering the empirical basis of environmental Kuznets curves”, Ecological Economics 25, 161-175
* Johnston Jack and John DiNardo 1997, *Econometric Methods*., McGraw-Hill

*Required Readings for Topic 4*

* Duchin, F. and A.E. Steenge, “Input-output analysis, technology and the environment”, in: ?
* van den Bergh J.C.J.M. Ed. 1999, *Handbook of environmental economics*, Edward Elgar, Cheltenham.
* Leontief, W. 1970. “Environmental Repercussions and the Economic Structure:

An Input-Output Approach,” Review of Economics and Statistics, pp. 262-71.

* Leontief, W. 1986, Input-Output Economics. 2nd ed., New York: Oxford University Press.
* Miller, R. and P.D. Blair, 1985, Input-Output Analysis: Foundations and Extensions, New Jersey: Prentice-Hall.
* Perman, R., Y. Ma, J. McGilvray and M. S. Common 1999, Natural

Resources and Environmental Economics, 2nd Edition, Longmans.

* Sadoulet, E. and A. de Janvry. 1995 *Quantitative Development Policy Analysis*, The Johns Hopkins University Press, Baltimore and London.

*Required Readings for Topic 5*

* Bergman, L. 2003 “CGE Modelling of Environmental Policy and Resource

Management”, mimeo, Stockholm School of Economics, Sweden

* Hassan, ? 1997. Trade liberalization and the environment: The case of agriculture in South Africa**.** Agrekon, Vol 36, No 4 (December 1997): 407-429.
* Nordhaus, William D. 1994, *Managing the Global Commons*, Cambridge, Massachusetts: MIT Press.
* Mansur, A. and John Whalley. 1983, ”Numerical Specification of Applied General

Equilibrium Models: Estimation, Calibration and Data,” in Herbert Scarf and John Shoven (eds.), *Applied General Equilibrium Analysis*, New York: Cambridge University Press.

* Perman, R., Y. Ma, J McGilvray and M. S. Common. 1999, *Natural Resources and Environmental Economics*, 2nd Edition, Longmans.
* Shoven, J.B. and John Whalley, 1992, *Applying General Equilibrium*, Cambridge: Cambridge University Press.
* Ginsburgh, V. and M. Keyzer, 1997, *The structure of applied general equilibrium models*, Cambridge, MIT Press.
* Harrison, G.W., S.E. Hougaard Jensen, L. Haagen Pedersen and T.F. Rutherford, Eds. 2000, *Using dynamic general equilibrium models for policy analysis*, NorthHolland, Amsterdam.
* Sadoulet, E. and A. de Janvry. 1995 *Quantitative Development Policy Analysis*, The Johns Hopkins University Press, Baltimore and London.
* Shoven, J. and J. Whalley. 1992, *Applying general equilibrium*, Cambridge University Press, Cambridge.
* Dellink,, Rob. 2005, GAMS for Environmental Economics Modelling: Reader, Wageningen University, Netherlands
* Dellink, Rob. 2005, Modelling the Costs of Environmental Policy: A dynamic applied general equilibrium assessment, Edward Elgar, Cheltenham, UK.
* Allan, G., N. Hanley, P. McGregor, K. Swales, and K. Turner 2007, A computable

General Equilibrium Analysis for the United Kingdom, Energy Economics, Volume 29, Issue 4: 779-798

**CAEE 5113: Natural Resource Economics and Management**

**Classification:** Elective **Number of Credits**: 3 **Semester**: 2

1. **Course Objectives**

This course deals with the theory and practice of natural resource economics, teaching techniques to solve key problems in this field. The course will build on economic theory and mathematical tools of optimisation over time introduced in the first year MSc mathematical economics course. Lectures will introduce the subjects and present the mathematics of natural resource economics and management. The course is designed to focus primarily on hands-on applications, rather than textbook theory. The course is designed to suit students with a primary interest in improving the extraction and use of natural and environmental resources over time. Computer lab sessions will be based on guided exercises designed to show students how to construct dynamic simulation and optimization models of various natural resource systems. The aim is to provide the skills required to understand key concepts, be able to construct, solve and interpret results of dynamic resource allocation models. The course will provide examples using case studies primarily from Africa.

1. **Expected Learning Outcomes**

Students are expected to acquire the skills required to construct, solve and interpret results of dynamic resource allocation models.

1. **Prerequisites**

Students will need to be well versed in multivariable calculus and the theory of static constrained optimization. Familiarity with basic principles and techniques of inter-temporal optimisation is expected from the mathematical economics foundation course. Familiarity with the subject matter covered in chapters 6 through 13 of Tietenberg (1988) update*Environmental and Natural Resource Economics* is recommended.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topic** |  | **Contact hours** | | | **Independent study** | **Total** |
| Lecture | Seminar | Practical | Subtotal | |
| **Theory Section** |  |  | | | |  |
| 1. Introduction to  National Resource  Economics | 2 |  |  | 2 | 4 | 6 |
| 2. Institutions and  natural resource management | 1 |  |  | 1 | 2 | 3 |
| 3. Review of optimal control theory | 6 |  |  | 6 | 16 | 22 |
| 4. Renewable resources | 6 |  |  | 6 | 12 | 18 |
| 5. Non-renewable resources | 4 |  |  | 4 | 8 | 12 |
| 6. Pollution control | 2 |  |  | 2 | 4 | 6 |
| 7. Natural resource accounting | 1 |  |  | 1 | 2 | 3 |
| *Sub-total* | *22* |  |  | *22* | *48* | *70* |
| **Practical Lab sessions** |  |  | |  |  |  |
| 1. Capture fishery (simulation and optimisation) |  |  | 2 | 2 | 4 | 6 |
| 2. Capture fishery  (welfare analysis) |  |  | 2 | 2 | 4 | 6 |
| 3. Capture fishery  (open access) |  |  | 2 | 2 | 4 | 6 |
| 4. Wildlife |  |  | 2 | 2 | 4 | 6 |
| 5. Grazing the  commons |  |  | 2 | 2 | 4 | 6 |
| 6. Water management |  |  | 2 | 2 | 4 | 6 |
| 7. Fuelwood and deforestation |  |  | 2 | 2 | 4 | 6 |
| 8. Exhaustible and renewable energy |  |  | 2 | 2 | 6 | 8 |
| 9. Exploration |  |  | 2 | 2 | 6 | 8 |
| 10. Stock pollutant |  |  | 2 | 2 | 6 | 8 |
| 11. Total user costs/benefits and the national accounts |  |  | 3 | 3 | 6 | 9 |
| *Total* |  |  | *23* | *23* | *46* | *69* |
| **Grand Course Total** | **22** |  | **23** | **45** | **94** | **139** |

1. **Detailed Description of Topics** 
   1. **Lectures**

**Topic 1: Introduction to natural resource economics**   What is a resource?

* + - Types of natural resources
    - Why study natural resource economics?
    - Resources and scarcity(resource reserves, depletion, exhaustion etc)
    - Values and market prices
    - Shadow prices

**Topic 2: Institutions and natural resource management**

* + - Property rights
    - Markets and governments
    - Policy game (Elinor Ostrom)

**Topics 3: Review of optimal control theory**

* + - The static optimisation problem o Economic interpretations (static welfare analysis) o Constrained optimisation and the Lagrange method
    - The dynamic optimisation problem o Economic interpretations (marginal user cost, total rent, total user costs / benefits, dynamic welfare analysis)

o Constrained optimisation and the Lagrange method

* + - Lagrange and the Hamiltonian
    - The maximum principle and the Hamiltonian
    - Discrete time problems
    - Continuous time problems
    - Steady state solutions

**Topic 4: Renewable Resources**

* + - Capture fishery
    - Wildlife management
    - Grazing the commons
    - Water management
    - Forests, plantation and natural

**Topic 5: Non-renewable resources**

* + - Mining
    - Exploration

**Topic 6: Pollution control**

* + - Stock pollutants

**Topic 7: Natural resource accounting**

* + - System of National Accounting (SNA)
    - System of Environmental and Economic Accounts (SEEA)
    - SEEA design for correction of SNA
  1. **Labs and tutorials**

***Lab 1: Capture fishery (simulation and optimisation)***

In this exercise students will begin constructing a model of a capture fishery. They will translate the mathematical model into a numerical model and find three solutions: simulation, optimisation of the simulation model and a mathematical programming solution. Simulation is a good place to begin with an unfamiliar model. Simulation is easy in Excel and will show whether or not the model has any obvious problems. Optimisation of the simulation model is not documented in textbooks or journals, but is related to the Calculus of Variations. It allows large problems to be solved as unconstrained optimisation problems with only an objective function and a few non-negativity constraints. The disadvantage is that the marginal user costs, as the shadow prices of scarce resources, are not automatically calculated and must be calculated separately. A dynamic optimum using mathematical programming requires the dynamic model to be entered as an objective function and a set of dynamic constraints. The advantage is that the marginal user costs are automatically calculated. The disadvantage is that a mathematical programming formulation is larger and more difficult to solve.

***Lab 2: Capture fishery (welfare analysis)***

In this exercise students will make the market price of harvested fish endogenous to the model and find a socially optimal solution. They will expand the Excel model to find the welfare benefits to three groups: consumers, producers and resource owners. They will calculate and interpret marginal user costs, total rent, total user costs/benefits and the Hamiltonian as a dynamic measure of welfare in each time period.

***Lab 3: Capture fishery (open access)***

In this exercise, students will learn how to solve the model for an open access solution and compare the results to optimal management. Because the open access solution requires an optimization for each time period in the model, students will also learn how to automate the process using macros. This will let them measure the policy gap for different situations. The policy gap is the difference in management between and optimal management, with perfect institutions, andopen access, with no institutions. Sometimes the gap is large and reform to institutions is urgent. Sometimes the gap is small and reform is not necessary. The model can also be used for evaluating policies such as gear restrictions, taxes and individual transferable quotas for managing capture fisheries.

***Lab 4: Wildlife management***

In this exercise, students will begin with a model of the capture fishery and modify it to become a model of wildlife management. Wildlife management can be very different from fisheries management because people and wildlife must coexist. The carrying capacity for wildlife may be reduced by conversion of land to agriculture and wildlife can be pests. Wildlife may be hunted, or conserved for tourism. This exercise will investigate different growth functions for wildlife. Large animals have a minimum viable population. Below a critical threshold, the population is no longer viable because there may be too few individuals for genetic diversity, reproduction may be disrupted and smaller numbers may become easier prey. A minimum viable population makes wildlife much easier to overexploit and even drive to extinction.

***Lab 5: Grazing the commons***

In this exercise, students will adapt the fishery model for grazing of livestock on the village commons. Grazing on the commons has unique features and policy questions. Many of the world’s natural resources are managed by traditional institutions among villages and communities. The policy question is what allows traditional institutions to succeed. A dynamic model can help identify the policy gap between open access and optimal management that traditional institutions must fill. The introduction of new technologies can disrupt traditional institutions.

***Lab 6: Water management***

In this exercise students will experiment with adapting the basic capture fishery model for irrigation from a stock such as an aquifer or reservoir. Replacing the growth function for the fishery with the recharge function for water and replacing the total willingness to pay by the total revenue of crop production, gives the model for water management. Students will find that open access is much less of a problem if rainfall exogenously recharges the stocks of water.

*Lab 7: Fuelwood and deforestation*

This exercise adapts the model of grazing to the problem of deforestation and expands the model to include the technology for burning wood. Students will investigate a policy of research to improve wood burning efficiency, reduce the harvest of wood for fuel and conserve forests. Students will find that institutions must be effective before investing in research is considered.

***Lab 8: Exhaustible and renewable energy***

This exercise will eliminate the growth function from the fisheries model to become a model of exhaustible resources. It will then expand the model for backstop technologies such as renewable energy. Students will be able to replicate various versions of the Hotelling rule of exhaustible resources and model the trajectories of prices and extraction over time.

***Lab 9: Exploration***

This exercise will implement the model of Pindyck for exploration to increase the proven reserves of exhaustible resources. Instead of costless renewal as with renewable resources, exploration is costly and uncertain. Exploration is an investment to augment the proven reserves of exhaustible resources.

***Lab 10: Stock pollutant***

In this exercise, students will modify a previous model to become a model of a stock pollutant such as sulfur dioxide or greenhouse gases. All previous models are for resources which improve welfare whereas pollutants decrease welfare. The results of previous exercises are reversed. The shadow prices are negative instead of positive. Optimal management keeps stocks low instead of high. Open access results in uncontrolled emissions with high stocks and large damages.

***Lab 11: Total user costs/benefits and the national accounts***

Total user costs are the depreciation costs of reducing natural capital and leaving less for future generations. Total user benefits are the appreciation benefits of increasing natural capital and leaving more for future generations. Thus total user costs/benefits can be used to adjust national accounts for the depreciation and appreciation of natural capital. In this exercise, students will not develop a new model, but integrate the total user costs/benefits of previous exercises into the System of Environmental and Economic Accounts.

1. **Mode of Delivery**

The material of this course described above will be delivered through 22 hours of lectures and 23 hours of computer lab sessions plus mandatory readings listed below on which students are expected to spend at least 94 hours of independent study. The aim is to provide the skills required to understand key concepts, be able to construct, solve and interpret results of dynamic resource allocation models. To achieve this, students will be required to complete an assignment using models they have constructed following instructions in the computer lab sessions. They will then adapt these models to complete a project of their own. The course will provide examples using case studies primarily from Africa.

1. **Assessment Method**

Students will be graded based on their performance in:

* + Homework assignments
  + Mid-semester test
  + Final examination

*Homework assignments:* Students will be required to do at least two assignments, in which they are expected to develop and solve dynamic optimisation models following guided inlab exercises.

*Examination*: There will be a 3-hour final examination consisting of short-answer problems and questions drawn from lectures and readings.

*Overall Performance in the Course:*

* + Homework

|  |  |
| --- | --- |
| assignments | (30% ) |
|  Mid-semester test | (20% ) |
|  Final examination | (50% ) |

*Software and Teaching Aids*

This course will use Excel workbooks for solving optimisation models and performing simulation analysis

1. **Course Material**

To be updated

*8.1 Readings for theory sections*  *Readings for topics 1 and 2:*

* + Tietenberg, Tom. 2006. *Environmental and Resource Economics,* seventh edition,

Pearson, Boston (Chapter 1: Visions of the Future; Chapter 4: Property Rights,

Externalities and Environmental Problems; Chapter 5: Sustainable Development, Defining the Concept; Chapter 22: Development, Poverty and the Environment).

* + Just, Richard E., Darrell L. Heuth and Andrew Schmitz. 2004 *The Welfare Economics of*

*Public Policy: A Practical Approach to Project and Policy Evaluation,* Edward Elgar,

Cheltenham (Chapter 1: Introduction; Chapter 2: Pareto Optimality and the Pareto Criterion; Chapter 3: The Compensation Principle and the Welfare Function).

* + Ostrom, Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action,* Cambridge University Press, Cambridge (Chapter 1: Reflections on the Commons).
  + Cornes, Richard and Todd Sandler, 1996 *The Theory of Externalities, Public Goods and Club Goods,* second edition, Cambridge University Press, Cambridge (Chapter 3: Theory of Externalities)
  + Dietz, Thomas, ElinorOstrom and Paul C. Stern, (2003) “The Struggle to Govern the Commons,” *Science*, 302:1907-1912
  + Sterner, Thomas. 2003. *Policy Instruments for Environmental and Natural Resource*

*Management*, RFF Press, Washington D.C., (Chapter 5, The Evolution of Rights)

* + Bromley, Daniel W. 2006. *Sufficient Reason: Volitional Pragmatism and the Meaning of Economic Institutions*, Princeton University Press, Princeton (Chapter 12, Volitional

Pragmatism and the Evolution of Institutions)

* + Hardin, Garrett, 1968 “The Tragedy of the Commons,” *Science*, 162:1243-1248.

*Readings for topics 3 and 4:*

* + Alpha C. Chiang, 2000. *Elements of Dynamic Optimization*, Waveland Press, Prospect Heights (Chapter 1: The Nature of Dynamic Optimization).
  + Just, Richard E., Darrell L. Heuth and Andrew Schmitz, 2004. *The Welfare Economics of*

*Public Policy: A Practical Approach to Project and Policy Evaluation,* Edward Elgar,

Cheltenham, ed.? (Section 14.6: Economic Welfare Analysis of Natural Resource Policy)

* + Conrad, Jon M. and Colin W. Clark. 1987. *Natural Resource Economics: Notes and*

*Problems*, Cambridge University Press, Cambridge, (Section 1.2, An Extension of the

Method of Lagrange Multipliers to Dynamic Allocation Problems; Section 1.3,

Dynamic Programming; Section 1.4, Continuous-time Problems and the Maximum Principle; Section 1.5, Discounting)

* + Benavie, Arthur, 1970).“The Economics of the Maximum Principle,” *Western Economic Journal*, 8(426- ?
  + Dorfman, Robert. 1969. “An Economic Interpretation of Optimal Control Theory,” *American Economic Review*, 59:817-831
  + Hassan, Rashid and Greg Hertzler, 1988.“Deforestation from Over Exploitation of Wood Resources as a Cooking Fuel: A Dynamic Approach to Pricing Energy Resources in Sudan,” *Energy Economics*, 10:163-168 .
  + Kamien, Morton I. and Nancy L. Schwartz, 1981 *Dynamic Optimization: The Calculus of Variations and Optimal Control in Economics and Management*, North Holland, New York, (Part II, Section 20, Dynamic Programming) .

*Readings for topic 5*

* + Alpha C. Chiang, 2000 *Elements of Dynamic Optimization*, Waveland Press, Prospect Heights (Section 9.3, The Neoclassical Theory of Optimal Growth) .
  + Kamien, Morton I. and Nancy L. Schwartz, 1981. *Dynamic Optimization: The Calculus of Variations and Optimal Control in Economics and Management*, North Holland, New York (Part II, Section 8, Discounting, Current Values and Comparative Dynamics)
  + Skonhoft, Anders and Jan Tore Solstad. 1998. “The Political Economy of Wildlife Exploitation,” *Land Economics*, 74:16-31

***8.2 Readings for Lab sessions***

Students will be given teaching notes describing the models above and be given instructions on how to build and solve models. They will be given questions and answers on interpretation of model results. These are usually complemented with journal articles and other published sources of relevance.

**CAEE 5114: Economics of Climate Change**

**Classification**: Elective **Number of Credits**: 3 Hours **Semester**: 2

1. **Course Description**

The goal of *Economics of Climate Change* is to provide students with a core knowledge of the science of climate change; an ability to think critically about its economic implications; and opportunities to apply this knowledge in classroom discussions, application activities and research.

The first part of the course provides an overview of current scientific knowledge of the changing climate system and its biophysical implications. We then review and critically evaluate economic analyses of climate change. This study focuses on cost-benefit analyses of climate change mitigation, the role of adaptation, and alternative approaches to quantifying climate change impacts, particularly in agriculture. The course encourages critical thinking about economic analysis, including uncertainties about the underlying science and how to value costs and benefits; and the role of norms and values, especially with respect to equity among and within countries and across generations. The course also provides an introduction to the global institutions in which coordinated action on climate change is taking place. The relevance for African countries of all of these topics is developed throughout the course.

1. **Course Learning Objectives**

At the end of the course, you should be able to***:***

* + Summarize and critically assess scientific knowledge about future climate change.
  + Explain an economic framework for analyzing the trade-off between the marginal costs and benefits of climate change mitigation efforts, and critically evaluate the uncertainties and values that are embedded in these analyses of mitigation.
  + Explain and critically evaluate alternative approaches to assessing the economic effects of climate change, particularly in agriculture, and the role for adaptation.
  + Apply your knowledge of the science and economics of climate change in substantive classroom discussions and application activities.
  + Explain the scientific and economic implications of climate change for Africa and develop ideas for effective policy responses in the context of your country.

**Course Materials**

The course utilizes primary sources. Most required readings, videos and other resources may be accessed by clicking on their hotlinks embedded in the course syllabus. You may download other articles using JSTOR or other databases available in your university library.

**Course Format and Instructional Framework**

Each class includes some or all of the following elements:

**Learning Objectives**

The learning objectives articulate the knowledge and/or skills you will demonstrate in completing the class assignments. The objectives for each class are related to the conceptual framework of the course, professional standards, and expected course outcomes.

**Discussion**

The course is organized as a seminar in which classroom discussion is one of the main tools for increased understanding of the material. The syllabus lists questions for each class that are based upon the learning resources. Discussion questions ask you to reflect on, and interpret or apply the ideas presented in that class. You are asked to prepare written answers to the discussion questions (2 paragraphs per question) before each class.

Group discussions are an effective way to learn this material at a deep level. Groups are able to draw on more resources than can an individual, because members bring in a diversity of perspectives, experiences and backgrounds. Group members can motivate each other by engaging, supporting and respectfully challenging each other. Active participation in discussions also provides you with opportunities to test and apply new ideas, develop or improve communication skills, and learn to work as part of a team.

**Discussion Leadership**

Each student will be assigned at least one class in which they will lead a guided discussion of that class’s questions. Class discussion questions provide a scaffold that you, as discussion leader, can use to frame and guide the dialogue. In your role as a leader:

* make sure that everyone participates by inviting each class member to contribute an opening remark,
* keep the discussion on track,
* be prepared to stimulate discussion with additional or follow-up questions.

**Application Activities**

Application activities are an opportunity to work with a small group to transfer new knowledge and skills to an authentic problem. Each application assignment requires reflection, analysis, synthesis, and personalization of the concepts and strategies presented during the previous weeks. There are 4 application activities, described in detail in the syllabus.

**Group Research Project**

In the group research project, members will collaborate in small groups to apply knowledge and skills learnt to an authentic climate change problem facing different countries. The policy recommendation should be grounded in a critical assessment of the scientific knowledge of climate change impacts, a critical assessment of economic analysis of the implications of climate change, and a criteria-based advocacy for adaptation and/or mitigation policies.

***Required Readings***

Required readings provide research and information related to the topic(s) of the class. You are expected to demonstrate your understanding of the concepts and ideas in the required readings in your discussions and application activities.

***Media***

Video presentations and multimedia components provide new knowledge and demonstrate skills related to the content of selected classes.

1. **Prerequisites**

Microeconomics, Macroeconomics, Research Methods and Econometrics

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic | Contact Hours | |  |  | Independent study | Total Hrs |
|  | Theory | Seminar | Practical | Sub Total |  |  |
| 1. The Science of Climate Change -  Overview | 3 |  | 0 | 3 | 15 | 18 |
| 2. The Science of Climate Change -  Impacts on Water | 5 |  | 2 | 7 | 24 | 31 |
| 3. Climate Change Impacts on  Agriculture in Africa | 5 |  | 1 | 6 | 14 | 20 |
| 4. Economic Analysis of Climate  Change | 6 |  | 2 | 8 | 18 | 26 |
| 5. Discounting and Uncertainty in the Economic Analysis of Climate Change | 6 |  | 3 | 9 | 27 | 36 |
| 6. Integrated Assessment Models and Natural Resource Accounting | 5 |  | 1 | 6 | 18 | 24 |
| 7. Climate Change Policies and  Economic development in Africa |  |  |  |  |  |  |
| 8. Climate Change and the Global  Institutional Framework | 5 | 0 | 1 | 6 | 13 | 19 |
| 9. Group Research Projects |  | 3 | 3 | 6 |  | 6 |
| Total | 35 | 3 | 13 | 51 | 129 | 180 |

1. **Detailed Topics**

**Topic 1.The Science of Climate Change – Overview**

* + **P**redictable and unpredictable climate
  + **p**rimary causes of climate change
  + Bio-physical changes due to rising temperatures
  + How climate change is expected to impact Africa
  + climate change mitigation versus adaptation policies

(Change bullet size from here)

**Topic 2.The Science of Climate Change – Impacts on Water**

* + GCM’s and SRES’s
  + alternative approaches to downscaling and evaluating benefits and limitations of SRES and GCM
  + How to change climate models to address uncertainty-the Monte Carlo method and other approaches.
  + climate and hydrologic systems and how they interact
  + projected impacts of climate change on key hydrologic variables
  + uncertainties generated in the projection process
  + main climate change impacts related to water in the African region

**Topic 3: Economic Analysis of Climate Change and Its Impacts on Agriculture**

* + modeling techniques in the IPPC or reduced uncertainty in model projections
  + current consensus view on climate change and tropical storms at the global versus the regional level, and **on agricultural development**

**Topic 4: Discounting and Uncertainty in the Economic Analysis of Climate Change**

* + challenges in developing projections for climate change impacts in Africa
  + Africa’s vulnerabilities to climate change
  + approacheson analysis of effects of climate change eg on agriculture.

**Topic 5: Integrated Assessment Models and Natural Resource Accounting** example of an externality in your country that has implications for climate change.

* + optimizing choice in the economic analysis of climate change
  + assumptions and uncertainties in the economic analyses of climate change
  + enumerative versus statistical approaches to analyzing the economic impacts of climate change.
  + marginal cost and benefit concepts in the analysis of climate change.
  + challenges faced in the valuation of costs and benefits from mitigation and adaptation activities
  + MACs and uncertainties in a calculation of a MAC
  + social cost of carbon and the shadow price of carbon
  + analyzing optimal abatement and pollution levels
  + types of costs in the valuation of climate change damages
  + choice of a discount rate in an economic analysis of climate change  Dismal Theorem

**Topic 6: Climate Change Policies and Economic development in Africa**  carbon emissionsas described in the Wirsenius plan.

* + climate change and well-being in both developed and developing countries
  + roles for adaptation and mitigation efforts in ameliorating growing African water crisis
  + efforts required to assist least developed countries to cope with climate change
  + climate-smart development policies
  + projected impacts of climate change on food security in Africa
  + links between climate change and**Agricultural Production and food insecurity**

**Topic 7: Climate Change and the Global Institutional Framework**  The roleof the UNFCCC institution in the fight against climate change?

* + the concept of second-best options for global action.
  + dimensions that should be addressed in a post-Kyoto framework
  + Barrett’s argument on incentive structure of climate mitigation

Group Research Project – National Priorities for Action on Climate Change

Two-thirds of the grade on the group research project reflects the quality of the group’s product and one-third of the grade reflects the quality of the individual’s contribution. After the research project is completed, group members are asked to fill in a form or email to the teacher, rating their peers and *themselves* on a scale of 0-3, as shown below.

The group project grading rubric is as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Rubric for Group Research Project (30 points)** | | | | |
|  | Criteria | 0-1 | 2-3 | 4-5 |
| Group grade | Critical use of scientific knowledge | Scientific basis not evident. | Relevant scientific evidence is described. | Relevant scientific    evidence is  described and critically evaluated. |
| Explicit use of economic principles | Economic concepts are not explicit. | Relevant concepts or principles are described. | Relevant economic  concepts or  principles are  described and critically evaluated. |
| Appropriate application to an authentic climate change problem | Research was not relevant to issue and  climate change problem not authentic. | Appropriate research was  identified but not applied in a  relevant way, or climate change  problem was not authentic. | Appropriate application of research to an  authentic climate change problem. |
| Paper | Multiple errors, poor table and  chart format, incorrect  bibliographical format. | Some spelling and grammatical errors, basic tables and charts, bibliography in APA style. | Spell- and grammar-  checked, neat  charts and tables, bibliography in APA style. |
| Presentation | Presentation has errors,  omissions, and poor design  and/or weak  preparation for follow-up discussion. | Presentation is  basic and clear, and some preparation is evident in followup discussion. | Professional PPT presentation: neat, well-  organized,  effective. Well  prepared for follow-up discussion |
| Individual Grade | Average peer rating 0-1 | 0-3 | | |
| Average peer rating 2 | 4-7 | | |
| Average peer rating 3 | 8-10 | | |

1. **Course Evaluation**

Assignments are listed in the syllabus on the date on which they are due. Students are expected to complete all assignments by the due dates and to submit work that meets the standard for graduate-level work.

Homework assignments (30% )

Mid-semester test (20% ) Final examination (50%)

**Mian Reference Text Books**

* + Arndt, Channing, Kenneth Strzepek, Finn Tarp, James Thurlow, Charles Fant and Len Wrigh. 2010.[“Adapting to Climate Change: An Integrated Biophysical and Economic Assessment for Mozambique.](http://www.ony.unu.edu/Adapting%20to%20Climate%20Change%3B%20An%20Intergrated%20Biophysical%20and%20Economic%20Assessment%20for%20Mozambique.pdf)”Working Paper No. 2010/101.UNWorld Institute for Development Economics Research, Helsinki, Finland.
  + Arrow, Kenneth J., William R. Cline, Karl-GoranMaler, Mohan Munasinghe, and Joseph E. Stiglitz. 1995. “Intertemporal Equity, Discounting, and Economic Efficiency,” in Mohan Munasinghe, ed. [*Global Climate Change: Economic and Policy Issues*.](http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/1995/12/01/000009265_3970128121426/Rendered/PDF/multi_page.pdf) World Bank Environment Paper No. 12, World Bank, Washington, DC.
  + Barnett, Jon and Saffron O’Neill 2010.[Maladaptation.](http://www.landfood.unimelb.edu.au/rmg/geography/papers/barnett16.pdf)*Global Environmental Change* 20: 211–213.
  + Barrett, Scott, 2002. [Towards a Better Climate Treaty.](http://www.feem.it/userfiles/attach/Publication/NDL2002/NDL2002-054.pdf)Nota de Lavoro 54.2002 FondazioneEni Enrico Mattei, Milan, Italy.
  + Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, eds.2008. *Climate Change and Water.*IPCC Technical Paper VI.Intergovernmental Panel on Climate Change, Geneva, Switzerland.
  + Broom, John. 2005. “[Should We Value Population?](http://docs.google.com/viewer?a=v&q=cache:gUyik-VbpXcJ:www.treasury.govt.nz/publications/media-speeches/guestlectures/pdfs/tgls-broome.pdf+broome+should+we+value+population&hl=en&gl=us&pid=bl&srcid=ADGEESi1lhc5xzY_tVAalqIpmCletbWQog4IxZFnrcqOxaNwG3slRGhlU7dP_Zi_UteFeVr1b1dtj0a6xDq3W_ciZsFiLmPMnDjqvaXA-tG--D1uQ_lyQSy0fkBb1Ldlm5YsEOzGVxyx&sig=AHIEtbQuRTIfjKjZ_6v6f2UFWsr_ElGXgg)” Speech to the Treasury, Government of New Zealand, September 23.
  + Burniaux, Jean-Marc and Truong Truong. 2002. ["GTAP-E: An Energy-Environmental Version of the GTAP Model"](https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=923) GTAP Resource #?923.Global Trade Analysis Project, Purdue University, West Lafayette, IN.
  + Collier, Paul, Gordon Conway and Tony Venables, 2008. “[Climate Change and Africa: Adaptation and Migitation.” U](http://economics.ouls.ox.ac.uk/11282/1/ClimateChangeandAfrica.pdf)npublished.
  + Congressional Budget Office. 2003.*The Economics of Climate Change: A* [*Primer.*](http://www.cbo.gov/ftpdocs/41xx/doc4171/04-25-ClimateChange.pdf)Congressional Budget Office, Washington, DC.

**Further Reading Materials**

* + Deressa, TemesgenTadesse (2006). [Measuring the Economic Impact of Climate Change on Ethiopian Agriculture: Ricardian Approach.”](http://www.ceepa.co.za/docs/CDPNo25.pdf) CEEPA Discussion Paper No. 25. Center for Environmental Economics and Policy in Africa, University of Pretoria, Pretoria, South Africa.
  + Emanuel, Kerry. Date? “[Phaeton’s Reins.](http://bostonreview.net/BR32.1/emanuel.php)”*Boston Review* January-February: 7-13.
  + Frankel, J. 2008: [*An Elaborated Proposal For Global Climate Policy Architecture: Specific Formulas and Emission Targets for All Countries in All Decades*.](http://belfercenter.ksg.harvard.edu/files/FrankelWeb4.pdf)Harvard Project on International Climate Agreements, Boston, MA.
  + Gillenwater, Michael and Stephen Seres 2011.[*The Clean Development Mechanism: A Review of the First International Offset Program.*P](http://www.pewclimate.org/docUploads/clean-development-mechanism-review-of-first-international-offset-program.pdf)ew Center on Global Climate Change, Washington, DC.
  + Global Environment Facility (nd). 2011?. *Least Developed Countries Fund*. Downloaded from 2011. [http://www.thegef.org/gef/ldcf on October 16.](http://www.thegef.org/gef/ldcf%20on%20October%2016),
  + \*Grossman, Iris and M. Granger Morgan 2011. “Tropical Cyclones, Climate Change, and Scientific Uncertainty: What Do We Know, What Does it Mean, and What Should Be Done? *“ Climatic Change*108:543–579.
  + Hardin, [Garrett 1968.](http://www.sciencemag.org/search?author1=Garrett+Hardin&sortspec=date&submit=Submit) [“The Tragedy of the Commons.](http://www.sciencemag.org/content/162/3859/1243.full.pdf)” *Science* 162: 1243-1248*.*
  + Hertel, Thomas W., Marshall B. Burke, David B. Lobell 2010. [“The Poverty Implications of Climate-induced Crop Yield Changes by 2030.](https://www.uni-hohenheim.de/fileadmin/einrichtungen/klimawandel/Literatur/Hertel-etal-GEC2010.pdf) Global Environmental Change 20: 577-585.
  + Hertel, Thomas W. and Stephanie Rosch 2010 “[Climate Change, Agriculture and Poverty.](http://www.tzdpg.or.tz/uploads/media/WB_paper_cc__poverty_and_agriculture_2010.pdf)”
  + Policy Research Working Paper 5468. Development Research Group, Agriculture and Rural Development Team. World Bank, Washington DC. Disclosure
  + Heyward, Madeleine (2007). “[Equity and International Climate Change](http://classwebs.spea.indiana.edu/kenricha/Oxford/Oxford%202011%20Readings/Heyward.pdf)

[Negotiations: a Matter of Perspective.”](http://classwebs.spea.indiana.edu/kenricha/Oxford/Oxford%202011%20Readings/Heyward.pdf) Climate Policy 7: 518–534.

* + Howard, Jeff (2008). *Climate Change and Adaptation: What’s the Difference and How Do*

*They Relate to Each Other?* Downloaded from

[http://www.climatechangeecon.net/index.php?option=com\_content&task=view&id= 18&Itemid=22](http://www.climatechangeecon.net/index.php?option=com_content&task=view&id=18&Itemid=22) on October 22, 2011.

* + Intergovernmental Panel on Climate Change (nd).*Sea Level Rise.* Downloaded from <http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch11s11-9-4.html>on October 23, 2011.
  + Knutson, Thomas R., John L. McBride, Johnny Chan, Kerry Emanuel, Greg Holland, Chris Landsea, Isaac Held, James P. Kossin, A. K. Srivastava and Masato Sug. 2010.

[“Tropical Cyclones and Climate Change.](http://www.aoml.noaa.gov/hrd/Landsea/knutson-et-al-nat-geo.pdf)”*Nature GeoScience*.3?.3: 157-163.

* + \*Knutti, R. 2010, “The End of Model democracy?” *Climatic Change*, 102, 395–404.
  + Kuik, Onno, Barbara Buchner, Michaela Catenacci, Alessandra Goria, EtemKarakaya and Richard S. J. Tol 2008.“[Methodological Aspects of Recent Climate Change Damage Cost Studies.”](http://journals.sfu.ca/int_assess/index.php/iaj/article/view/269/233)*The Integrated Assessment Journal*8: 19–40.
  + KurukulasuriyaPradeep and Robert Mendelsohn 2006.[A Ricardian Analysis of the Impacts of Climate Change on African Cropland. CEEPA Discussion Paper No. 8. Center for Environmental Economics and Policy in Africa, University of Pretoria, Pretoria, South Africa.](http://www.ceepa.co.za/docs/cdp8.pdf)
  + \*Lange, Andreas, Carsten Vogt and Andreas Ziegler 2007. “ On the Importance of Equity in International Climate Policy: An Empirical Analysis.” Economics 29, 545– 562
  + Lobell, David B., Marshall B. Burke, Claudia Tebaldi and Michael D.

Mastrandrea,Title and publisher?

* + Walter P. Falcon, Rosamond L. Naylor. 2008.“[Prioritizing Climate Change Adaptation Needs for Food Security in 2030.](http://leadingmatters.stanford.edu/dallas_ftworth/documents/Lobell_Environmental.pdf)” *Science* 319: 607-609.
  + Lobell, David, Kimberly Nicholas Cahill and Christopher B. Field 2007. “[Historical Effects of Temperature and Precipitation on California Crop Yields.](http://iis-db.stanford.edu/pubs/21963/lobell_cahill_field_2007.pdf)”*Climatic Change* 81:187–203
  + Mabugu, Ramos and Margaret Chitiga 2002.[Accounting for Forest Resources in Zimbabwe.C](http://www.ceepa.co.za/dispapers/ranesa_zimbabwe_forestry.pdf)EEPA Discussion Paper Series, Department of Economics, University of Zimbabwe,Harare, Zimbabwe.
  + Mankiw, N. Gregory 2008.“[Smart Taxes – An Open Invitation to Join the Pigou Club.](http://www.economics.harvard.edu/files/faculty/40_Smart%20Taxes.pdf)” Paper presented to the annual meeting of the Eastern Economics Association, Boston, MA.
  + McCluskey, Alyssa andHallaQaddumi 2011. Water and Climate Change: Synthesis of the Science. Working Paper, World Bank Water Anchor: Energy, Transport and Water Department, United Nations University-World Institute for Development Economic Research.

**CAEE 5122: Quantitative Analysis for Agricultural Policy**

**Classification:**Elective. **Credit:**3 **Semester:**3

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1. **Course Objective**

The course seeks to acquaint the learners with fundamental techniques of analysis and different model forms commonly used in the evaluation of agricultural and food policies. This will provide them with an understanding of the importance of developing empirical policy evaluation models iteratively with data generation process; and a firm foundation to develop analytical skills for solving agricultural policy problems.

1. **Expected Learning Outcomes**

At the end of the course, the students are expected to have acquired:

* + The knowledge and skills for conducting *ex ante* evaluations of the possible effects of policy measures;
  + Theoretical and analytical tools to describe, analyse and diagnose agricultural policy problems;
  + Quantitative techniques to analyse and evaluate the possible effects of policy measures;
  + Skills to define and develop models for policy estimation, simulation, forecasting and optimisation and impact assessment; and
  + Skills to report analytical results (including policy brief).

1. **Prerequisites**

Graduate courses in Mathematics-for-Economists, Econometrics, Microeconomics and Macroeconomics.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic | Contact Hour (s) | |  |  | Suggested hours of Independent study | Total |
|  | Lecture | Seminar | Practicals/ tutorial | Sub-total |
| Topic1: Review of Structure of Policy Evaluation Models | 3 | - | - | 3 | 13 | 16 |
| Topic 2: Model Specification and Data Generation | 3 | - | - | 3 | 9 | 12 |
| Topic 3: Mathematical  programming approach to policy analysis | 4 | 2 | 2 | 8 | 20 | 28 |
| Topic 4: Econometric approach to policy analysis | 4 | 2 | 2 | 8 | 20 | 28 |
| Topic 5: Impact Assessment of Interventions. | 3 | 2 |  | 5 | 21 | 26 |
| Topic 6: Empirical Analysis of  Agricultural Household Models | 5 | 2 | - | 7 | 25 | 32 |
| Topic7: Trade Policy Analysis | 3 |  | 3 | 6 | 10 | 16 |
| Topic 8: Multi-Sectorial  Models | 3 | - | 2 | 5 | 17 | 22 |
| Total | 28 | 8 | 9 | 45 | 135 | 180 |

1. **Detailed Description of Topics**

Topic 1**: Review of Structure of Policy Evaluation Models**

This topic aims to present the theoretical foundations of quantitative policy analysis as well as a broad overview of quantitative models commonly used in policy evaluation.

Key topics:

* + Welfare analysis and public policies;
  + Typologies of economic policy instruments;
  + Typologies and structure of Policy Evaluation Models;
  + Elements of an agricultural sector analysis model;
  + Limitations of economic models in policy making;

**Required textbooks**

* + Ellis, F. 1992: Agricultural policies in developing countries. Cambridge University Press.
  + Sadoulet, E and A. de Janvry 1995: Quantitative development policy analysis. The Johns Hopkins University Press, Baltimore, London.
  + Gujarati, D. N. 2005: Essentials of Econometrics. McGraw-Hill. International Edition.

**Further readings**

* + Sankhayan P. L. 1988: Introduction to the Economics of Agricultural Production. Prentice-Hill of India, Private LTD. New Delhi*.*

Topic 2**: Model Specification and Data Generation**

This topic takes the learners through a review of model specification emphasizing the importance of clear conceptual and empirical model designs and the need for an iterative process in their design and identification of data needs.  Key topics: Developing a conceptual framework;  Types and sources of data.

* + Data mining
  + Model specification and data generation

**Required text books**

* + Ellis, F. 1992: Agricultural policies in developing countries. Cambridge University Press.
  + Sadoulet, E and A. de Janvry. 1995: Quantitative development policy analysis. The Johns Hopkins University Press, Baltimore, London.
  + Deaton, A. 1997. The Analysis of Household Surveys: A Micro-econometric Approach to Development Policy. The Johns Hopkins University

**Further readings**

* + Gujarati, D. N. 2005: Essentials of Econometrics. McGraw-Hill. International Edition.
  + Sankhayan P. L. 1988: Introduction to the Economics of Agricultural Production. Prentice-Hill of India, Private LTD. New Delhi.
  + Sterman, J. D. 1991: A Skeptic’s Guide to computer Models. In Barney, G. O. el al. (eds.), Managing a Nation: The Microcomputer Software Catalog. Buolder, CO: Westview Press, pp. 209-229.
  + KEMFERT, in caps/ Claudia 2003. Applied economic- environment- energy modeling for quantitative impact assessment. In Amelung, Rotmans, Valkering: Integrated Assessment for Policy Modelling

Topic 3**. Mathematical programming approach to policy analysis**

This topic focuses on general presentation of mathematical programming tools for policy evaluation. The sub-key topics include:

* + The classical MP models;
  + Limitation of MP models and extension to positive Mathematical Programming;
  + Classification of Mathematical Programming models commonly used in policy analysis.
  + Application in hypothesis testing;
  + Application in analysing policy instruments and commodity policy; and  Application in forecasting.

**Required textbooks**

* + Bruce, A McCarl and Thomas H. Spreen 2004. Applied Mathematical Programming Using Algebraic Systems. Modeling for the Real World: GAMS/COIN; GAMS Development Corporation, 1217 Potomac Street, NW Washington, DC 20007, USA. <http://www.gams.com/presentations/index.htm>
  + Hazell, P. B. And R. D. Norton 1986: Mathematical programming for economic analysis in agriculture. New York: Macmillan Publishing CO.

**Further readings**

* + Howitt, R. E. 1995. Positive mathematical programming. American Journal of Agricultural Economics. Vol. 77. N0. 2. pp. 329-342.
  + De Frahan, B. H. 2005. PMP, extension and alternative methods: Introductory review of the state of the art. Paper presented at the PMP, extensions and alternative methods organized session of the XIth EAAE Congress. Copenhagen, Denmark, August 23-27.
  + Jensen, P. A. and J. F. Bard Date?.: Nonlinear programming methods. S2: Quadratic programming. Publisher and location?
  + Arfini, F, M. Donati and Q. Paris. 2003. A national PMP model for policy evaluation in agriculture using micro data and administrative information.
  + Sterman, J. D. 1991. A Skeptic’s Guide to computer Models. In Barney, G. O. el al. (eds.), Managing a Nation: The Microcomputer Software Catalog. Buolder, CO: Westview Press, pp. 209-229.
  + Okoruwa, V.O, M.A. Jabbar and J.A. Akinwumi. 1996. Crop-Livestock Competition in the West African Derived Savanna: Application of a Multiobjective Programming Model. Agricultural Systems, 52, pp**,** 439-453
  + Nyikal, Rose A. and W.O. Kosura. 2003. Risk preference and optimal enterprise combinations in Kahuro division of Murang’a district, Kenya. Agricultural Economics, Vol. 32, pp. 131-140.
  + Sumpsi, Jose Maria, Francisco Amador and Carlos Romero. 1996: On farmers' objectives: A multi-criteria approach.European Journal of Operational Research 96 (1996) 64-71
  + Yates C. M. and T. Rehman 1998. A Linear Programming Formulation of the Markovian Decision Process Approach to Modeling the Dairy Replacement Problem. Agricultural Systems, Vol. 58, No. 2, pp. 185-201.
  + Michael T. Wallace and Joan E. Moss 2002. Farmer Decision-Making with Conflicting Goals: A Recursive Strategic Programming Analysis. Journal of Agricultural Economics. Volume 53, Number 1, Pages 82-10?.
  + Kuyiah1? Joanne Wasswa, Gideon Obare, Mario Herrero and Michael Waithaka. 2006:Agriculture, Income Risks and Rural Poverty Dynamics: Strategies of Smallholder Producers in Kenya:Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia.
  + Olarinde, L. O., V.M. Manyong and V. O. Okoruwa. 2008: Analysing Optimum and Alternative Farm Plans for Risk Averse Grain Crop Farmers in Kaduna State, Northern Nigeria. World Journal of Agricultural Sciences 4(1): 28-35,

**Topic 4: Econometric approach to policy analysis**

This topic exposes the learner to different econometric approaches to policy analysis.

The sub-key topics include:

* + Classification of econometric models commonly used in policy analysis: o Linear and non-linear models
    - * Limited and censor dependant variable approaches (logit, probit, tobit, and their extension such as multinomial logit and probit etc.)
      * System of equations or simultaneous equations
    - Application in hypothesis testing
    - Application in analyzing policy instruments and commodity policy
    - Application in forecasting
    - Problem of causality in policy analysis  Limitation of econometric models.

**Required text books**

* + - Gujarati, D. N. 2005. Essentials of Econometrics. McGraw-Hill. International Edition.

**Further readings**

* + - Hattink, W., N. Heerink, and G.? N. Thijssen. 1998. Supply response of cocoa in Ghana: a farm-level profit function analysis. Journal of African Economics. Vol. 7. No. 3. pp 424-444.
    - Williams, T. O. 1993. Livestock Pricing Policy in Sub-Saharan Africa: Objectives, Instruments and Impact in Five Countries. Agricultural Economics. Vol. 8. pp. 139-159.
    - Bezlepkina, I. V., G. J. M. Alfons, Osude Lansink and A. J. Oskam. 2005. Effects of subsidies in Russian dairy farming. Agricultural Economics. Vol. 33. pp. 277288.
    - Langyintuo, A. S., G. Ntoukam, L. Murdock, J. Lowenberg-DeBoer and D. J. Miller. 2004. Consumer preferences for cowpea in Cameroon and Ghana. Agricultural Economics. Vol. 30. pp. 203-213.
    - Alvarez Antonio and Carlos Arias 2004.Technical efficiency and farm size: a conditional analysis. Agricultural Economics 30 pp 241–250.
    - Herath, P.H.M.U. and Hiroyuki Takeya 2003.Factors determining intercropping by rubber smallholders in Sri Lanka: a logit analysis.

Agricultural Economics 29 pp 159–168

**Topic 5: Impact Assessment Approach to Policy Analysis**

This topic exposes the learner to different impact empirical strategies and approaches to policy analysis. The sub-key topics include:

* + - Randomized control trials (RCT).
    - Propensity Score Matching.
    - Regression discontinuity designs.
    - Panel data to analyze with staggered entry.

**Required text books**

* + - Gujarati, D. N. 2005. Essentials of Econometrics. McGraw-Hill. International Edition.

**Further readings**

Aker, Jennifer. 2008. Does Digital Divide or Provide? The Impact of Cell Phones on Grain Markets in Niger. Center for Global Development, Working Paper Number 154. October 2008 [Staggered entry in panel data].

Ashraf, Nava, Xavier Giné, and Dean Karlan. 2009. Finding Missing Markets (and a disturbing epilogue): Evidence from an Export Crop Adoption and Marketing Intervention in Kenya. *American Journal of Agricultural Economics* 91, no. 4 (November 2009.

[Randomization and Double-difference]

Galiani, Sebastian, Paul Gertler, and Ernesto Schargrodski. 2005. Water for Life: The Impact of the Privatization of Water Services on Child Mortality. *Journal of Political Economy.* 113(1). [Staggered entry in panel data].

Godtland, Erin, Elisabeth Sadoulet, Alain de Janvry, Rinku Murgai and Oscar Ortiz, 2004. “The Impact of Farmer Field Schools on Knowledge and Productivity: A Study of Potato Farmers in the Peruvian Andes,” *Economic Development and Cultural Change*, 53(1): 63-92.

(Regression and PSM)

Li, Hongbin and Lingsheng Meng. 2008. Evaluating China’s Poverty Alleviation Program: A Regression Discontinuity Approach. Department of Economics, University of Maryland.

[Regression Discontinuit

Nkonya, Ephraim, et al. 2008. From the Ground Up. Impacts of a Pro-Poor CommunityDriven Development Project in Nigeria, IFPRI Discussion Paper 00756, March 2008 (PSM and double-difference)

Topic 6**: A Theoretical and Empirical Analysis of Agricultural Household Models.** The topic aims at acquainting the learners with the agricultural household models and their application to policy analysis including, price policy analysis, adoption studies, explaining farm-household decision-making under imperfect market conditions, and in analysing the influence of development policy on rural welfare and development.

Key topics:

* Modelling the integrated production and consumption decisions of the farmhousehold;
* Market imperfections: Non-separability of agricultural household decision-making; and
* Transaction costs: explaining differentials in policy impacts, and market behaviour across farm-households.

**Required text books**

* Sadoulet, E and A. de Janvry. (1995. Quantitative development policy analysis. The Johns Hopkins University Press, Baltimore, London.
* Singh, I., L. Squire and J. Strauss 1986. Agricultural household models. The Johns Hopkins University Press, Baltimore and London.
* Bryant K. W 1990. The economic organization of the household. Cambridge University Press.

**Further readings**

* Haddad, L., J. Hoddinott, and H. Harold eds. 1997. Intrahousehold Resources Allocation in Developing Countries: Models, Methods and Policy. John Hopkins University Press. Baltimore,
* Strauss J. 1984. Marketed surpluses of agricultural households in Sierra Leone.

American Journal of Agricultural Economics. Vol. 66, No. 3. pp 321-331.

* Omamo, S. W. 1998. Farm-to-market transaction costs and specialization in smallscale agriculture: Explorations with a non-separable household model. The Journal of Development Studies. Vol. 35. No. 2. pp 152-163.

Topic 7**: Trade Policy Analysis**

This topic presents analytical tools commonly used to measure the effects of trade policies. The Key topics include:

* The partial equilibrium analysis of welfare effects of trade policy-(Quantitative approaches)
* Measures of price distortions
* Limitations of partial equilibrium models

**Required textbooks**

* Tsakok, I. 1990. Agricultural Price Policy: A practitioner’s guide to partialequilibrium analysis. Library of Congress Cataloging-in-Publication Data. Washington D.C.
* Arulpragasam, J. and P. Conway 2003. “Partial Equilibrium Multi-market Analysis.” In F. Bourguignon and L.A. Pereira da Silva (eds.) Evaluating the Poverty and Distributional Impact of Economic Policies (Techniques and Tools. Washington, DC.
* Sadoulet, E. and de Janvry 1995. Quantitative Development Policy Analysis. Baltimore: The John Hopkins University Press.

**Further readings**

* Williams, T. O. 1993: Livestock pricing policy in sub-Saharan Africa: objectives, instruments and impact in five countries. Agricultural Economics. Vol. 8. pp. 139-159.
* Hong Choeun, Yoshihisa Godo and Yujiro Hayami. 2006: The economics and politics of rice export taxation in Thailand: A historical simulation analysis, 19501985. Journal of Asian Economics, Vol. 17, pp. 103-125.
* Banjamin, C, C. Gueguen and M. Houee. 2003: World cereals markets under alternative common agricultural policy reforms. In proceedings of 25th International Conference of Agricultural Economists (IAAE).
* Niek Koning, Muriel Calo and Roel Jongeneel. 2004: Fair trade in tropical crops is possible. Wageningen UR North-South Center Working paper 3.
* Steve McCorriston, Ian M. Sheldon, and Joseph G. Hirschberg. 1993. Simulating changes in conjectural variation: Tariff and quota nonequivalence in food processing. Journal of Agricultural Economics. Vol. 75 (5). Pp 1221-1225.

Topic 8**: Multi-Sectorial Models**

This topic aims at providing the learners with theoretical and analytical tools suitable in describing and analysing sub-sector, sector, regional and economy-wide economic systems; diagnosing their development problems; and designing policies based on the respective levels.

Key topics:

* Characteristics of multi-sectorial models including; o Linear models (input-output analysis, policy analysis matrix)

o Computable/Applied General Equilibrium Models/ Social Accounting Matrix

* Application in representing the structure of production, analysing the effects of the market or agricultural policy.

**Required textbooks**

* Sadoulet, E. and de Janvry. 1995. Quantitative Development Policy Analysis. Baltimore: The John Hopkins University Press.
* FAO. 1982. Agricultural Sector Analysis Models in Developing Countries. FAO economic and social development paper 5.

**Further readings**

* Thorbecke, Erick. 2001. The social accounting matrix deterministic or stochastic concept. Paper presented at the Institute of Social Studies, The Hague, Netherlands.
* Partridge, M.D and Rickman, D.S. 1998: Regional computable general equilibrium modeling: A survey and critical appraisal. International Regional Science Review. Vol. 12 (3) PP 205 – 248.
* Shantayanan Devarajan and Sherman Robinson 2002. The influence of computable general equilibrium models on policy. Trade and Macroeconomic Division Discussion Paper No. 98. TMD, IFPRI, Washington, D.C. USA.
* Mustafa Babiker Date?.: Impacts of public policy on poverty in Arab countries: Review of CGE Literatures.
* Shantayanan Devarajan and Sherman Robinson. 2002. The influence of computable general equilibrium models on policy. Trade and Macroeconomic Division Discussion Paper No. 98. TMD, IFPRI, Washington, D.C. USA.
* Hong Choeun, Yoshihisa Godo and Yujiro Hayami. 2006.: The economics and politics of rice export taxation in Thailand: A historical simulation analysis, 1950-1985. Journal of Asian Economics, Vol. 17, pp. 103-125.
* Banjamin, C, C. Gueguen and M. Houee 2003. World cereals markets under alternative common agricultural policy reforms. In proceedings of 25th International Conference of Agricultural Economists (IAAE).
* Niek Koning, Muriel Calo, and Roel Jongeneel. 2004. Fair trade in tropical crops is possible. Wageningen UR North-South Center Working paper 3.
* Olayemi, J. K. and C. E. Onyenwaku. 1999. Quantitative Methods for Business Decisions. A publication of the Dept. of Agricultural Economics, University of Ibadan Nigeria.

1. **Mode of Delivery**

The course will use the mode of class lectures, class seminars, reading assignment and exercises.

1. **Assessment Method**

Assessment criteria will be through Term Paper, assignments, and final examination:

* + - Continuous assessment comprising of take home assignments, midterm test, Seminar presentation 30%
    - Term papers 20%
    - End of semester examination 50%

**Required textbooks**

* + - Ellis, F. 1992. Agricultural policies in developing countries. Cambridge University Press.
    - Sadoulet, E and A. de Janvry 1995. Quantitative development policy analysis. The Johns Hopkins University Press, Baltimore, London.
    - Gujarati, D. N. 2005. Essentials of Econometrics. McGraw-Hill. International Edition.
    - Bruce, A McCarl and Thomas H. Spreen. 2004. Applied Mathematical Programming Using Algebraic Systems. Modeling for the Real World: GAMS/COIN; GAMS Development Corporation, 1217 Potomac Street, NW Washington, DC 20007, USA. <http://www.gams.com/presentations/index.htm>
    - Deaton, A. 1997. The Analysis of Household Surveys: A Micro-econometric Approach to Development Policy. The Johns Hopkins University
    - Bryant K. W 1990: The economic organization of the household. Cambridge University Press.
    - Tsakok, I. 1990. Agricultural Price Policy: A practitioner’s guide to partial-equilibrium analysis. Library of Congress Cataloging-in-Publication Data. Washington D.C.

**Further Readings**

* + Hazell, P. B. And R. D. Norton 1986. Mathematical programming for economic analysis in agriculture. New York: Macmillan Publishing CO.
  + Howitt, R. E. 1995. Positive mathematical programming. American Journal of Agricultural Economics. Vol. 77. N0. 2. pp. 329-342.
  + Singh, I., L. Squire and J. Strauss. 1986. Agricultural household models. The Johns Hopkins University Press, Baltimore and London.
  + Jensen, P.A. and J. F. Bard. 2008. Operations Research Models and Methods. Wiley, Hoboken, New?
  + Arulpragasam, J. and P. Conway 2003. “Partial Equilibrium Multi-market Analysis.” In F. Bourguignon and L.A. Pereira da Silva (eds.) Evaluating the Poverty and Distributional Impact of Economic Policies (Techniques and Tools. Washington, DC.  Sadoulet, E. and de Janvry. 1995. Quantitative Development Policy Analysis. Baltimore: The John Hopkins University Press.
  + FAO. 1982 Agricultural Sector Analysis Models in Developing Countries. FAO economic and social development paper 5.
  + Thorbecke, Erick 2001. The social accounting matrix deterministic or stochastic concept. Paper presented at the Institute of Social Studies, The Hague, Netherlands.
  + Sankhayan P. L. 1988. Introduction to the Economics of Agricultural Production. Prentice-Hill of India, Private LTD. New Delhi*.*
  + Gujarati, D. N. 2005. Essentials of Econometrics. McGraw-Hill. International Edition.
  + Sankhayan P. L. 1988. Introduction to the Economics of Agricultural Production. Prentice-Hill of India, Private LTD. New Delhi.
  + Sterman, J. D. 1991. A Skeptic’s Guide to computer Models. In Barney, G. O. el al. (eds.), Managing a Nation: The Microcomputer Software Catalog. Buolder, CO: Westview Press, pp. 209-229.
  + KEMFERT, Caps? Claudia 2003. Applied economic- environment- energy modeling for quantitative impact assessment. In Amelung, Rotmans, Valkering: Integrated Assessment for Policy Modelling
  + De Frahan, B. H. 2005. PMP, extension and alternative methods: Introductory review of the state of the art. Paper presented at the PMP, extensions and alternative methods organized session of the XIth EAAE Congress. Copenhagen, Denmark, August 23-27.
  + Arfini, F, M. Donati and Q. Paris. 2003: A national PMP model for policy evaluation in agriculture using micro data and administrative information.
  + Sterman, J. D. 1991: A Skeptic’s Guide to computer Models. In Barney, G. O. el al. (eds.), Managing a Nation: The Microcomputer Software Catalog. Buolder, CO: Westview Press, pp. 209-229.
  + Okoruwa, V.O, M.A. Jabbar and J.A. Akinwumi. 1996. Crop-Livestock Competition in the West African Derived Savanna: Application of a Multi-objective Programming Model. Agricultural Systems, 52, pp**,** 439-453
  + Nyikal, Rose, A. and W.O. Kosura 2003. Risk preference and optimal enterprise combinations in Kahuro division of Murang’a district, Kenya. Agricultural Economics, Vol. 32, pp. 131-140
  + Sumps, Jose Maria , Francisco Amador and Carlos Romero. 1996. On farmers' objectives: A multi-criteria approach.European Journal of Operational Research 96 (1996) 64-71
  + Yates C. M. and T. Rehman. 1998: A Linear Programming Formulation of the Markovian Decision Process Approach to Modeling the Dairy Replacement Problem. Agricultural Systems, Vol. 58, No. 2, pp. 185-201.
  + Wallace, Michael T. and Joan E. Moss. 2002. Farmer Decision-Making with Conflicting Goals: A Recursive Strategic Programming Analysis. Journal of Agricultural Economics. Volume 53, Number 1, Pages 82-10?.
  + Kuyiah, Joanne Wasswa, 1,? Gideon Obare, Mario Herrero and Michael Waithaka. 2006. Agriculture, Income Risks and Rural Poverty Dynamics: Strategies of Smallholder Producers in Kenya:Contributed paper prepared for presentation at the

International Association of Agricultural Economists Conference, Gold Coast, Australia,

* + Olarinde, L. O., V.M. Manyong and V. O. Okoruwa. 2008. Analysing Optimum and Alternative Farm Plans for Risk Averse Grain Crop Farmers in Kaduna State, Northern Nigeria. World Journal of Agricultural Sciences 4(1): 28-35,
  + Hattink, W., N. Heerink, and G./ N. Thijssen. 1998. Supply response of cocoa in Ghana: a farm-level profit function analysis. Journal of African Economics. Vol. 7. No. 3. pp 424-444.
  + Williams, T. O. 1993. Livestock pricing policy in sub-Saharan Africa: objectives, instruments and impact in five countries. Agricultural Economics. Vol. 8. pp. 139159.
  + Bezlepkina, I. V., G. J. M. Alfons, Osude Lansink and A. J. Oskam. 2005. Effects of subsidies in Russian dairy farming. Agricultural Economics. Vol. 33. pp. 277-288.

**CAEE 5123: Food Policy Analysis**

**Classification:**Elective. **Credit:** 3 **Semester:** 3

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1. **Course Objectives**

Food is an increasingly urgent political and economic issue for developing countries. For most rural people in developing countries, food production is the primary economic activity, while the availability of food at low and stable prices is the central political demand of wage earners in urban areas. Thus, food policy is of paramount concern to economic development efforts. Governments are trying to confront their food problems, and this requires good analysis and good analysts. This course attempts to show that food problems are immersed in the broader problems of economic development, and that solving food problems is a complex task. Objectives of the course are to:

* + Familiarize students with the extent of the global food problem, the human problem of hunger, and the role of food policy;
  + Improve the students’ understanding of the context and causes of hunger, and sustainable policy interventions that work to eliminate it;
  + Increase students’ awareness of food production issues and farming systems;
  + Equip students with skills for analyzing food production systems, food marketing systems, and food consumption and nutrition;
  + Increase the students’ understanding of the relationship between the food system and the macro economy; and
  + Provide lessons and perspectives of an effective food policy and elements of a workable food policy.

1. **Expected Learning Outcomes**

After successfully completing the course, the students will acquire the knowledge and skills to:

* + Understand the global food and human hunger problems and the importance of food policy analysis in resolving them;
  + Assess the impact of food production issues (e.g., gender, HIV/AIDS, environment and biotechnology) on food security;
  + Analyze and evaluate the performance of food production systems, food marketing systems, and food consumption and nutrition;
  + Assess the effects of macroeconomic policies on the food system;
  + Analyze and provide policy recommendations that will help improve the performance of the food system and food security in their nations. and
  + Understand the pillars of food security (Availability, Accessibility, Utilization and Stability)

1. **Prerequisites**

Microeconomics, Macroeconomics, Research Methods and Econometrics

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic | Contact Hour(s) | |  |  | Suggested hours of Independent study | Total |
| Lecture | Seminar | Practical  s/tutoria  l | Sub-  total |
| 1. A Review of  Concepts of Food  Policy analysis | 4 | - |  | 4 | 10 | 14 |
| 2. Analysis of Food  Consumption and  Nutrition | 5 | 2 |  | 7 | 25 | 32 |
| 3. Analysis of Food  Production Systems | 5 | 2 | 1 | 8 | 22 | 30 |
| 4. Marketing functions, markets, and food price formation | 10 | 2 | 2 | 14 | 30 | 44 |
| 5.Food security and  Food safety | 5 | 2 |  | 7 | 20 | 27 |
| 6. Food demand and  its role in agricultural analysis | 6 | 2 | 2 | 10 | 25 | 35 |
| **Total** | **30** | **10** | **5** | **45** | **132** | **180** |

1. **Detailed Description of Topics**

Topic 1: **A Review of Concepts of Food Policy Analysis**

This section provides the students with background information on food policy analysis.

The following will be covered:

* + The Global Food problem
  + Human Problem of hunger
  + Right to food
  + Concept, Scope, objectives and role of Food policy.

Topic 2**: Analysis of Food Consumption and Nutrition**

This section aims at improving the students’ understanding of the context and the causes of hunger and increasing their capacity to analyse food consumption and nutrition. The section also identifies sustainable policy interventions that work to eliminate hunger. The topics covered include:

* + Food consumption patterns: o The food balance sheet o Nutrition patterns o Nutrition surveys o Food availability at household level.  Food consumption analysis:

o Theoretical perspective o Estimating consumption parameters.

 Using consumption parameters: o Food and nutrition interventions o Targeting mechanisms.

***Exercises***

Exercises related to food balance sheets and food consumption analysis. Seminars or papers targeting mechanisms used by different nations.

Topic 3**: Analysis of Food Production Systems**

Agriculture is the basic source of food, and farmers are the basic food producers. Farmers are remarkably diverse people, ranging from near-subsistence peasants to corporate businessmen. This section provides an understanding of food production issues and farming systems, and presents the techniques that are used in analyzing food production and the elements of a successful agricultural development strategy. The following topics will be covered:

* Understanding food production issues:
  + Size of agriculture in GNP;
  + Technology and efficiency in food production; o Characteristics of agricultural production functions; o Food production and the environment;(Climate Change) o Women in African food production and food security o HIV/AIDS and food security
  + Biotechnology and food security; (GMOs) o Globalization and food security.
* Food production analysis:
  + Theoretical perspective o Estimating farmer supply response  Understanding farming systems:
  + Describing the agricultural sector
  + Modelling farmer response with a farming system tableau o Using a farming system tableau for policy analysis, o Social profitability analysis  Forming a production strategy:
  + Improving the social profitability of agriculture o Elements of a production strategy

***Exercises***

Exercises related to food production analysis, farming system tableau and social profitability analysis.

Topic 4**: Marketing Functions, Markets, and Food Price Formation**

The food-marketing sector transforms raw agricultural commodities produced by farmers into food, purchased and eaten by consumers. This section provides an understanding of the productive functions of marketing, role of the market as arena for exchange, and the formation of food prices at which exchange takes place. The following topics will be covered:

* Marketing issues:
  + Elements of market efficiency and market failure
  + Marketing functions and price formation

* Understanding the marketing system:
  + Structure of the food marketing system: A competitive market or a market dominated by oligopolies and monopolies?
  + Marketing chains o Marketing costs and margins
  + Analytical techniques for measuring marketing efficiency
  + International commodity markets

* Domestic markets and price policy: o Price policy analysis o Subsidies and food price dilemma o Subsidising marketing costs o Subsidising poor consumers
  + Government intervention and policy perspective

***Exercises***

Exercises related to marketing channels, marketing costs and margins, and intermarket price correlations.

Topic 5**: Food Security and Food Safety**

This topic provides an understanding of how food security is defined, what issues are raised by various approaches to addressing food security, what relationships exist between government policies and food safety and who benefits or not from food safety regulations. The following topics will be covered:

* Concepts of food security
* Approaches to addressing food security
* Relationship between government polices and food safety
* Beneficiaries and non-beneficiaries of food safety

Topic 6**: Food demand and its role in agricultural analysis**

This topic provides learners with an understanding demand, supply, and income approaches to output estimation and household surveys for analyzing food demand.

The following topics will be covered:

* Demand, supply and income approaches to national output estimation
* Survey types and data for analyzing food demand
* Household Surveys and cross-country data analysis
* Element of workable food policy
* Stability of Prices
* Food Balance Sheet

1. **Mode of Delivery**

Lectures, Tutorials/ Group discussions, Seminars

1. **Assessment Methods**

Evaluation of the course will take the form of course work, assignments/exercises, term paper and end of course exam as follows:

* + Course assessment (Midterm test, take home assignments): (20%)
  + Term Paper: (30%)
  + End of course Examination: (50%)

**Required Texts**

* + Tolley, G.S., C.M. Wong and V. Thomas. 1995. Agricultural Price Policies and the Developing Countries. Baltimore: John Hopkins University Press.
  + Sadoulet, E. and de Janvry 1995. Quantitative Development Policy Analysis. Baltimore: The John Hopkins University Press.

**Further readings**

* + Timmer, C. Peter, W. P. Falcon; and S. R. Pearson. 1983. *Food Policy Analysis*.

Baltimore: The Johns Hopkins University Press.

* + -Global Hunger Index. 2012: The Challenge of Hunger

? Global Food Policy Report: 2012

**Further Readings**

* + **-** Gibbon, Peter , Stefano Poute and Evelyne Lazaro, eds. 2010. Global Agro-Food, Trade and Standards: Challenges for Africa. Palgrave Macmillan.
  + Crawford, I. M. 1997. Agricultural and Food Marketing Management. Rome: FAO.
  + Gittinger, J. Price, J. Leslie; and C. Hoisington,, eds. 1987. *Food Policy: Integrating Supply, Distribution, and Consumption.* Baltimore: The Johns Hopkins University Press.
  + Sage, Colin. 2007. 'Bending Science to Match their Convictions': Hygienist

Conceptions of Food Safety as a Challenge to Alternative Food Enterprises in Ireland. Pp. 203-221 in Alternative Food Geographies: Representation and Practice. Damian Maye, Lewis Holloway and Moya Kneafsey (eds.). Oxford, UK: Elsevier.

* + DeLind, Laura B. and Philip H. Howard. 2008. "Safe at any Scale? Food Scares, Food Regulation and Scaled Alternatives." Agriculture and Human Values, 25, 3: 301-317.
  + Pothukuchi, Kami and Jerome Kaufman. 1999. “Placing the Food System on the Urban Agenda: The Role of Municipal Institutions in Food Systems Planning.” Agriculture and Human Values. 16: 213-224.
  + Anderson, Molly D. and John T. Cook. 1999. "Community Food Security: Practice in Need of Theory." Agriculture and Human Values. 16, 2: 141-150.
  + Haddad, Lawrence, ed. 1997. Achieving Food Security in Africa: New Challenges, New Opportunities. Washington, D C: International Food Policy Research Institute.
  + Mann, C. K. and B. Huddleston, eds. 1986. *Food Policy: Frameworks for Analysis and Action* Bloomington: Indiana University Press.
  + Pinstripe-Andersen, Per and R. Pandya-Lorch, eds. 2001. The Unfinished Agenda:
  + Perspectives on Overcoming Hunger, Poverty and Environmental Degradation.
  + Washington D C: International Food Policy Research Institute.

**CAEE 5124: International Trade and Policy**

**Classification:**Elective **Credit:**3 **Semester:**3

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* Acquaint the learners with the fundamental concepts underlying international trade.
* Give the learners an appreciation of the factors that make international trade to be an important policy agenda;
* Provide the learners with a firm foundation to develop basic analytical skills for diagnosing, describing and analyzing agricultural trade policy problems;
* Provide the learners with an appreciation of why nations should constantly monitor changes in the international market environment;
* Understand the role of economic integration. Familiarize the learners with the motives, types and institutional framework of regional integration schemes, and with international commodity agreements; and
* Expose the learners to global trade and agricultural policies of main institutions influencing agricultural trade involving developing countries.

1. **Expected Learning Outcomes**

Upon completion of the course, the students will have acquired:

* + An appreciation of the trade scene for agricultural products
  + Theoretical and analytical skills to diagnose, describe and analyse agricultural trade policy problems;
  + Theoretical and analytical skills to analyze and evaluate the impacts of the contemporary trade policy options available to policy-makers;
  + Analytical skills to analyze the economic and welfare effects of trade policies;

1. **Prerequisites**

Basic courses in Quantitative Methods, Microeconomics and Macroeconomics.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic | Contact Hour(s) | |  |  | Suggested hours of Independent study | Total |
| Lecture | Seminar | Practical  s/tutoria  l | Sub-  total |
| 1. The theoretical concepts underlying international trade | 6 | 1 |  | 7 | 30 | 37 |
| 2. An overview of world trends in agricultural trade | 3 | 1 |  | 4 | 20 | 24 |
| *3:* Trade Policy | *5* | *1* |  | *6* | *20* | *26* |
| 4. Welfare Analysis of  Trade Policies | 6 | 2 |  | 8 | 20 | 38 |
| 5. Policy Analysis Matrix  (PAM) | 5 | 1 |  | 6 | 20 | 26 |
| 6. Regional Integration | 3 | 1 |  | 4 | 10 | 14 |
| 7. Institutions and trade policies | 4 | 1 |  | 5 | 2 | 7 |
| 8. Emerging issues in agricultural policy and trade.( Cross Border  Trade) | 3 | 1 |  | 4 | 10 | 14 |
| **Total** | **35** | **9** |  | **45** | **132** | **180** |

1. **Detailed Description of Topics**

Topic 1**. The Theoretical Concepts Underlying International Trade**

This part is aimed at providing the learners with classical and neoclassical theories underlying international trade and to familiarize them with the theoretical and analytical tools used in analyzing international trade.

Key topics to be covered are:  Mechantilist Theory

* + The Ricardo theory
  + The Hecksher-Ohlin model
  + Factor price equalization theorem
  + Stoper-Samuelson theorem
  + Factor mobility
  + The general equilibrium models  Gravity Model.

**Required textbooks**

* + Dixit, A. and ? Norman (1980). *Theory of International Trade,* Cambridge University Press: Cambridge. (Chapters 2 and 3).

Markusen, J.R. and J.R. Melvin. 1988. *The Theory of International Trade.* New York:

Harper and Row. (Chapter 1).

Pergarson M.M. 2001. Theory in international trade and policy. Cambridge University Press.

Topic 2**: An overview of world trends in agricultural trade** This topic will familiarize students with an understanding of .

* + Major agricultural commodities traded in the world
  + Major importers and exporters
  + Application of trade map tools
  + Agricultural trade trends
  + Potential agricultural markets

**Required textbooks**

* + Corden, W. M. 1997, *Trade Policy and Economic Welfare.* Oxford University Press  Tweeten, L. 1992. *Agricultural Trade: Principles and Policies.* Boulder: Westview Press.
  + Dixit, A. and ?Norman 1980. *Theory of International Trade,* Cambridge University Press: Cambridge.
  + Pergarson, M.M. 2001. Theory in international trade and policy. Cambridge University Press

Topic 3**: Trade Policy**

This topic will present the main instruments of policy as well as the arguments for and against protectionist policies.

Key topics to be covered are:

* + Tariff
  + Quota
  + Voluntary export restraints
  + Non-tariff barriers
  + Application of game theory to international trade

**Required textbooks**

* + Markusen, J.R. and J.R. Melvin. 1988. *The Theory of International Trade.* New York: Harper and Row.
  + Vousden, N. 1990. *The Economics of Trade Protection.* Cambridge University Press: Cambridge.
  + Pergarson M.M. 2001. Theory in international trade and policy. Cambridge University Press

**Further reading**

* + Swinnen, Johan. 1994. A Positive Theory of Agricultural Protection: American Journal of Agricultural Economics 76 (1). Pp 1-14.

Topic 4**: Welfare Analysis of Trade Policies**

This topic equips the students with techniques for analyzing international trade policy impacts of taxes, subsidies and quotas. Use will be made of the partial equilibrium analysis to demonstrate the welfare impacts and trade-off of trade policies as follows:  The partial equilibrium analysis of welfare effects of free trade

The partial equilibrium analysis of welfare effects and various trade protection

measures including tariffs, quotas, and subsidies Measures of price distortions

* + Limitations of partial equilibrium models

***Exercise: analyzing the impacts of taxes, subsidies, and quotas***

The aim of the exercise is to enable the learners’ master the techniques used in analyzing the impacts of trade policies.

**Required textbook**

* Gandolfl, G 1987. International Economics I: The pure Theory of International Trade, Spinger-Verlag: Berlin.
* Vousden, N. 1990. *The Economics of Trade Protection.* Cambridge University Press: Cambridge.
* Pergarson M.M. 2001, Theory in international trade and policy. Cambridge University Press

Topic 5**.Policy Analysis Matrix (PAM)**

This topic describes a tool for analysis. The topic focuses on both theoretical and practical aspects of the tool. The sub-topics covered include:

* Review on PAM framework and data requirements
* Common measures for assessing distortion and competitiveness  Measurement of shadow prices:
  + Labour
  + Land
  + Fixed assets o Methodological problems
* Interpreting PAM results

***Exercise:*** *Constructing PAM*

The aim of this exercise is to deepen the learners understanding of the PAM by giving them practice in calculating shadow prices and conversion factors for domestic resources, constructing PAM, and calculating and interpreting the common coefficients arising from the PAM

**Required textbooks**

* Monke, L and R. Pearson, 1989. The Policy Analysis Matrix for agricultural Policy Analysis Cornell University.
* Van Tongeren, F. 2008, "Agricultural Policy Design and Implementation: A Synthesis", *OECD Food, Agriculture and Fisheries Working Papers*, No. 7, OECD publishing, Paris.

**Further readings**

* Tweeten, L. ed. 1989. *Agricultural Policy Analysis Tools for Economic Development*. Boulder: Westview Press.
* Adesina, A. A. and O. N. Coulibaly. 1998. Policy and competitiveness of agroforestrybased technologies for maize production in Cameroon: An application of policy analysis matrix. *Agricultural Economics*. vol. 19: 1-13.
* Monhanty, S., C Fang and J. Chaudhary. 2003. Assessing the competitiveness of Indian cotton production: A policy analysis matrix approach. *Journal of Cotton Science*. Vol. 7:65-74.

Ortiz, Jaime. 1999. The role of interest groups in agricultural policy design: Chile 1960-1988 *Journal of International Development*[Volume 11 Issue 2,](http://www3.interscience.wiley.com/journal/61004632/issue) Pages 241 – 258. Department of Agriculture, 1998. Agriculture in South Africa, fourth Ed. Chris Van Rensburg Publications (Pty) Ltd., Melville, Johannesburg.

* Pergarson, M.M. 2001. Theory in international trade and policy. Cambridge University Press

Topic 6**: Regional Integration**

This topic exposes the learners to the motives, types and institutional set-up of integration schemes, and highlights the interface between regionalism and food security. The following will be covered:

* Motives of regional integration
* Types of regional integration
* Free trade area
* Customs union
* Common market
* Economic union  Monetary union
* Regional integration and food security
* Institutional aspects of regional integration

**Reading textbooks**

* Pergarson, M.M. (2001) Theory in international trade and policy. Cambridge University Press.

Topic 7**: Institutions and Trade Policies**

This topic familiarizes the learners with trade policies of the main institutions influencing agricultural trade involving developing countries, and international commodity agreements.

The following will be covered:

* The International Monetary Fund
* The World Bank
* Regional international institutions
* Common Market for Eastern and Southern Africa (COMESA)
* Southern Africa Development Community (SADC)
* SACU
* East African Community (EAC)
* International Commodity Agreements, including WTO

**Required textbooks**

* Pergarson, M.M. 2001. Theory in international trade and policy. Cambridge University Press.
* Vousden, N. 1990. *The Economics of Trade Protection.* Cambridge University Press: Cambridge.
* Bates Robert H. and Steven Block,. 2009. Economy of Agricultural Trade Interventions in Africa

Topic 8**: Emerging Issues in Food and Agricultural Trade**

This topic familiarizes the learners with the motives, types and institutional set-up of economic integration. The following topics will be covered:

Regulations standards and product certification (SPS, HACCP);

* The changing structure of marketing and the transformation of food retail market;
* Cross Border Trade and implications
* Regional integration
* Globalization

**Required textbooks**

* Corden, W. M. 1997. *Trade Policy and Economic Welfare.* Oxford University Press
* Pergarson, M.M. 2001. Theory in international trade and policy. Cambridge University Press
* Krugman P.R and M. Obstfeld. 2000. International Economics: Theory and Policy. MA: Addison Wesley.

1. **Mode of Delivery**

The course will be delivered through lectures, tutorial and assignments. 2 hours lectures, tutorials and class seminars will be held each week for 15 weeks.

1. **Assessment Methods** 
   * Continuous assessment (midterm test, take home assignments) (20%)
   * Term paper (30%)
   * Final exam (50%)

**Required Texts**

* + Corden, W. M. 1997.. *Trade Policy and Economic Welfare.* Oxford University Press  Tweeten, L. 1992. *Agricultural Trade: Principles and Policies.* Boulder: Westview Press.
  + Pergarson, M.M. 2001 Theory in international trade and policy. Cambridge University Press
  + Monke, L and R. Pearson. 1989. The Policy Analysis Matrix for agricultural Policy Analysis. Cornell University.

**Further Readings**

* + Dixit, A. and ?Norman. 1980. *Theory of International Trade,* Cambridge University Press: Cambridge
  + Gandolfl, G 1987. International Economics I: The pure Theory of International Trade,
  + Spinger-Verlag: Berlin
  + Krugman P.R. and M. Obstfeld. 2000. International Economics: Theory and Policy.
  + MA: Addison Wesley.
  + Markusen, J.R. and J.R. Melvin. 1988. *The Theory of International Trade.* New York: Harper and Raw.
  + Timmer ? 1986. *Getting Prices Right: The Scope and Limits of Agricultural Policy*. Ithaca, Cornell University Press
  + Vousden, N. 1990. *The Economics of Trade Protection.* Cambridge University Press:
  + Cambridge.

**CAEE 5131: Agricultural Marketing and Price Analysis**

**Classification:** Elective **Credits:**3 **Semester:**3

***1. Objectives***

* To expose students to the economic role of prices and approaches to the study of agricultural markets (structure, conduct and performance) in Africa and elsewhere.
* To equip students with economic theory and analytical tools to analyse the market forces that affect commodity and food prices.
* To provide students with practical experience with application of tools to analyse and interpret marketing data.

***2. Expected Learning Outcomes***

After completing this course, the students should be able to:

* Apply economic theory to problems of agricultural marketing;
* Design strategies for effective market performance;
* Use marketing concepts for analysing market structure and performance in agriculture and formulate effective agricultural marketing policy;
* Apply theoretical models of imperfect market structures to inform public policy;
* Appreciate organizational forms unique to agricultural industries;
* Estimate demand and supply functions of various agricultural products;

***3 Prerequisites***

The student is expected to have covered the program’s core course

***3. Thematic Plan***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic |  | Contact Hours | |  | Independent Study | Total  Workload |
|  | Lectures | Seminar | Practical | Sub-  total |
| 1. Review on economic role of prices and approaches to the study of agricultural market organization and performance | 3 | - | - | 3 | 10 | 13 |
| 2. Theoretical models of market structure and performance | 5 | - | - | 5 | 15 | 20 |
| 3. Households, Markets and  Consumption | 2 | - | - | 2 | 10 | 12 |
| 4. Market characteristics | 2 | - | - | 2 | 10 | 12 |
| 5. Demand analysis | 3 | 1 | 4 | 8 | 12 | 20 |
| 6. Demand system estimation under alternative functional forms | 6 | 1 | - | 7 | 15 | 22 |
| 7. Supply Analysis | 5 | 1 | 4 | 10 | 10 | 20 |
| 8. Spatial and inter-temporal analysis of agricultural markets for policy | 7 | 1 | - | 8 | 15 | 23 |
| 9. Horizontal and vertical integration of agricultural industries | 3 | 1 | - | 4 | 15 | 19 |
| 10.Market organizational forms unique to agriculture | 3 | 1 | - | 4 | 15 | 19 |
| Total | 39 | 6 | 8 | 53 | 127 | 180 |

1. **Detailed Description of Topics**

**Topic 1: Review of the Economic Role of Prices and Approaches to the Study of Agricultural Market Organization, Conduct and Performance**

* + - Economic role of prices o Distributive and allocative functions o Equilibrating functions with the market
    - Approaches to the study of agricultural market organization and performance o The functional approach o The commodity approach o The institutional approach o The managerial approach

o Structure-conduct-performance paradigm

**Topic 2: Theoretical Models of Market Structure and Performance**

* + - Perfectly competitive markets
    - Imperfectly competitive markets o Monopoly and bilateral monopoly o Oligopoly

-Joint profit maximization

-Quantity-setting model

-Price-setting model

-Conjectural variation

-Dominant firm model

-Leader-follower model o Monopolistic competition and product differentiation o Price discrimination

o Monopsony and oligopsony models of agricultural product markets

-Conditions for monopsony and oligopsony

-Price and output determination under different market structures  Game and industrial organization theories

**Topic 3: Households, Markets and Consumption**

* + - Access
    - Preferences
    - Demand elasticities
    - Marginal propensities to consume
    - Terms of Trade

**Topic 4: Market Characteristics**

* + - Market-shed mapping
    - Marketing functions
    - Marketing costs and margins
    - Price formation
    - Marketing efficiency
    - Value chain analysis

**Topic 5: Demand Analysis**

* + - Review of consumer theory
    - Functional forms for single equation models
    - Duality and models of demand
    - Separability and aggregation
    - Flexible functional forms

**Topic 6: Demand System Estimation Under Alternative Functional Forms**

* + - Cobb-Douglas
    - Linear expenditure systems
    - Rotterdam
    - Translog specifications
    - Almost Ideal Demand System (AIDS) ? (This will create confusion, because used earlier in this book) model
    - Inverse demand systems

**Topic 7: Supply Analysis**

* + - Review of producer theory
    - Linkages between production and supply
    - Specification of variables
    - Specification bias
    - Supply specification
    - Supply estimation
    - Duality and supply
    - Supply dynamics
    - Uncertainty, risk aversion and supply
    - Supply chains

**Topic 8: Spatial and Inter-temporal Market Linkages**

* + - Inter-temporal market linkages cobweb cycle, seasonal patterns and secular trends, futures markets and forward contracting
    - Spatial market linkages
    - Transaction costs: types and dimensions
    - Spatial Market Integration Models
    - Spatial Equilibrium Models

**Topic 9: Horizontal and Vertical Integration of Agricultural Industries**

* + - Determinants of horizontal and vertical integration
    - Imperfect competition models o Successive monopoly model
    - Backward integration by a monopsony
    - Market Integration and Product differentiation
    - Policy implications

**Topic 10: Market Organizational Forms Unique to Agriculture**

* + - Farmer co-operatives o Model of a marketing/processing co-operative o Competitive effect of cooperatives on imperfect markets
    - Farmers’ bargaining associations o Bilateral monopoly model o Other theoretical models
    - Marketing Disorders, Disturbances and Policies o Demand and Supply Shifters in a Single Market o Shifters and Technical Change

o Demand and Supply Shifters in Two Related Markets

1. **Mode of Delivery** 
   * + - Lectures
       - Reading assignments
       - Practical Exercises (Computer applications)  Presentations of Term papers and assignments.

1. **Assessment Methods**

|  |  |  |
| --- | --- | --- |
|  | Continuous assessment (assignments, practical exercises, tests) | 20% |
|  | Term/Issues paper | 30% |
|  | Final examination | 50% |

1. **Course Materials**

**Required Textbooks**

* + ***Principles of Agricultural Marketing***, 6th edition, Roger Brown (Not available at the UP library). It may be replaced by this available book:
  + ***Agribusiness: fundamentals and applications*,** 2nd edition**,** Cliff Ricketts, Kristina Ricketts (2008)
  + ***Economics of Agricultural Markets***, Ronald Schrimper (Available at the UP library) (2001)

**Further Reading**

***The Instructors will streamline this reading list to retain the relevant ones***

* Abdulai, Awudu. 2000. Spatial Price Transmission and Asymmetry in the Ghanaian Maize Market. *Journal of Development Economics*, Vol. 63:327-349.
* Baumol, W.J., J.C. Pansar, and R.D. Willig. 1982. *Contestable Markets and the Theory of Industry Structure.*  New York: Harcourt Brace Jovanovich.
* Barrett C. 2008. *Spatial Market Integration*, in Durlauf, S., and Blume, L., ed. New Palgrave: Dictionary Economics.
* Carlton, Dennis W., and Jeffrey M. Perloff. 1994. *Modern Industrial Organization*, 2nded. New York: Harper Collins College Publishers.
* Carman, H.E. 2002. *Agricultural Price Analysis*, In Padberg, D.I., C. Ritson and L.M. Albisu, ed. Agro food Marketing, Wallingford: CAB International, pp.51-84.
* Deaton, A. and J. Muellbauer. 1980. “An almost Ideal Demand System”. *American Economic Review* 70:312-26.
* Eales, J.S. and L.J. Unnevehr. 1980. ‘Demand for Beef and Chicken Products: Separability and Structural Change”. *American Journal of Agricultural Economics* 70:520-532.
* Enders, Walter. 1995. *Applied Econometric Time Series*. New York: John Wiley and Sons, Inc, Chapter 6.
* Fackler, P.L. and B.K. Goodwin. 2001. *Spatial Price Analysis*, in G. Rausser and B.

Gardner, eds., Handbook of Agricultural Economics, Amsterdam, Elsevier.

* Ferris, J.N. 1998. *Agricultural Prices and Commodity Market Analysis*. Boston: WCB

 McGraw-Hill.

* Farris, P.L. 1997. *Market Structure and Institutions*, In Padberg, D.I., C. Ritson and L.M. Albisu, ed. Agro food Marketing, Wallingford, CAB International, pp.135-161.
* FEWS Net. 2008. *Market Assessment and Analysis: Learners Notes.* Lesson 3: Market indicators: Annex 3: Policy impacts on markets and population, FAO, pp 24.
* Gabre-Madhin, E., C. B. Barrett, and P. Dorosh. 2002. *Technological Change and Price effects in Agriculture: Conceptual and Comparative Perspectives*. International Food policy Research Institute (IFPRI), pp.1-61.
* Gardner, B.L. 1975. “The Farm-Retail Price Spread in a Competitive Food Industry”. *American Journal of Agricultural Economics*, Vol. 57, No. 3, pp.399-409.
* Goodwin, B.K and T.C. Schroeder. 1991). “Co integration Tests and Spatial Price Linkages in Regional Cattle Markets”. *American Journal of Agricultural Economics* Vol.?:452-464.
* Grosh, M.and P. Glewwe,, Eds. 2000. *Designing Household Survey Questionnaires for Developing Countries: Lessons from 15 years of the Living Standards Measurement Surveys*. World Bank volume1, Chapters 2 and 13.
* Henderson, James M., and Richard E. Quandt. 1980. *Microeconomic Theory: A Mathematical Approach*, 3rded. New York: McGraw-Hill Publishing Co., pp. 222-226.
* Holtzman et al. 1995. *Using Rapid Appraisal to Examine Course Grain Processing and Utilization in Mali.* In Scott, Gregory J., ed. 1995. Prices, Products, and People: Analyzing Agricultural Markets in Developing Countries. Lynne Rienner, Boulder.
* Houck. J.P. 1986. *Elements of Agricultural Trade Policies*. New York: Macmillan Publishing Company Ch. 3-6.
* Jhingan, M.L. 1977. *Microeconomic Theory*. New Delhi: Vikas Publishing House Pvt Ltd, pp.94-98.
* Kohls, R. L. and N.U. Uhl. 1990. *Marketing of Agricultural Products*, 7thed. New York: Macmillan.
* Mwanaumo, A., W.A. Masters and P.V. Preckel. 1997. “A Spatial Analysis of Maize Marketing Policy Reforms in Zambia”. *American Journal of Agricultural Economics* 79:514-523.
* Padberg, D.I., C., Ritson, and L.M. Albisu. 2002. *Agro-Food Marketing*. Wallingford: CAB International.
* Panigyrakis, G.G. 1997. *Pricing Policy*, In Padberg, D.I., C. Ritson and L.M. Albisu, ed. Agro-food Marketing, Wallingford, CAB International, pp.295-318.
* Shepherd, William G. 1997. *The Economics of Industrial Organization*, 4thed. New Jersey: Upper Saddle River, NJ: Prentice Hall, Chapter 1
* Silberberg, Eugene. 1990. *The Structure of Economics: A Mathematical Analysis*, 2nd ed. New York: McGraw-Hill Publishing Co, pp.1-25.
* Timmer, C.P., W.D. Falcon, and S.R. Pearson. 1983. *Food Policy Analysis*. Baltimore: John Hopkins University Press.
* Tomek, W.G. and K.L. Robinson. 2003. *Agricultural Product Price.* 4th ed. Ithaca: Cornell University Press.
* Varian, Hal R.2010. *Intermediate Micro-economics: A Modern Approach.* 8th ed.
* New York: W.W. Norton & Company, Chapters 27 and 28.
* Wetzstein, M.E. 2005. *Microeconomic Theory: Concepts and Connections*. Mason, Ohio: Thomson, South Western.
* World Food Program. 2008. PDPE Market Analysis Tool: Price and Income

Elasticities.

* World Food Program. 2008. PDPE Market Analysis Tool: Terms of Trade.

* Alexander, C. and J. Wyeth. 1994. ‘Co-integration and Market Integration: An Application to the Indonesian Rice Market’. *Journal of Development Studie*s, Vol. 30, No. 2, pp. 303-328.
* Ardeni, P.G. (1989). “Does the Law of One Price Really Hold for Commodity Prices?” *American Journal of Agricultural Economics* 71 (3): 661-669.
* Askari, H. and J.T. Cummings (1976). Agricultural Supply Response: A Survey of the Econometric Evidence. New York, NY: Praeger.
* Azam, J.P., P. Coller and A. Cravinho 1994. ‘Crop Sales, Shortages and Peasant Portfolio Behaviour: An Analysis of Angola’. *The Journal of Development Studies*, 30 (2): 361-379.
* Bardhan, K. 1970. ‘Price and Output Response of Marketed Surplus of Food grains: A Cross-Sectional Study of Some North Indian Villages’. *American Journal of Agricultural Economics*, 52(1): 51- 61.
* Bardhan, P. and K. Bardhan 1971. ‘Price Response of Marketed Surplus of Food grains: An Analysis of Indian Time-Series Data’. *Oxford Economic Papers*, 23 (2): 255267.
* Barrett, Christopher B. 2001. “Measuring Integration and Efficiency in International Agricultural Markets.” *Review of Agricultural Economics* 23: 19-32.
* Baulch, B., 1997. “Testing for Food Market Integration Revisited,” *The Journal of Development Studies*, Vol. 33, No. 4, pp. 512-534.
* Bates, R.H. 1981. *Markets and States in Tropical Africa: The Political Basis of Agricultural Policies.* Berkeley: California University Press.
* Benirschka, Martin and James K. Binkley. 1995. “Optimal Storage and Marketing over Space and Time.” *American Journal of Agricultural Economics* 77: 512-24.
* Bond, M.E. 1983. ‘Agricultural Responses to Prices in Sub-Saharan African

Countries’. *IMF Staff Papers*, 30 (4): 703-726.

* Booth, D. 1991. ‘Timing and Sequencing in Agricultural Policy Reform: Tanzania’. *Development Policy Review*, 9 (4): 353-379.
* Boyd, M. and B.W. Brorsen. 1986. “Dynamic Price Relationships for US and EC Corn Gluten Feed and Related Markets.” *European Review of Agricultural Economics* 13: 199215.
* Burton, Diana M. and H. Alan Love 1996. “A Review of Alternative Expectations Regimes in Commodity Markets: Specification, Estimation, and Hypothesis Testing Using Structural Models.” *Agricultural and Resource Economics Review* 25: 213-31.
* Chavas, Jean-Paul. 1999. “On the Economic Rationality of Market Participants: The Case of Price Expectations in the U. S. Pork Market.” *Journal of Agricultural and Resource Economics* 24: 19-37.
* Cleaver, K.M. 1985. ‘The Impact of Price and Exchange Rate Policies on Agriculture in Sub-Saharan Africa.’ World Bank Staff Working Paper No. 728. Washington D.C.: World Bank.
* Dercon, S. 1993. ‘Peasant Supply Response and Macroeconomic Policies: Cotton in Tanzania’. *Journal of African Economies*, 2 (2): 157-194.
* Derseh Endale 1993. ‘Rural Markets, Food-Grain Prices and Famines: A Study on Selected Regions in Ethiopia.’ Working Paper No.104, World Institute for Development Economics Research, United Nations University, Japan.
* Dicky, D.A. and W. A. Fuller. 1979. Distribution of the Estimators for the Autoregressive Time Series with a Unit Root. *Journal of American Statistical Association* 74 (366): 427-31.

**CAEE 5134: Farming Systems & Sustainable Livelihood Analysis**

**Classification:** Elective **Credits:**3 **Semester:**3

1. **Course Objectives**

:

* + To provide an understanding of the concepts of farming systems and sustainable livelihoods approach.
  + To expose students to the interface between farming systems and the sustainable livelihoods approach.
  + To equip students with analytical skils for analysing specific farming systems for sustainable livelihoods.
  + To expose students to the determinants of both farming systems and the sustainable livelihoods
  + examine the interface between farm management practices, techniques and technologies and the environment from a system approach
  + Analyse the extent to which farming systems are shaped by agro-ecological constraints and/or socio-economic factors.

1. **Expected Learning Outcomes**

By the end of this course, students will be able to:

* + Understand farming systems’ determinants and their interactions;
  + Apply systems approach to research and development;
  + Assess and evaluate existing practices and design of specific appropriate farming systems for sustainable livelihoods;
  + Acquire skills in the conduct of farmer-researcher collaboration in identifying critical production constraints, and in designing and critically analyzing alternative solutions to identified problem

1. **Prerequisites**

Graduate courses in Statistics, Agricultural Development and Research Methods.

1. **Thematic**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Topics** |  | | **Contact Hours** | |  | **Independent**  **Study hours** | **Total**  **Hrs** |
| **Theor**  **y** | **Seminar** | | **Practicals** | **Sub-**  **total** |
| 1. Review of concepts | 2 |  | |  | 2 | 6 | 8 |
| 2. Issues in agricultural production | 2 |  | | 2 | 4 | 12 | 16 |
| 3. Determinants of  Farming Systems and  Sustainable  Livelihoods | 4 | 2 | |  | 6 | 18 | 24 |
| 4. Farming systems approach | 5 | 2 | |  | 7 | 21 | 28 |
| 5. Farming system methodologies | 4 |  | | 2 | 6 | 18 | 24 |
| 6.Designing farming systems option(s) and impact assessment of  designed  system frames | 5 | 2 | |  | 7 | 21 | 28 |
| 7.Policies and strategies for sustainble livelihoods and Farming Systems | 11 | 2 | |  | 13 | 39 | 52 |
| **Total** | 37 | 8 | |  | 45 | 135 | 180 |

1. **Detailed Description of Topics**

**Topic 1: Review of Concepts**

* + - Agriculture and the society
    - Classification of agricultural systems
    - Hierarchy of agricultural systems
    - Agricultural systems versus farming systems
    - Formalizing farming systems
    - A conceptual framework for Sustainble Livelihoods

**Topic 2: Issues in Agricultural Production**

* + - Sustainable Livelihoods and farming systems
    - Household, livestock, crop and market subsystems
    - Modern agricultural technology and their relevance
    - Neutrality and non-neutrality of research and technology

**Topic 3: Determinants of Farming Systems and Sustainable Livelihoods**

* + - Biophysical environment
    - Economic/Socio-cultural
    - Biophysical and economic socio-physical interactions
    - Policy environment
    - External and exogenous influence

**Topic 4: Farming Systems Approach**

* + - Farming systems approach in general
    - Classifying, characterizing and reviewing farming systems, (Determinants lands/hierarchies, typology of farming systems, farming systems vis-à-vis farmers’ systems)
    - Smallholder, Resource-poor Family Farms o Relationships among household, crops, livestock and subsystems o Socio-economic characteristics of smallholder, resource-poor family farms and their implications on technology design and extension

o Farming systems and their improvement

* + - Systems approach to production, research and extension
    - Variations of farming systems approach (Evolution of more participatory approaches; links to sustainable livelihood analysis; role of indigenous knowledge)

**Topic 5: Farming System Methodologies**

* + - Generalized procedure
    - Rationale for micro orientation in framing systems
    - Institutional history and setting for micro oriented research in farming systems
    - Participatory research tools and techniques
    - Problem diagnosis and opportunities identification
    - Appraisal methods (Underlying concepts; range of methodologies; situations and applications of suitable rapid appraisal methodologies)

**Topic 6: Designing Farming Systems Option(s) and Impact Assessment of designed**

**Systems frames**

* + - Managing and administering farming systems projects
    - Procedures for screening options and alternative practices
    - Experimentation and testing design
    - Critical analysis of formulated solutions and/or options
    - Assessing and monitoring the impacts of designed farming systems

**Topic 7: Policies and strategies for sustainble livelihoods and Farming Systems**

* + - Overview of agricultural food production strategies (National Agricultural Development Plans)
    - Policy/Institutional support to farming systems
    - Linkages, networking and collaboration (Local, Regional and International)
    - Mitigation measures - role of National Strategic Grain Reserves and sustainability
    - Environment and sustainable food production systems

1. **Mode of Delivery**

The course will be delivered through

* + lectures,
  + assignments and  Presentations/seminars.

1. **Assessment Methods** 
   * + Continuous assessment (tests and assignments) (20%)
     + Term paper (30%)
     + Final examination (50%)

1. **Course Materials**

***Required Textbooks***

* - National Research Council. 2010. Towards sustainable agricultural systems in the 21st Century. National Academies Press, Washington D.C.
* Chamber, R. 1997. *Whose Reality Counts? Putting the First Last*. London: Intermediate Technology Publications.
* Beets, W.C. 1990. *Raising the Productivity of Smallholder Farming Systems in the Tropics*. Akamar, The Netherlands: AgBe Publishing.
* Hildebrand, P.E. 1986. *Perspectives in Farming Systems Research*. Boulder, CO: Lynne Rienner Publishers. Cambridge.
* Norman, D.W., J.D. Siebert, E. Modiakgotla, and F.D. Worman 1995. *The Farming Systems Approach to Development and Appropriate Technology Generation*. Rome: Food and Agricultural Organization (FAO).
* Ruthenberg, H. 1980. *Farming Systems in The tropics* (3rd edition). Oxford, UK: Clarendon Press.

***Further Readings***

* Altieri, M.A. 1995. *Agro ecology: The Science of Sustainable Agriculture* (2nd edition). London, UK: Intermediate Technology Publications.
* Andrew, C.O. and P.E. Hildebrand 1993. *Applied Agricultural Research: Foundations and Methodology*. Boulder, CO: West view Press.
* Beets, W.C. 1982. *Multiple Cropping and Tropical Farming Systems*. Boulder, Colorado, USA. West view Press.
* Bernstein, H. 1979. ‘African Peasantries: A Theoretical Framework’. *The Journal of Peasant Studies*, 6 (4): 421-443.
* Bewley, R., T. Young, and D. Colman 1987. ‘A System Approach to Modelling Supply Equations in Agriculture’. *Journal of Agricultural Economics*, 38 (2): 151-166.
* Byerlee, D., L. Harrington and D.L. Winkleman 1982. Farming Systems Research: Issues in Research Strategy and Technology Design. *American Journal of Agricultural Economists*, Vol. 64 (5): 897 – 904.
* Chamber, R. 1983. *Rural development: Putting the Last First*. Essex, England: Longman
* Chamber, R. 1992. *Methods for Analysis by Farmers: The Professional Challenge.* Institute ofDevelopment studies.University of Sussex. Brighton, UK.
* Chamber, R., A. Pacey, and L.A. Thrupp 1993. *Farmer First: Farmer Innovation and Agricultural Research*. London: Intermediate Technology Publications.
* Collin, J.P and Eric W. Crawford 2001. *Research in Agricultural Systems:*

*Accomplishments, Perspectives, and Issues*. NOVA Publishers.

* Dillon? and ?Hardaker 1980. *Farm Management Research for Small Farmer Development*. FAO Services Bulletin *#?* 41.Rome: FAO.
* Dixon, J., A. Gulliver and D. Gibbon. 2001. *Global Farming Systems Study: Challenges and Priorities to 2030. Synthesis and Global Overview*. Rome: FAO.
* Dyer, G. 1996. ‘Output per Acre and Size of Holding: The Logic of Peasant Agriculture Under Semi-Feudalism’. *Journal of Peasant Studies*, 24.
* Ellis, F. 1988. *Peasant Economics: Farm Households and Agrarian Development*.

Cambridge: Cambridge University Press.

**CAEE 5135: Science and Technology Policy Analysis**

**Classification:**Elective **Credits:**3 **Semester:**3

1. **Course Objectives**

To develop the analytical capacity to investigate strategic national, regional and international S&T policy covering food and agriculture that serve as input to policy and decision making by governments, funding agencies and research and development service providers through monitoring and evaluation of science and technology trends and the evaluation of investment and policy alternatives

**Motivation**

Agricultural Science R&D, its governance and direction of focus, has evolved into a specialized and complex field of research complete with analytical methodologies and techniques designed to investigate the policy issues involved. Students are often required to master a wide array of analytical principles and the technical concepts involved before they can adequately apply their discipline in advising research managers and policy makers appropriately. In doing so they must apply the theoretical concepts of the economics of productivity, growth, and technical change; the generation and diffusion of technologies, and apply methods for evaluating the impact of R&D to set research priorities for the future and be conversant with the economics of intellectual property rights.

1. **Expected Learning Outcomes**

After completing the course, the students will be able to:

* Understand and appreciate the role of technology in agricultural development
* Gain a working knowledge of economic principles and practices on a range of topics pertaining to science and technology policy.
* Analyse the economics of technological innovation, transfer and adoption
* Evaluate the process of technology innovation to adoption for development
* Evaluate the various technologies in the context of rural and agricultural development
* Evaluate technology and market developments
* Analyse and formulate/design technology policy for development

1. **Prerequisites**

Graduate level courses in Microeconomics, Issues in Agricultural and Applied Economics, and Macroeconomics.

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topics** |  | **Contact Hours** | |  | **Independ ent Study** | **Total**  **Hrs** |
| **Lecture** | **Seminar** | **Practical** | **Sub-**  **total** |
| 1. Technology generation, adoption and  constraints | 3 |  | **-** | **3** | 9 | **12** |
| 2. Technological innovation and the firm | 5 |  | **-** | **5** | 14 | **19** |
| 3. Economic analysis and  technological Change | 7 |  | **-** | **7** | 20 | **27** |
| 4. Political and social aspects of technological change | 4 | 1 | **-** | **5** | 18 | **23** |
| 5. International technology transfer | 5 | 1 | **-** | **6** | 21 | **27** |
| 6. Technology and environment | 4 | 1 | **-** | **5** | 18 | **23** |
| 7. Technology evaluation | 6 | 1 | **-** | **7** | 20 | **27** |
| 8. Policy Framework for Technology Transfer | 6 | 1 | **-** | **7** | 15 | **22** |
| Total | **40** | **5** |  | **45** | **135** | **180** |

1. **Detailed Description of Topics**

**Topic 1: Technology Generation, Adoption and Constraints**

* + Role of technology generation and adoption in characterization of farmers
  + Characterization of technology
  + Adoption patterns
  + Identification of constraints and motivator( new topic)

**Topic 2: Technological Innovation and the Firm**

* + Technology and technological change: Economies of scale, economies of scope, factor intensity, evolutionary process of technological change, technology and market structure
  + The firm production and technological change:
  + Research and development in the firm
  + Strategy and structure: Theoretical context of R & D strategy formulation, determinants of R & D budget, allocation of resources to activities within R & D, allocation of resources within areas
  + Organization and execution: R & D projects – origin, evaluation and selection, monitoring and control; Organization of the R & D function

**Topic 3: Productivity, Innovation and Technological Change**

* + Measuring productivity and technical change o aggregating inputs and outputs o technical change and input substitution o rates of change and factor biases o data and measurement issues
  + Patterns of innovation: The demand pull/technology push debate – theoretical and empirical – induced innovation, innovation firm size and market structure, technology, selection environment and firm, diffusion of technological innovation – the model, criticisms and alternatives
  + Technological change, output, employment and trade: Classical economics and economic trade, the Harrod-Domar model, Neo-classical models of economic growth, Heterodox approaches, an evolutionary approach to economic growth, technological change and unemployment, technological change and international trade
  + Technology and structural change: Waves of economic trade, neo-Schumperian theories of waves of economic trade, the role of the Labor market, institutional innovation in long waves, information technology
  + Technological capabilities: financing technological innovation, firm level capabilities, investment capabilities, production capabilities  Indigenous technologies

**Topic 4: Political and Social Aspects of Technological Change**

* + Government intervention in technical change: The possibility of intervention, reasons for government intervention, historical background to government intervention
  + Government promotion and control of technology: Labor policies for technology promotion, preconditions for government control of technology, mechanisms for control, risk assessment for technology control, institutions for technology control, effects of regulation on innovation
  + Non-government influences on technical change: Public participation in technology policy, the trade union movement, pressure groups, conflict and consensus, the role of experts

**Topic 5: International Technology Transfer**

* + International trade and technology: Trade with technological change – dynamic comparative advantage, dynamic effects of trade liberalization, trade technology and less skilled workers, geography and industry clustering, strategic trade theory – theory and evidence
  + Foreign direct investments: Imperfect competition and FDI, technology transfer and FDI, financing and taxation of direct investment, transfer prices, FDI - incentives and restrictions, effect of FDI on technological innovation
  + Exchange of goods and services, licensing and joint ventures
  + International technology transfer: importance and impacts, motivation, innovation and imitation across borders, appropriate technology, international agricultural research and technology transfer, intellectual property and patenting in an international context
  + The role of National Agricultural Research Systems (NARS), CGIAR and National Extension Systems

**Topic 6: Technology and Environment**

* + Optimal resource extraction: sustainable development
  + Environmental consequences of technical innovation
  + Some applications: deforestation, biodiversity, and climate change.

**Topic 7: Technology Monitoring and Evaluation**

* + Monitoring, Evaluation and Impact Assessment; the concepts of monitoring, evaluation, and impact assessment are defined and a framework for comprehensive impact assessment is developed. The emphasis is on the process, not on individual project M&E

**Readings**: Please format the following

Anandajayasekeram, P., C.J Van Rooyen, and F. Liebenberg. eds. 2004. Chapters 12—18. Designing M&E system; key considerations in designing an M&E system. Publisher and place?

Anandajayasekeram, P., C.J.,Van Rooyen and F. Liebenberg eds. 2004. Chapters 19—20 & 28. Research Priority Setting Methods. Publisher and place?

The decisions that must be made in the analysis and definition of problems, the identification and screening of possible solutions and the matching of problems with the solutions are the core of any priority setting process. Priorities are set at different levels within any national

research system. The various priority setting techniques are discussed

**Topic 8: Policy Framework for Technology Transfer**

* Challenges in managing creative talent- internal and external constraints
* Role of public policy in technology acquisition and transfer
* Technology transfer databases-country profile and inventory of technology
* Technology and industrial policies
* Education and training
* Intellectual property rights
* Standards
* Technology transfer institutions
* Strategies for commercializing technology

1. **Mode of Delivery**

The course will be delivered through

* + - Lectures,
    - Assignments,
    - Case studies and term paper

1. **Assessment Methods** 
   * + - Continuous assessment tests (20%)
       - Term paper (30%)
       - Final Examination (50%)

1. **Course Materials**

**Required Textbooks**

* + Schultz, T.W. 1956. “Reflections on Agricultural Production Output and Supply.”*Journal of Farm Economics* 38:748-762.
  + Griliches, Zvi. 1963. “The Sources of Measured Productivity Growth: Agriculture, 19401960.” *Journal of Political Economy* 71(4):331-346.
  + Griliches, Zvi. 1994. “Productivity, R&D and the Data Constraint.”*American Economic Review* 84(1): 1-23.
  + Acquaye, A.K.A., J.M. Alston, and P.G. Pardey. 2003. “Post-War Productivity Patterns in U.S. Agriculture: Influences of Aggregation Procedures in a State-Level Analysis.” *American Journal of Agricultural Economics* 85, 1 (February): 59-80.
  + Alston, J.M., B.A. Babcock and P.G. Pardey, eds. 2010. *The Shifting Patterns of Agricultural Production and Productivity Worldwide*, CARD-MATRIC on-line volume, Ames: Iowa State

University, 2010. Available at [http://www.matric.iastate.edu/shifting\_patterns/pdfs/chapter13.pdf.](http://www.matric.iastate.edu/shifting_patterns/pdfs/chapter13.pdf)(Especially Chapter 15)

* + Coombs, R., P. Saviotti, and V. Walsh. 1987. *Economics and Technological Change*. New Jersey: Rowman & Littlefield.
  + Feder, G. R.E. Just and D. Zilberman, 1985. “Adoption of agricultural innovations in developing countries: A survey.” *Economic Development and Cultural Change*, 33(2): 255-298.
  + Freeman, J. and J.S. Engel. 2007. Models of Innovation: Start-ups and Mature Corporations. *California Management Review* (Fall 2007): 94-119.
  + Freeman, C. and L. Soete 1997. *The Economics of Industrial Innovation* (3rd edition). Cambridge: MIT Press.
  + Gorman, R. 2002. Types of Knowledge of the Role of Technology Transfer. *Journal of Technology Transfer* 27:219-231
  + Hoekman, Maskus and ? Saggi 2005. Transfer of technology to developing countries: Unilateral and multilateral policy options. World Development 33 (10): 1587-1602.
  + Malecki, E.J. 1994. *Technology and Economic Development: The Dynamics of Local, Regional, and National Change*. Essex: Longman.
  + Ruttan, V.W. 2001. *Technology, Growth, and Development: An induced Innovation Perspective*. New York: Oxford University Press.
  + Teece, D.J. 2008. *The Role of Management, Enterprise and Technology and the Wealth of Nations: Dynamic Capabilities and the Business Enterprise.* New York: Oxford University Press.
  + Teece, D.J. 2006. Reflections on Profiting from Innovation. *Research Policy* (2006): 1131-1146.
  + Teece, D.J. 2000. *Managing Intellectual Capital*. New York: Oxford University Press.
  + Utterback, J. 1996. *Mastering the Dynamics of Technological Innovation*. HBS Press.

***Further Readings***

* Barro, R. 1997. *Determinants of Economic Growth*. Cambridge: MIT Press.
* Beynon, J.; S. Akroyd, A. Dunkin and S. Jones, 1998. *Financing the Future: Options for the Agricultural Research and Extension in Sub Saharan Africa.* Oxford Policy Management.
* Binswanger, H., Ruttan, V.W. et al. 1978. *Induced Innovation: Technology, Institutions, and Development*. New York: Johns Hopkins.
* Carleton, D. and J. Perloff. 1994. *Modern Industrial Organization*. Harper Collins.
* Caves, R. 1996. *Multinational Enterprises and Economic Activity*. Cambridge: Cambridge University Press.
* Chesbrough, H. and R.S. Rosenbloom. 2002. The Role of the Business Model in Capturing Value from Innovation: Evidence from Xerox Corporation’s Technology Spin-off Companies. *Industrial and Corporate Change* 11: 3.
* Conley and C. Udry. 2000. Learning about a New Technology: Pineapple in Ghana. Yale University, Economic Growth Center Discussion Paper.
* Dasgupta, P. and Stoneman, P. 1987. *Economic Policy and Technological Performance*.

Cambridge: Cambridge University Press.

* Edriss, A. K. 2003. *The Dynamics of Food Production Systems, and Adoption of Technologies in a Village Economy*: *Case studies in Malawi*. International Publishers and Printers, Banda College of Agriculture, Lilongwe, Malawi.
* Evenson, R. and G. Ranis. 1990. *Science and Technology: Lessons for Development Policy*. Boulder, CO: West view Press.
* Hagedoorn, J. 1989. *The Dynamic Analysis of Innovation and Diffusion: A Study in Process Control*. New York and London: Pinter Publishers.
* Haswell, M. and D. Hunt. 1991. *Rural Households in Emerging Societies: Technology and Change in Sub-Saharan Africa*. Berg Publishers.
* Mansfield, E. 1968. *The Economics of Technological Change*. Norton.
* Master, W.A. 2003. “Research prizes: A mechanism to reward agricultural innovation in low-income countries”. *AgBioForum* 6(1&2): 71-74.
* Masters, W.A. T. Bedingar and J.F. Oehmke, (998. “The impact of agricultural research in Africa: Aggregate and case study evidence”. *Agricultural Economics* 19(12): 81-86.*.*

**CAER 5141: Agricultural Finance and Risk Management**

**Classification:**Elective**Number of credit:**3**Semester:**3

**1. Course Objectives**

Agricultural Finance and Risk Management is an applied course focussing on

* Planning, analysing and controlling business performance in agriculture and on related financial markets;
* Subjective probability in the difference between and quantifying uncertainty and consequences regarding a risky prospect;
* Identifying and managing down side risk;

Differentiation between deterministic and stochastic planning and analysis.

***2. EXPECTED LEARNING OUTCOMES***

Students must acquire during tutorials the practical skills to, inter alia:

* Identify and compose a stock portfolio based on various risk attitudes.
* Understand the various markets, the instruments of each market and the investment process of each market.
* Understand the philosophy behind the investment process and develop an investment philosophy whereby the student can trade.
* Understanding fundamental and technical analysis and how these techniques can be applied in optimally managing an investment portfolio.
* Measure and integrate uncertainty (probability theory) and attitude towards consequences (utility theory) in decision analysis of risky prospects;
* Develop and interpret cumulative density functions from scarce and abundant data.
* Applying Bayes’ Theorem in risky decisions.
* Understand First and Second Order Stochastic Dominance;
* Apply deterministic and stochastic programming for a rather simple to an extended agri-business (intensive mixed farm).

1. **Prerequisites**

* + Basic accounting.
  + Time value of money.
  + Investment analysis and discounting techniques.
  + Statistics including probability theory.
  + Production economics.
  + Advanced operational knowledge *of Excel.*

1. **Thematic Plan**

This course comprises of two parts. In the first part, an overview to agribusiness management and its dynamics is presented during the first lectures. The second part of the course focuses on agribusiness strategic management. Assignments and case studies will be done during the course*.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Contact Hours | | | |  |  |
|  | Lecture | Seminar | Practical | Sub-  Total | Independent  Study | Total |
| 1. Review nature and scope of financial management including managerial goals. | 2 |  |  | 2 | 4 | 6 |
| 2.Introduction to Investment philosophy | 2 | 4 | 2 | 8 | 12 | 20 |
| 3.Investment alternatives and Agric endowment funds | 2 |  | 2 | 4 | 6 | 10 |
| 4.The returns and risks from investing | 2 |  | 2 | 4 | 6 | 10 |
| 5.Security analysis, valuation and  management | 2 |  | 2 | 4 | 6 | 10 |
| 6.Process Industry analysis as part of the investment process Assignment | 2 |  | 2 | 4 | 6 | 10 |
| 7.Turnaround strategies when under financial stress Unbundling and unlocking value | 2 |  | 2 | 4 | 6 | 10 |
| 8.Asset allocation and portfolio management | 2 |  | 2 | 4 | 6 | 10 |
| 9.Influence of mega forces on financial decisions. Introduction to risk agriculture. | 2 |  | 2 | 4 | 6 | 10 |
| 10.Introducing the concept of subjective probability in the difference  between uncertainty and consequences regarding a risky prospect. | 2 |  | 2 | 4 | 6 | 10 |
| 11.Applying subjective probabilities and calculating posterior probabilities. | 2 |  | 2 | 4 | 6 | 10 |
| 12.Expanding the utility concept and integrating decision maker's beliefs and preferences. | 2 |  | 2 | 4 | 6 | 10 |
| 13.Application of stochastic efficiency measures and simulation. | 2 | 4 | 2 | 8 | 13 | 21 |
| 14.Exposing students to an elementary dynamic decision model. | 4 | 4 | 8 | 16 | 13 | 29 |
| 15.Discussing different forms of risk  and how to manage and be aware of it. | 4 |  |  | 4 |  | 4 |
| Total | 34 | 12 | 32 | 78 | 102 | 180 |

1. **Detailed Description of Topics**

**Topic 1: Review nature and scope of financial management including managerial goals.**

* Understand and interpret integrated financial statements. ii. Sound financial management system.

**Topic 2: Introduction to Investment philosophy**

* The ingredients of an investment philosophy iv. The job of a portfolio manager v. An assignment where the student has to develop his/her own investment philosophy

**Topic 3: Investment alternatives & Agric endowment funds**

* Introducing various investment markets to the students. ii. Analyzing various investment instruments iii. Calculating the returns of each instrument iv. Investing in other African countries – pitfalls & opportunities

**Topic 4: The returns & risks from investing**

* Measuring risks and returns of various instruments ii. Identifying the risks of each investment market

**Topic 5: Security analysis and valuation**

* Economic analysis as part of the investment

**Topic 6: Process Industry analysis as part of the investment process Assignment**

* Analyzing selected industries Fundamental analysis as part of the investment

Assignment on calculating stock values and PE ratios

* Technical analysis as part of the investment process

**Topic 7: Turnaround strategies when under financial stress Unbundling & unlocking value**

* Identifying survival strategies Mergers and acquisitions takeovers

**Topic 8: Asset allocation & portfolio management**

* Portfolios for different types of investors Assignment where student has to select his/her own portfolio
* Optimal asset allocation and risk management
* Portfolio management

**Topic 9: Influence of mega forces on financial decisions**.

* Introduction to risk in agriculture**.**
* Exposing the diversified face to risk.
* Down side risk is expanded on as it is important to distinguish between deterministic and stochastic analysis of risk..

**Topic 10: Introducing the concept of subjective probability in the difference between uncertainty and consequences regarding a risky prospect**.

* Measure independently and then integrate the assessment of beliefs about uncertainty as well as preferences for consequences.
* Probability and utility defined.
* A simple risky problem is initiated that will be expanded on as other explanatory concepts are introduced.

**Topic 11: Applying subjective probabilities and calculating posterior probabilities**.

* Application of subjective probabilities, DF’s and posterior probabilities.
* Relevant tutorial classes complement lectures. Study material covered in tutorials is included in class tests. Ability to calculate and interpret.

**Topic 12: Expanding the utility concept and integrating decision maker’s beliefs and preferences.**

* Discussing the effect of risk attributes and risk aversion in decision making. Utility function elicitation, expanding on the application of decision trees in solving more complex decision problems under uncertainty.

**Topic 13: Application of stochastic efficiency measures and simulation**.

* Enabling student in inserting first and second order stochastic dominance and do a stochastic simulation with relevant CDF’s. The above objectives, discussed in a contact session(s) are complemented with tutorial session..

**Topic 14: Elementary dynamic decision model**

* Explaining the effect of a non-perfect market situation on an inter-temporal dynamic model. The effect of state of the nature, time and other variable on a dynamic decision model’s outcome. To test whether students grasp the effect of time on decision making. Testing cognitive understanding.

**Topic 15:Discussing different forms of risk and how to manage and be aware of them**.

* Discuss the classical demarcation of risks originating from various sources including government and when and/or if to outright accept or sell the evolving risk and the presence of down side risk. The classical demarcation of risk and risks emanating from government policy and decisions.

Understanding of the different characteristics of risks. Knowledge regarding the nature of risk and the role of down side risk.

6. **Study Materials**

**6.1 Core Texts**

* Hardaker, J. B., R. B. M. Huirne, J. R. Anderson, G Lien. 2004: *Coping with risk in agriculture* (Second Edition), CAB International, New York. (Abbr. Coping)
* Rae, Allan N. 1981. *Crop management economics*. Granada Publishing, London. (Abbr.

Rae).

Selections from.

* Palisade, ? 2012: @? Risk 6.1: *Advanced risk analysis for spreadsheets. Windows version*.

See also BestFit Read Me, as well as BestFit Tutorial on Computers in Computer Lab

* Mpofu, R and G. van de Venter. 2003. *Investment Management*. Marx, J. (ed),Van Schaik Publishers: Pretoria (only selected chapters) Bodie,ZVI,
* Kane, A. and A.J. Marcus. Date?*Essentials of Investments*. McGraw-Hill : Boston (only selected chapters)

Damodaran, A. *Investment philosophies*. Available online at <http://pages.stern.nyu.edu/~adamodar/New_Home_Page/>

* **6.2 References and selected readings**

Barry, Peter, J., Paul N. Ellinger , John A. Hopkin and C. B. , Baker. 1995. *Financial management in agriculture*. Interstate Publishers, Danville, Illinois. (Abbr. FMA).

* Anderson, Jock R., John L Dillon., Brian, Hardaker. 1977. *Agricultural decision analysis.*The Iowa State University Press, Ames, Iowa. (Abbr. ADA).
* Jones, C.P. 2000. *Investments: Analysis and Management*. 7th ed. John Wiley & Sons: NY.
* Atwood, J.A. and D.E. Buschena. 2003. Evaluating the magnitudes of financial transactions costs on risk behavior. *Agricultural Systems*, February 2003, Vol. 75(2): 235249.
* Gudbrand, L. 2003. Assisting whole-farm decision-making through stochastic budgeting. *Agricultural Systems*, May 2003, Vol. 76(2): 399-414.
* Hailu, G., S. Jeffrey and J. Unterschultz. 2005. Cost Efficiency for Alberta and Ontario Dairy Farms: An Interregional Comparison. *Canadian Journal of Agricultural Economics*, July 2005, Vol. 53(2): 141-160.
* Lohano, H.D. and, R.P. King. 2009. A Stochastic Dynamic Programming Analysis of Farmland Investment and Financial Management. *Canadian Journal of Agricultural Economics*, December 2009, Vol. 57(4): 575-600.
* Louw, A. 2002. Application of modern risk management techniques in agricultural financing. *Proc. Fertiliser Society of South Africa*. 7 June 2002.
* Olynk, N.J. and C.A. Wolf. 2009. Stochastic economic analysis of dairy cattle artificial insemination reproductive management programs. *Journal of Dairy Science*, March 2009, 92(3): 1290-1299.
* Thompson, A.A. and A.J. Strickland. 2003. *Strategic Management: Concepts and Cases*.

13th edition. New York: McGraw-Hill.

* Van Zyl, M.J., J.F. Kirsten, G.K. Coetzee. and C.S. Blignaut. 2013. *Finansiering en die boer*. Johannesburg: Standard Bank van Suid Afrika.
* Winston, W.L. 2003. *Operations research: Applications and algorithms*. Boston: Duxbury.

**6.3 Articles (to be provided on CD)**

Ferguson, R.C. 2006. *Applying Debt to Equity Ratio*. The Ferguson Ag Report. 1 February.

Subscribed at www.thefergusongroupltd.com

Somwaru,A. 1999. *Managing Risk in Farming: Concepts, Research and Analysis*. Economic Research Services, USDA. www.usda.org.

Harwood, J., R. Heifner and , K. Coble and A. Somwaru. 1999. *Managing Risk in Farming:*

*Concepts, Research and Analysis*. Economic Research Services, USDA. www.usda.org. Dismukes, R. and J. Harwood 2000. *Farmers sharpen tools to confront business risks*. www.usda.org.

Safex, ? 2013. Safex contract prices. www.safex.co.za

United States Department of Agriculture (USDA) (2000). *Building a risk management plan.*www.usda.org.

6.4 **Case Studies and Reports**

* Expansion and Risk at Hansson Private Label, Inc
* Malan, D.J.C. 2007. Risk management for successful commercial agriculture.
* Unpublished MBA thesis. Pretoria. University of Pretoria

1. **MODE OF DELIVERY** 
   1. **Lecturing**

The division of the teaching load is between two lecturers according to fields of expertise. The style of lecturing is co-operative and student-centred learning. PowerPoint slides cover the formal study material. Lectures are in a computer room to encourage inter-action between students and students and lecturer.Adequately referenced study material is available in the textbooks, the study guide and on the department’s website.

* 1. **Development of Knowledge and Understanding**

**Simulation trading**

The students are confronted with a simulation game where they have to identify and choose various stocks traded on the JSE Pty Ltd. They obtain access to buy and sell these shares real time and have to keep track of their performance. This serves a two fold purpose: First, to let the student experience the results of his/her portfolio selection and secondly, to introduce the student to the world of stock broking.

**Tutorials**

The tutorials are an important element of teaching cognitive and intellectual skills**.**

Tutorials are actually self-study time. The use of specific software and exercises based on

the prescribed textbooks, complemented with own developed exercises, help to internalise

the cognitive skills students are exposed to during formal lectures. Students need access to

computers and relevant software packages. Based on theory and the necessary

cognitive skills to apply the theory, students learn in a “hands on fashion”, these skills which include Decision Tree and Stochastic Analysis. Including basic calculations such as changing a simple Excel based cash flow from deterministic to stochastic, stochastic simulations of partial budgets, an extensive mixed farm’s enterprise budgets and integrated financial statements as well as ratio and DuPont analysis for the case farm are executed. This culminates in an Assignment to comparatively evaluate and interpreting a deterministic and stochastic format of the case study.

**8. ASSESSMENT METHODS**

|  |  |
| --- | --- |
| A three hour set exam. | 50% |
| Two written assignments of between 1000 and 1500 words. | 25% |
| Two class tests | 25% |

**Course 5142: Agribusiness Supply Chain Management**

**Classification:** Elective **Credits:** 3 **Semester:** 3

**1. Course Objectives**

The primary objective of this course is to make students understand and appreciate how two powerful forces – the producer and the consumer - drive the process of agricultural valueadding activities in an increasingly competitive environment.

The course will specifically aim at:

* Acquainting students with the generic concepts of Supply Chain Management: planning, implementing, control and co-ordination;
* Equipping students with practical and analytical skills to undertake value-chain analysis;
* Providing students with knowledge about different elements of agro-chain logistics and how they can be used to create a strategic fit between supply chain and competitive strategy
* Making students understand the role of support services in improving agro-chain performance;
* Making students appreciate and evaluate risk management strategies or tools used by key players of an agro-chain;
* Creating student awareness of emerging issues in modern agro-chain management; and
* Equipping students with tools to build up case studies that demonstrate how to practically plan, implement and control activities in the agro chain.

**2. Expected Learning Outcomes**

At the end of the course, the students should be able to:

* Demonstrate an understanding of agro-chain management by critically analysing an existing supply chain or restructuring an existing supply chain or by analysing a specific section of a supply chain;
* Execute an audit on all the logistics servicing the supply chain with the aim to identify its strengths and weaknesses, areas of potential improvement and opportunity;
* Apply a wide range of practical and analytical skills to undertake value-chain analysis among common agro-based marketing chains to identify their weaknesses, strengths, opportunities, and threats;
* Formulate supply chain strategy by identifying and introducing new logistics or sourcing raw materials from a specific supplier, decreasing inventory, increasing value added in the entire chain, and so forth.
* Build case studies of product transformation through agro-chain.

1. **Prerequisites**

Microeconomics, Macroeconomics, Production Economics, and Issues in Agricultural and Applied Economics

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic | Contact Hours | |  |  |  |  |
|  | Lecture | Seminar | Practical/Tutorial | Sub-  Total | Suggested  Hours of  Independent  Study | Total |
| 1. Introduction | 1 | - | - | 1 | 3 | 4 |
| 2. Value-Addition in  Agro-chains | 4 | 2 | - | 6 | 18 | 24 |
| 3. Performance of Agrochains | 6 | 1 | - | 7 | 21 | 28 |
| 4. Network design in the agro-chain | 6 | - | 2 | 8 | 24 | 32 |
| 5. Control and coordination of agrochains | 4 | 1 | - | 5 | 15 | 20 |
| 6. Support services in agro-chains | 4 | 1 |  | 5 | 15 | 20 |
| 7. Review of risk mitigation strategies in  agro-chains | 3 | 1 |  | 4 | 12 | 16 |
| 8. Emerging issues in modern agribusiness  supply chain management | 2 | 2 | - | 4 | 12 | 16 |
| 9. Case studies in  Agribusiness supply management | 3 | 2 |  | 5 | 15 | 20 |
| Total | 33 | 10 | 2 | 45 | 135 | 180 |

1. **Detailed Description of Topics**

**Topic 1. Introduction**

* Supply chain and supply chain management
* Supply chain versus value chain – Conceptual and empirical clarifications
* Cross-boarder supply chain
* Global value chains (GVCs)
* Agro-chains

o Theories of value chain formation, organization and management o Management of postharvest losses  Types of supply/value chains o Buyer-driven chains o Supplier-driven chains

**Topic 2. Value-Addition in Agro-Supply Chains**

* Backward and forward linkages in agro-chains
* Value chain analysis

Vertical versus Horizontal Analysis

* Mapping value chains

Actors, their activities and geographical locations

Classifying actors of the value chain (Primary, Support, and Institutional actors)

* Governance of value chains
* Upgrading in value chains
* Value chain research

**Topic 3. Performance of Agro-Chains**

* Supply chain strategy
* Drivers/Enablers of agro-chain performance

o Facilities/plants o Inventory/stock o Transportation o Information o Sourcing o Pricing

* Management of cross-functional factors of agro-chains

**Topic 4. Network Design in the Agro-chain**

* Decisions in agro-chain network design
* Factors influencing agro-chain network design
* Agro-chain network optimization models
* Transportation model
* Demand allocation model
* Plant location model
* Capacity allocation model
* Agro-chain network design in uncertain environment

**Topic 5: Control and Coordination of Agro-chains**

* Control of agro-chains
* Coordination of agro-chains in relation to governance of the value chain

**Topic 6. Support Services in Agro-chains**

* Private services (e.g. credit and transport)
* Institutional services (infrastructure, markets, and research)

**Topic 7. Review of Risk Mitigation Strategies in Agro-chains**

* Price risk
* Crop and livestock insurance
* Contractual arrangements and market instruments
* Informal insurance

**Topic 8. Emerging Issues in Modern Agribusiness Supply chain Management**

* New forms of vertical integration and alliances
* Globalization of agro-chains
* Agro-chain financing
* Use of technology and advanced techniques in agro-chains
* Electronic commerce
* Transfer of ownership rights and information in agro-chains
* Private and public food quality and safety standards (Compliance to HACCP)
* Food traceability and country of origin labelling (COOL, EurepGap, GlobalGap etc)

**Topic 9. Case Studies in Agribusiness Supply Chain Management**

* Established case studies in agro-chain management will be used, for example, FAO, Harvard, Wageningen, or any other existing case studies in Africa.

1. **Mode of Delivery**

The course will be delivered through class lectures, case studies, role plays, assignments, and field visits. There will be 2 lecture hours and 1 practical hour per week for a 15 weeks semester**.**

1. **Assessment Methods**

The course will be evaluated through continuous assessment tests and home assignments (20%), case study/term paper (30%), and final exam (50%).

1. **Course Materials**

**Required Textbooks**

* Van der Vorst, Jack, G.A.J., da Silva, A. Carlos and Jacques H. Trienekens. 2007. *Agro-industrial supply chain management: Concepts and applications*. FAO, Rome.
* Chopra, S. and P. Meindl 2006. Supply Chain Management: Strategy, Planning, and Operation. Third Edition. Prentice Hall.

**Further Readings**

* Trienekens, ? 2011. Agricultural Value Chain in Developing Countries, A framework for Analysis. *International Food and Agribusiness Management Review*. 14 (2), 51 – 82.
* Alberta Agriculture, Food and Rural Development Information Packaging Centre. 2002. Value chain handbook: new strategies to create more rewarding positions in market place. Edmonton, Alberta.
* Ballou, R.H. 2004. Business Logistics/Supply Chain Management. Fifth Edition. Pearson Education, Inc.
* Bourlakis, Michael A,, Paul W. H. Weightman Edts. *Food supply chain management.* Blackwell Publishing, Oxford.
* De Villiers Gerard, Gideon Nieman and Wesley Nieman Edts. 2008. *Strategic logistics management. A supply chain management approach*. Van Schaik Publishers, 1064 Arcadia Street, Hatfield, South Africa.
* Gereffi, G. 1994. “The Organization of Buyer-drive Global Commodity Chains: How US Retailers Shape Overseas Production Networks.” In Gereffi, G. and M. Lorzeniewicz (eds.) *Commodity Chains and Global Capitalization*. Westport: Praeger: 95-122.
* Handfield, Robert B and Nichols, Ernest L, Jr. 2002. *Supply chain redesign. Transforming supply chains into integrated value systems*. Prentice Hall PTR, Upper Saddle River, NJ.
* Kaplinsky, R. and M. Morris. 2000. “A Handbook for Value Chain Research.” IDRC.
* Kherallah, M. and J. Kirsten. 2001 The New Institutional Economics: Applications ior Agricultural Policy Research in Developing Countries. MSSD Discussion Paper No. 41. Washington, D.C.: Markets and Structural Studies Division, International Food Policy research Institute.

**On-Line References**

* Dolan, C., J. Humphrey and C. Harris-Pascal. Date?. “Horticulture Commodity Chains: The Impact of the U.K. Market on the African Fresh Vegetable Industry.” IDS Working Paper 96. ([www.inti.gov.ar/cadenasdevalor/horticultura.pdf)](http://www.inti.gov.ar/cadenasdevalor/horticultura.pdf).
* FAO Date?). Strengthening farm-agribusiness linkages in Africa in [(http://www.fao.org/docrep/008/y5785e/y5785e01.htm)](http://www.fao.org/docrep/008/y5785e/y5785e01.htm).
* Kaplinsky, R. 2000. Spreading the Gains from Globalization: What can be Learned from Value Chain Analysis. IDS, Working paper 110. Institute of Development Studies: 8. ([www.ids.ac.ac.uk/ids/global/valchn/html)](http://www.ids.ac.ac.uk/ids/global/valchn/html).
* Ribbink, G., P. Nyabuntu, and S. Kumar. 2005. “Successful Supply Chains in Uganda:

A Study of the Three Successful Chains in the Coffee, Dried Fruit, and Vegetable

Sectors in Uganda.” Report. Business Services Market Development. DFID and ILO.([www.bdsknowledge.org/.../**Successful**%20Supply%20**Chains**report%2020050607.pdf)](http://www.bdsknowledge.org/.../Successful%20Supply%20Chains-report%2020050607.pdf).

* Roekel, J.,V., S. Willens, and D.M. Boselie. 2002. “Agri-Supply Chain Management to

Stimulate Cross-Border Trade in Developing Countries and Emerging Economies.”

World Bank Paper. ([http://siteresources.worldbank.org)](http://siteresources.worldbank.org)/)

**Journal References**

* Cooper, Martha C, Douglas M. Lambert, Janus D. Pagh. 1997. Supply Chain Management: More Than a New Name for Logistics. *The International Journal of Logistics Management*. Volume 8 (1), pp. 1-14.
* Drabenstott, O.M. 1995. Agricultural Industrialization: Implications for Economic Development and Public Policy. *Journal of Agricultural and Applied Economics* 27 (1): 13-20.
* Gereffi G., J. Humphrey, and T. Sturgeon. 2005.“The Governance of Global Value Chains.” *Review of International Political Economy*, 12:1, 78 – 104.
* Kaplinsky, R. 2004. “Spreading the Gains from Globalization.” *Problems of Economic Transition*, 47:2, 74-115.
* Lacroix, R. and P. Varangis 1996. “Using Warehouse Receipts in Developing and Transition Economies.” *Finance and Development* 33(3): 36-39.
* Neven, D., and T. Reardon. 2004. “The Rise of Kenyan Supermarkets and the Evolution of their Horticulture Product Procurement Systems.” *Development Policy Review* 22:669-699.
* Reardon, T., C.P. Timmer, C.B. Barrett, and J. Berdegué*.* 2003. “*The* Rise of Supermarkets in Africa, Asia, and Latin America” *American Journal of Agricultural Economics* 85:1140-46.
* Vickery, Shawnee, Roger Calantone, Cornelia Dröge. 2006. Supply Chain Flexibility:

An Empirical Study*. Journal of Supply Chain Management*. Vol 35(3): 16 -24, 5 April.

* Walton, Steve V., Robert B. Handfield, Steven A. Melnyk . 2006. The Green Supply Chain: Integrating Suppliers into Environmental Management Processes.*Journal of Supply Chain Management.*2-11. April.
* Weatherspoon, D.D., an*d T. Reardon.* 2003. *“The Rise of Supermarkets in* Africa: Implications for Agri-food Systems and the Rural Poor.” *Development Policy Review* 21:333-55.

**Case Studies**

- KIT, Faida MaLi and IIRR. 2006*. Chain empowerment. Supporting African farmers to develop markets.* Royal Tropical Institute, Amsterdam; Faida Market Link, Arusha; and International Institute of Rural Reconstruction, Nairobi.

**CAER 5143: Operations Research in Agribusiness Management**

**Classification:** Common **Credits:** 3 **Semester:** 3

1. **Course Objectives**

The primary objective of the course is to impart to trainees an ability to make informed agribusiness management decisions using common quantitative methods and up to date computer software. It aims at providing students with skills and knowledge necessary to link theory and practice in day-to-day planning, implementation and control of agribusinesses.

The specific objectives will be to:

* + Expose students to quantitative methods applicable to agribusiness management.
  + Guide students in using quantitative methods and computer packages for agribusiness management for planning, executing and controlling agribusiness activities
  + Guide students on how to apply knowledge gained to plan, execute and control agribusiness activities and to solve practical problems in agribusinesses
  + Expose students on how to predict the behavior of economic firms in changing economic conditions

1. **Expected Learning Outcomes**

At the end of the course the student should be able to:

* + Apply quantitative methods in agribusiness management;
  + Apply quantitative methods and computer packages to plan, execute and control agribusiness activities
  + Apply knowledge gained to analyze and solve practical problems in agribusinesses
  + Apply the knowledge gained to predict the behavior of economic firms in changing economic conditions

1. **Prerequisites** 
   * Graduate courses in Statistics, Mathematics, Econometrics and Microeconomics

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Topic | Time (in Hours) | |  |  |  |  |
|  | Lectures | Seminar | Practical | Sub-  Total | Independent Study | Total |
| 1. Review of quantitative and qualitative methods | 2 |  |  | 2 | 6 | 8 |
| 2. OR based methods | 4 |  |  | 4 | 12 | 16 |
| 3. Application of linear and non  linear programming in Agribusiness Management | 5 | 1 |  | 6 | 18 | 24 |
| 4. Transportation/network flow and assignment problem | 4 | 2 |  | 6 | 18 | 24 |
| 5. Simulation and risk | 5 | 2 |  | 7 | 21 | 28 |
| 6. Queuing models | 6 | 2 |  | 8 | 24 | 32 |
| 7. Forecasting and predictions | 5 | 1 |  | 6 | 18 | 24 |
| 8. Transportation models | 5 | 1 |  | 6 | 18 | 24 |
| Total | 36 | 9 | 0 | 45 | 135 | 180 |

1. **Course Description**

**Topic 1. Review**

* + Review of quantitative and qualitative methods
  + Mathematical and geometric notations
  + Slopes and differential and integral calculus, exponents
  + Production functions

**Topic 2. Operations Research Based Methods**

* + Nature of OR operations
  + Modeling OR problems
  + Decision theory
  + Decision making with uncertain demand
  + PERT?/Time, cost, critical path analysis

**Topic 3. Applications of Linear (L.) and Non-linear Programming (P) in Agribusiness**

* + Unconstrained maximization
  + Maximizing and minimizing subject to a constraint
  + The Lagrangian function
  + The simplex algorithm
  + Primal and dual problems of LP
  + Parametric programming
  + Whole farm programming
  + Sensitivity analysis

**Topic 4. Simulation and Risk**

* + Risk and uncertainty
  + Decision rules and the pay off matrix
  + Measuring risk and financial dimensions of risk
  + Methods of risk analysis and management for agribusiness firms
  + Probabilistic budgeting with simulation
  + Probability distributions in simulation

**Topic 5. Queuing Models**

* + Use of arrival rates and service rates
  + Queuing applications
  + Uniform arrivals and service times
  + Single and multi-channel
  + Queuing theory
  + Monte Carlo Approach

**Topic 6. Transportation Methods**

* + Methods of solving the transportation
  + Vogel’s approximating method
  + Stepping-Stone Method – using the Northwest Corner rule and inspection method
  + Modified distribution method (MOD)
  + Simplex Method of LP (Computer method)
  + Placement of orders on machines
  + Transportation application

**Topic 7. Inventory Control Models**

* + Functions performed by inventories
  + Inventory decisions
  + Inventory costs
  + Concept of average inventory
  + Economic order quantity
  + Quantity discounts
  + Reorder point and safer (Buffer) stock
  + Inventory and uncertainty

**Topic 8. Game and Strategies**

* + Two-person, zero-sum games
  + Mixed strategies and game values (2 x 2 games)
  + Mixed strategies and game values (3 x 3 and larger games) Limitations of game theory

**Topic 9. Forecasting and Prediction in Agribusiness**

* + Components of a time series in agribusiness
  + Smoothing methods in agribusiness
  + Trend and seasonal components and projections

1. **Mode of Delivery**

The course will be delivered through Lectures, exercises, assignments and a term paper. There will be 3 contact hours (2 lectures and 1 practical session) per week for the 15 weeks semester.

1. **Assessment Methods**

The course will be evaluated through assignments and continuous assessments (20%), term paper (30%) and the final examination accounting for 50% of the total marks.

1. **Course Materials**

*Required Texts*

* + Swarup, K., P.K. Gupta and M. Moham. 1997. *Operations Research*. Sultan Chand and Sons Educational Publishers.
  + Thierauf, Robert J. and Robert C. Klekamp 1975. *Decision Making through OperationsResearch*. New York. John Wiley and Sons.

**Further Readings**

* + Amemiya Takeshi. 1994. *Introduction to Statistics and Econometrics*. Harvard University Press.
  + Anderson, D.R., D.J. Sweeney and A.T. Williams. 2000. *An Introduction to ManagementScience: Quantitative Approaches to Decision Making*. Cincinnati: South Western CollegePublishing Co.
  + Anderson, J.R., J.L. Dillon and J.B. Hardeker. 1977. *Agricultural Decision Analysis*. Iowa:State University Press.
  + Beattie, B.R. and R. Taylor 1985. *The Economics of Production*. New York: John Wiley andSons.
  + Gupta, P.K. and D.S. Hira 1993. *Operations Research*. Millennium edition, Sultan Chandand Company Limited.
  + Hazell, P.B. and R.D. Norton. 1986. *Mathematical Programming for Economic Analysis inAgriculture.* New York: Macmillan Publishing Co.
  + Heerink, N., H.V. Keulen, M. Kuiper and H. Van Keulen 2002, Economic Policy andSustainable Land Use: Recent Advances in Quantitative Analysis for DevelopingCountries. Contributions to Economics. Springer-Verlag Telos.
  + Maddala G.S., P. Hammond, and A. Holly. 1986. Limited-Dependent and QualitativeVariables in Econometrics. Econometric Society Monographs. Cambridge University-Press.
  + Maddala, G.S. 2001, *Introduction to Econometrics*. John Wiley & Sons.
  + Mukherjee, C., H. White, H. ? and M. Wuyts, 1997, *Econometrics and Data Analysis forDeveloping Countries* UK: Taylor & Francis Ltd.
  + Sadoulete, E. and A. de Janvry 1991, *Quantitative Development Analysis*. Baltimore:

theJohns Hopkins University Press.

**CAER 5144: Microfinance and Small Business Management**

**Classification:** Elective **Number of Credits:** 3 **Semester:** 3

1. **COURSE OBJECTIVES**

The course will provide the learner with a thorough understanding of the principles and practices of planning and financing as a means towards new opportunities and greater financial rewards to start and successfully manage small enterprises. Specific objectives of the course are to:

* + Expose students to essential financial concepts and skills critical to the successful financing of the small enterprise.
  + Guide students on how to identify and evaluate small enterprise financing sources.
  + Expose students on how to develop effective financial sources.
  + Enhance application of fundamental enterprise analytical techniques for venture planning and development.

Enhance the use of fundamental financial ratios.

* + Develop an understanding of the factors affecting small enterprise financing and development.

1. **Expected Learning Outcomes**

At the end of the course, the students should be able to:

* + Understand and apply economic and financial principles in the context of microfinancing in respective countries
  + Summarize detailed research data into a concise business plan.
  + Guide groups and individuals on how to explore and exploit small business entrepreneurial opportunities
  + **Acquire f**inancial concepts and skills critical to the successful financing of the small enterprise.
  + To identify and evaluate small enterprise financing sources.
  + To develop effective financial sources
  + Apply fundamental enterprise analytical techniques for venture planning and development.
  + Use fundamental financial ratios.
  + Understand the factors affecting small enterprise financing and development.
  + Develop a business plan for a microfinance institution

Case studies, practical sessions are required to be able to apply the above in practice.

1. **Pre-requisites**

* Basic micro and macroeconomic principles
* Basic financial accounting skills
* Financial background and banking principles; and
* The ability to think strategically and assess a credit application

**4.Thematic Plan**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Contact hours | |  |  |  |
| Topic | Lecture | Seminar | Sub-  Total | Independent  Study | Total Hours |
| 1 Overview | 1 | - | 1 | 3 | 4 |
| 2 Financing needs and levels of business  Development | 2 | - | 2 | 6 | 8 |
| 3 Financial planning | 4 | 2 | 6 | 18 | 24 |
| 4 Financing agribusiness | 3 | 1 | 4 | 12 | 16 |
| 5.Microfinance for small enterprise development | 3 | 2 | 8 | 12 | 20 |
| 6 Microfinance institutions and markets | 4 | 1 | 5 | 15 | 20 |
| 7. Microfinance programmes and models for micro-enterprises | 5 | 2 | 8 | 12 | 20 |
| 8. Financial intermediation systems in Africa | 3 | 1 | 4 | 12 | 16 |
| 9. Constraints of lending to micro-enterprises | 2 | 1 | 3 | 9 | 12 |
| 10. Major contemporary issues in microfinance | 3 | 1 | 4 | 12 | 16 |
| 11.Economics of Entrepreneurship | 2 | 0 |  | 12 | 12 |
| 12.Information and Communication  Technology (ICT) and small businesses | 2 | 0 |  | 12 | 12 |
| TOTAL | 34 | 11 | 45 | 135 | 180 |

1. **Detailed Sescription of Topics**

**Topic 1. Overview**

* + Objectives and goals of a firm
  + Functions of microfinance owner – manager
  + Importance of microfinance in agricultural development
  + Overview of microfinance in developing countries

**Topic 2. Financial Needs of Micro-Enterprise**

* + Factors affecting financing methods
  + Finance needs and stage of enterprise development: - o Pre-start up stage o Start up stage o Growth stage

o Maturity stage

**Topic 3. Financial Planning**

* + Importance of competence in financial planning
  + Planning requirements
  + Planning assumptions and business plans
  + Assumptions
  + Planning for proactive management: balance sheet, forecast monthly sales, cash flow analysis, income statement, breakeven analysis
  + Performance analysis: financial ratio analysis
  + Business planning: uses and benefits, planning process, strategic planning, and components of a business plan.
  + Limitations of a business plan.
  + Understanding financial projections
  + Attracting shareholders.

**Topic 4. Microfinance for Small Enterprise Development (SED)**

. • Credit schemes for SED

. • The informal sector

. • Policies and regulations

**Topic 5. Microfinancing Agribusiness Ventures**

* + Factors affecting source of agribusiness microfinance
  + Financial infrastructure and its limitations
  + Sources of agribusiness microfinance
  + Finding equity capital for agribusiness
  + Debt capital in agribusiness
  + Alternative sources of agribusiness finance
  + Obtaining agribusiness capital
  + PrinInput financing (Contract Farming)

**Topic 6. Microfinance Institutions and Markets**

* + Informal microfinance institutions and markets
  + Linking informal and formal financial institutions in a global environment
  + Savings and credit

**Topic 7. Microfinance Programmes and Models**

* + Role of resource institutions
  + Changing role of institutions in implementing credit programmes
  + Designing gender sensitive microfinance
  + Models/approaches to microfinance **o** Minimalist credit model **o** Minimalist model based on existing groups **o** Minimalist individual credit models **o** Community based enterprises **o** Integrated models **o** Credit guarantee schemes **o** Social promotion **o** Village banking
  + Economic and social impact

**Topic 8. Financial Intermediation Systems in Africa**

* + General intermediation
  + Country specific systems (Case studies) Asterisk?

**Topic 9. Constraints of Lending to Micro-enterprises**

* + Collateral requirements
  + Attitudes and risk perception of lending institutions
  + Inadequate loanable funds – volume, supply and demand

**Topic 10. Major Contemporary Issues in Microfinance**  Review and conclusions on:

* + Delivery systems
  + Transaction costs
  + Interest rates
  + Credit guarantees
  + Loan recovery
  + Graduation to formal lending institutions
  + Impact of programmes and models.

**Topic 11. Economics of Entrepreneurship**

Foundations of entrepreneurship, convergence and cornerstone hypothesis, personal agency beliefs, locus of control, perceived self-efficacy, entrepreneurship and classical economics

**Topic 12. Information and Communication Technology (ICT) and small businesses** Mobile phones and microenterprises, Money transfers through mobile phones, extension through mobile phones.

1. **MODE OF DELIVERY**

The mode of delivery is class lectures, case studies, Presentations, and assignments**.** There will be 34 lecture hours and 11 seminar hours during the semester.

1. **ASSESSMENT METHOD**

Evaluation of students will be through continuous assessment tests and Precis , presentation:

* + Precis and Presentation (20%),
  + Test (30%)
  + Final exam (50%)

**8 Course Materials a) Required Textbooks**

* Copestake, J., S. Bhalotra and Susan Johnson. 2009. Assessing The Impact Of Microcredit On Poverty: A Zambian Case Study (access the electronic copy at http://www.sadhan.net/Adls/Microfinance/PerspectivePoverty/assessingtheimpact.p df ).
* Helms, Brigit. 2006. Access for all: Building Inclusive Financial Systems. CGAP, the World Bank, Washington DC (access the electronic copy at [http://www.cgap.org/gm/document1.9.2715/Book\_AccessforAll.pdf)](http://www.cgap.org/gm/document1.9.2715/Book_AccessforAll.pdf).
* Kuriloff, A.H. and J.M. Hemphill. 1999. *Starting and Managing the Small Business*. New York: McGraw-Hill.
* Sub-Saharan Africa 2009 Microfinance Analysis And Benchmarking Report (access the electronic copy at

[http://www.themix.org/sites/default/files/2009%20Africa%2](http://www.themix.org/sites/default/files/2009%20Africa%25)0Microfinance%20Analys is%20and%20Benchmarking%20Report.pdf).

**b) Further readings including journals**

* Harper, D.A. 2003. Foundations of Entrepreneurship and Economic Development. Routledge- Taylor and Francis: New York & London
* Adekunle B. 2011. Determinants of microenterprise performance in Nigeria.

*International Small Business Journal* 29(4): 360–373

* Aker, Jenny C. and Isaac M. Mbiti. 2010. “Mobile Phones and Economic Development in Africa.” Journal of Economic Perspectives. Summer 2010: 24(3): 207232.
* Abdi-Khalil Edriss. 2003. *Integrated Micro Credit Micro Enterprises and Market Reforms in Subsistence Economy: Experiences from Malawi*. Las Vegas: International Publishers and Press.
* Chaia, Alberto, Aparna DalalTony, Goland, Maria Jose Gonzalez, Jonathan Morduch and Robert Schiff.. 2009. Half the World is Unbanked. Financial Access Initiative Framing Note.
* Christian, R. and R. Rosenberg, 2000. ‘The Rush To Regulate: Legal framework for Microfinance’ Washington D.C. CGAP occasional paper No 4.
* Gonzalez – Veza, Claudio. 1998. Microfinance Apex Mechanisms: Review of the Evidence and Policy Recommendations, World Bank.
* Levine, Ross. 1997. Financial development and economic growth: Views and agenda. *Journal of Economic Literature.* Vol. XXXV: 688-726.
* Mosley Paul. 1999. Micro-Macro Linkages in Financial Markets: The Impact of Financial Liberalization on Access to Rural Credit in Four African Countries.
* Bhatt, Nitin and Shui Yan Tang, 2001. “Making Micro Credit Work in the United States: Social, financial and administrative dimensions,” Economic Development Quarterly Vol. 15 No. 3 pp 229 – 241.
* English, Philip and Georges Henault Eds. 1995. Agents of Change: Studies on the Policy Environment for Small something missing?

**CAER 5145 Agribusiness Marketing Management**

**Classification:** Elective **Number of credit hours:** 3 **Semester: 3**

1. **Course Objectives:**

The general objective of this course is to focus on the issues impacting on global food markets, marketing management principles, food quality, labelling and food safety, commodity marketing, processing and value adding, the role of supermarkets, their procurement strategies and contracting in Southern Africa, as well as intellectual property issues. The course will expose students to the principles and techniques used in marketing and in commodity marketing in a changing global, competitive and even hostile environment. It will focus on developing and developed marketing issues in the Southern African and global context.

1. **.Expected Learning Outcomes**

After completion of this course, studets are expceted to:

* Have acquired ability to think analytically and strategically in the field of strategic marketing, commodity marketing, processing and value adding, contracting and procurement strategies of supermarkets
* Apply sound marketing management principles to commodities and processed foods in agriculture
* Obtain a sound understanding of the global agricultural commodity markets
* Understand consumer behaviour in food markets
* Facilitate creative and innovative thinking in agribusiness marketing and in commodity markets
* Explain the evolution of supermarkets and retail markets in the modern agro food industry in the developed and developing markets
* Conduct competitor intelligence surveys in marketing
* Support the above concepts through exposure and case studies of the South African agrofood market
* Work effectively with others as a member of a team.
* Understand and conduct a consumer marketing survey.
* Understand the development of intellectual property.
* Understand certain merchandizing principles in food retail.
* Understand the principles and implications of contracting.

1. **Prerequicites:**

Microeconomics, Macroeconomics and Institutinal and behavioral economics

1. **Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Contact Hours |  |  |  |  |  |
| Topic | Lecture | Seminar | Practical/ Tutorial | Sub-  Total | Suggested  Hours of  Independent  Study | Total |
| 1. Introductionton to Global Food  Markets | 1 | - | - | 1 | 3 | 4 |
| 2. Understanding Marketing  Management | 4 | 2 | - | 6 | 18 | 24 |
| 3. Consumer Behaviour and  Marketing Research | 6 | 1 | - | 7 | 21 | 28 |
| 4. Marketing Management | 6 | - | 2 | 8 | 24 | 32 |
| 5. Risks in Agricultural Commodity  Marketing | 4 | 1 | - | 5 | 15 | 20 |
| 6. Marketing High Value and Agro-  Processed Foods | 4 | 1 |  | 5 | 15 | 20 |
| 7. Food Quality, Labeling and Food  Safety, Interlectual Property and Geographical Indicators | 3 | 1 |  | 4 | 12 | 16 |
| 8. Contract Growing and Marketing | 2 | 2 | - | 4 | 12 | 16 |
| 9. Case studies | 3 | 2 |  | 5 | 15 | 20 |
| Total | 33 | 10 | 2 | 45 | 135 | 180 |

1. **Detailed Discussion of the Topics**

**Topic 1: Introduction to Global Food Markets**

* + - Globalisation, as well as the trends and driving forces in the global food markets
    - Developments that have occurred in developing and developed countries
    - Global competition and food retail strategies
    - Principles of strategic marketing management;
    - Difference between Commodities and Products: Reasons for differentiation; and
    - Characteristics of agricultural production and its Influence on market perception and government policy

**Prescribed Material:**

* + - Brown, O. 2005. Supermarket Buying Power, Global commodity Chains and Smallholder Farmers in the Developing World, Human Development Report*.*
    - Heins, O. 2006. Top 30 Grocery Retailers in Africa & the Middle East, 2005, *Planet Retail*, Issue 180, 21 September.
    - Heins, O. 2006. South Africa: An active corner of the world, *Planet Retail*, Issue 185, 30 November.
    - Reardon, T. and Peter C. Timmer. 2005. PCT Transformation of markets for Agricultural Output in Developing Countries since 1950: How has thinking changed?,Chapter 13 in Evonson, R.E., Pingale, P. and Schultz, T.P. (eds), Vol. 3: *Handbook of Agricultural Economics: Agricultural Development: Farmers, Farm Production and Farm Markets* .

**Topic 2: Understanding Marketing Management**

* + - Dynamics and realities of marketing in the 21st century
    - Insights within marketing planning
    - Fundamental marketing concepts
    - Marketing management has changed
    - Marketing affects customer value

**Prescribed Material:**

* + - Kotler, P and K.L. Keller. 2012, Chapters 1 – 2

**Topic 3: Consumer Behaviour and Marketing Research**

* + - Marketing information system
    - Principles of marketing research
    - Customer value, satisfaction and loyalty
    - Theory of consumer behaviour in the food marketing context
    - Global and local food consumption environment, and the implications of these trends.
    - Principles of market segmentation on a theoretical level, as well as through practical examples within the South African consumer market (e.g. LSM market segmentation tool).

**3.2 Prescribed Material:**

* + - Kotler, P and K.L. Keller. 2012. Marketing Management*,* 14th edition, Prentice-Hall, Chapters 3-6.
    - BFAP Baseline ( August 2011) Background information and presentations on the SAARF Living Standards Measure, [www.saarf.co.za](http://www.saarf.co.za/)  South African Agricultural Outlook, BFAP Baseline, August 2011
    - Loureiro,M.L. and W.J. Umberger, 2007. A choice experiment model for beef: What US consumer responses tell us about relative preferences for food safety, country-oforigin labelling and traceability. *Food Policy*, 32, 496–514

**Journals and Other Periodicals**

Students are encouraged to read articles relevant to agricultural marketing in the following journals:

International Food and Agribusiness Review

American Journal of Agricultural Economics

Journal of Agricultural Economics

The Economist

Harvard Business Review

**Topic 4: Marketing Management The aim is for the student to:**

* + - Understand the principles and driving forces involved in marketing
    - Develop a compelling value proposition and creating value for customers
    - List the principles of strategic management in marketing
    - Conduct a competitor analysis
    - Understand what marketing management is and the principles thereof
    - Capture marketing insights
    - understand the concept of consumer relationship management, loyalty and service  Build strong brands
    - Know how to shape the market offerings for consumer markets
    - Analyse business markets
    - Deliver and communicate value to customers
    - Create sustainable long-term growth

**Topic 5: Risks in Agricultural Commodity Marketing**

* + - Innovative approaches for managing risks in agricultural commodity marketing
    - Credit and price risk management issues using systematic and operational procedures to conduct strategic analyses of the agribusiness organization/firm/agency.
    - Impact of risk on financing in the commodity market with specific reference to warehouse receipts **Prescribed Material:**
    - Scott, Nigel. 2003. *Agribusiness and Commodity Risk: Strategies and Management, Risk* Books, London. (Chapter 1 and 2)

**Topic 6: Marketing High Value and Agro-Processed Foods**

* + - marketing agricultural and food products in developing countries
    - The principles of value adding/ processing/ packaging
    - The potential role of cooperatives/ producer organisations, etc
    - Transaction Costs, Risk and the organization of the Private Sector Food Commodity System in Africa **Prescribed Material:**
    - Jaffe, S and John Morton . 1995. *Marketing Africa’s High Value Foods, (Chapters 1-2),* World Bank, Washington
    - Mather, C. 2005. SMEs in South Africa’s Food Processing Complex: Development Prospects, Constraints and Opportunities. *TIPS,* Working paper 3: 2005.

**Topic 7: Food Quality, Labelingand Food Safety, Interlectual Property and Geographical Indicators**

* + - Trends in quality driven differentiation of markets and products
    - Implications of quality trends in the evolution of agro-food systems globally and locally
    - Institutionalization of food quality in Africa: current status of quality and food safety related certification and labelling
    - Intellectual property with specific reference to Geographical indications and its impact on food labelling.
    - Development of quality assurance systems.

**Prescribed Material:**

* + - Babcock, Bruce A. 2003.‘Geographical indications, property rights and value-added agriculture, *Review Paper (IAR),* vol. 9, no. 4, pp. 1-3.
    - Goodman, D. 2003. The quality ‘turn’ and alternative food practices: reflections and agenda, *Journal of Rural Studies*, 19: pp. 1-7. (Reading of other papers from this special issue is recommended).
    - Ponte, S and P. Gibbon 2007. Quality standards, conventions and the governance of Global value chains, *Economy and Society*, vol. 34, no. 1, pp.1-31.
    - Raynolds, LT. 2004, The globalization of Organic Agro-food Networks*, World*

*Development,* vol. 32, no. 5, pp. 725-743.

* + - Trienekens J.H. and P.J.P Zuurbier. 2008. Quality and safety standards in the food industry, developments and challenges, *International Journal for Production Economics*, 113 (1), 107-122

**Topic 8: Contract Growing and Marketing**

More and more agricultural contracts are used in the marketing of agricultural produce. This section explores the nature and extent of these contracts.

* + - Principles and importance of contract growing in agriculture
    - Potential of contract growing at different levels in agribusiness
    - Contract growing alternatives
    - Positives and negatives of contract growing in Africa

**Readings**

* + - Eaton, C, and A.W. Shepherd. 2001. Contract farming. Partnerships for growth, *FAO Agricultural Services Bulletin,* no. 145, Rome.(Updated version)
    - Pultrone C, CA da Silva and A. Shepherd. 2012. Guiding Principles for responsible contract farming operations. FAO, Rome
    - Sartorius, Kurt, Johann Kirsten. 2006. Contracts and contract farming as potential mechanisms to improve market access for Black farmers in South Africa.
    - Vermeulen, H,, K, Sartorius and J. Kirsten 2004. Changing agribusiness procurement practices and the future of small scale farmers in South Africa. Potential of contract farming as a mechanism for the commercialization smallholder agriculture in Southern Africa Research Programme.

www.fao.org

**Mode of Delivery Lecturing**

The division of the teaching load is between lecturers according to fields of expertise. The style of lecturing is co-operative and student-centred learning. PowerPoint slides cover the formal study material. Lectures are in a computer room to encourage interaction between students and students and lecturer.Adequately referenced study material is available in the textbooks, the study guide and on the department’s website.

**7. Course Evaluation**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Two written assignments |  | 25% |
|  | Two class tests |  | 25% |
|  | Final Examination |  | 50% |

**CAER 5146: Strategic Management in Agribusiness**

1. **COURSE OBJECTIVE**

The modern agribusiness industry includes commercial farmers, businesses providing them with supplies and services, businesses adding value to farm products and those businesses that facilitate the marketing of agricultural products to an ever-growing marketplace. This sector is continuously facing new challenges including technological developments in production and manufacturing processes, heightened environmental concerns and increased nutritional awareness throughout the community. The overall objective of this course is to generate students’ understanding of the stratergic decision points and instruments for efficient and effective management of food and agribusiness firms from a top managerial perspective. The course will enable students to actively use the principles and techniques of strategic management to explain the global, ever changing, competitive and even hostile environment.

1. **EXPECTED LEARNING OUTCOMES**

After completing the course, the learner should be able to:

* + Relate strategic goals of the organization and policies
  + Define major stratergic phases, deliverables and decision gates
  + Strategic options along the agribusiness value chains
  + Use **Strategic direction and Leadership in Agribusiness** to develop practical, realistic managemnet of the firms

1. **PREREQUISITES** 
   * Agribusiness management **4. Thematic Plan**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Time (in Hours) | |  |  |  |  |
| Topic | Lectures | Seminar | Practical | Sub-  Total | Independent Study | Total |
| 1 Strategic Management process in  Agribusiness | 2 |  |  | 2 | 0 | 2 |
| 2. Strategic direction and Leadership in  Agribusiness | 2 |  | 1 | 3 | 5 | 8 |
| 3. Corporate governance and strategy | 4 | 2 |  | 6 | 15 | 21 |
| 4. Internal and External Environmental analysis for Agribusiness Competitiveness | 3 |  |  | 3 | 5 | 8 |
| 5 Strategy formulation: long-term goals and generic strategies | 2 |  |  | 2 | 5 | 7 |
| 6. Strategy formulation: grand and functional strategies for an Agribusiness | 5 | 2 | 1 | 8 | 25 | 33 |
| 7. Aligning strategy with industry life cycle in  Agribusiness | 4 |  |  | 4 | 15 | 19 |
| 8. Strategic analysis and choice in Agribusiness | 4 | 1 | 1 | 6 | 25 | 31 |
| 9. Structural Drivers and Instruments for Strategy implementation and Change  management | 5 | 1 |  | 6 | 20 | 26 |
| 10. Continuous improvement through strategic control and evaluation | 5 |  |  | 5 | 20 | 25 |
| Total | 36 | 6 | 3 | 45 | 135 | 180 |

**5. Detailed Description of Topics**

**Topic 1: Strategic Management process in Agribusiness Learning outcomes:**

* + Understand the definition and explanation of strategic management.
  + Identify the people involved in strategic management and explain what strategy planning champions are.
  + Differentiate between qualitative and quantitative decisions.
  + Understand the strategic management process as well as strategic visualisation.
  + Strategic management concepts and techniques for non-profit or non-for-profit organisations.
  + Difference between revenue sources for profit-seeking and not-for-profit organisations.
  + Identify the constraints on strategic management for not-for-profit organisations.

**Mandatory Readings:**

* + Ehlers, T & Lazenby, J.A.A.: Chapter 1
  + Source Book: Chapter 17

**Topic 2: Strategic direction and Leadership in Agribusiness**

**Learning outcomes:**

* + Distinguish between the great leader view and the great groups view of strategy.
  + Know the components of strategic leadership.
  + Discuss the six leadership tasks that are emerging as priorities. Understand and apply strategic intelligence.

**Readings:**

 Ehlers, T and J.A.A. Lazenby. Date ? Title ? : Chapter 2. Publisher and place ?

**Topic 3: Corporate governance and strategy**

**Learning outcomes:**

* + - Define the terms “responsible leadership”, “sustainability” and “corporate citizenship”.
    - Define “corporate governance.”
    - Explain how corporate governance related to corporate citizenship, sustainability and responsible leadership.
    - Explain what the agency problem is and how it relates to corporate governance.

**Readings:**

 Ehlers, T and J.A. Lazenby A.Date ? Title ? : Chapter 3. Publisher and place ?

**Topic 4: Internal and External Environmental analysis for Agribusiness**

**Competitiveness**

**Learning outcomes:**

* Discuss the importance and challenge of internal and external environmental analysis.
* Apply SWOT analysis and explain its importance in environmental analysis
* Identify all the important resources and capabilities in an organisation and discuss their importance in the resource-based view with regard to internal environmental analysis.
* Describe and identify what an industry is and how to do an industrycompetitive analysis by using Porter’s model.
* Describe value chain analysis as a method for performing environmental analysis.
* Understand the scope and dynamics of the global business arena.
* Distinguish between globalisation and “glocalisation”.
* Identify the various strategic orientations of a global firm.
* Identify global Competitiveness and the Cost of Doing Business  Understand the strategy and organisation on international business

**Mandatory Readings:**

* Ehlers, T and J.A.A**.** Lazenby. Date ? Title ?: Chapter 4, 5 and 6.
* Ernst & Young (2010) Business Redefined: A look at the global trends that are changing the world of business.
* Hingley, M.K, P.R. Custance and K.E. Walley. 2006. Competition within United Kingdom agri-food chain. *Harper Adams University College, Newport, Shropshire.*  United Kingdom: 1-14.
* \*Kirsten, J.and F, Abdulrahman. 2007. The impact of market power and dominance of supermarkets on agricultural producers in South Africa.  *Report commissioned by the National Agricultural Marketing Council.*
* Revell B J. And X, Liu. 2006. Chain management challenges and market power in the Chinese fresh produce sector - *Paper presented at the 7th International Conference on Management in AgriFood Chains and Networks, Ede, The Netherlands*
* Reardon T. and A. Gulati. 2008. The Supermarket Revolution in Developing

Countries - Policies for “Competitiveness with Inclusiveness” *IFPRI Policy Brief 2 June 2008*

* Sodano, V. 2006. A power-based approach to the analysis of the food system - *Paper presented at the 7th International Conference on Management in AgriFood Chains and Networks, Ede, The Netherlands, 31 May – 2 June, 2006*
* USAID. 2011. Global Competitiveness.Publisher and place?

**Topic 5: Strategy formulation: long-term goals and generic strategies**

**Learning outcomes:**

* Define long-term goals and discuss the requirements that they should meet in order to be used effectively in the strategic management process.
* Explain what competitive advantage is.
* Understand how capabilities contribute to competitive advantage.
* Discuss the generic strategies identified by Michael Porter and illustrate with practical examples how these strategies can contribute to the attainment of competitive advantage for an organisation.

**Readings:**

* Ehlers, T and J.A.A. Lazenby Date ?: Title ?Chapter 6. Publisher and place ?
* \*Boehlje, Michael: Gray, W. Allan.and Joshua. D. Detre, 2005. Strategy Development in a turbulent business climate: concepts and methods. *International Food & Agri-businessManagement Review*, Volume 8 (2): 21-40.

**Topic 6: Strategy formulation: grand and functional strategies for an Agribusiness Learning outcomes:**

* Explain the relationship between Porter’s generic strategies and grand strategies.
* Discuss the grand strategies that organisations can pursue to achieve their longterm objectives, with specific reference to the circumstances under which each strategy would be appropriate.
* Illustrate with practical examples how each of the grand strategies is implemented by organisational environment.
* Explain what a combination of strategies entails.  **Readings:**
* Ehlers T and J A A. Lazenby. Strategic Management, Chapter 7 .
* Author? Date? Source Book : Chapters 17 and 18.

**Topic 7: Aligning strategy with industry life cycle in Agribusiness**

**Learning outcomes:**

* + Understand the importance of the industry life cycle when doing an external environmental analysis.
  + Identify the strategies applicable to organisations in emerging markets.
  + Apply your knowledge in the identification of strategic options for competing in turbulent high-velocity markets.
  + Understand the strategies for competing in mature markets. **Readings:**

 Ehlers T and J A A. Lazenby. Date? Strategic Management, Chapter 8 .

**Topic 8: Strategic analysis and choice in Agribusiness Learning outcomes:**

* + Discuss the strategy analysis framework.
  + Implement the SWOT Matrix
  + Implement the SPACE Matrix
  + Implement the Grand Strategy Matrix
  + Implement the Quantitative Strategic Planning Matrix (QSPM) **Readings:**

 Ehlers T and J A A: Lazenby. Date? Strategic Management, Chapter 9 Publisher and Date?

**Topic 9: Structural Drivers and Instruments for Strategy implementation and Change management Learning outcomes:**

* + - Understand the significance of strategy implementation.
    - Differentiate between strategy formulation and strategy implementation.
    - Assess strategy implementation as a component of the strategic management process.
    - Examine the problem of and barriers to successful strategy implementation. Evaluate leadership, organisational culture and reward systems as drivers for strategy implementation.
    - Describe the relationship between corporate governance, leadership, organisational culture and reward systems.
    - Analyse and discuss the use of organisational design as a driver for strategy implementation.
    - Realise and evaluate the importance of resource allocation as a driver for strategy implementation.
    - Apply and discuss the role of short term goals, functional tactics and policies as instruments for strategy implementation.

**Readings:**

* + Ehlers T. and J A A. Lazenby. Strategic Management, Chapters 10-12.
  + Author? Date? Source Book : Chapters 22 – 26. Publisher and place.

**Topic 10: Continuous improvement through strategic control and evaluation Learning outcomes:**

* + Understand and discuss strategic control as a component of the strategic management process.
  + Describe the different types of strategic control.
  + Design a strategic control system.
  + Comment on the value of the role of the balanced scorecard in strategy implementation and control.

**Readings:**

* + Ehlers T and J A A. Lazenby. Date? Strategic Management, Chapter 13. Publisher and place?
  + Cardemil-Katuaric, Gustavo and Shadbolt, Incola. 2004. *The Balanced Scorecard as a spontaneous framework in an agricultural hybrid cooperative under strategic change: A case study in the New Zealand kiwifruit industry.* Massey University, Palmerston North
  + Rawlings K. M., W.J. Parker and N. M. Shadbolt. 2000*.* The Applicability and Use of the Balanced Scorecard for the Farm Manager. *Australian Agri-FoodResearch Forum, Melbourne*, August 17

**Topic 11: Strategic management in not-for-profit organisations Learning outcomes: ?**

1. **MODE OF DELIVERY** 
   1. **Teaching method**

A problem and solutions driven approach to learning will be followed. Studentcentred and co-operative learning and teaching methods will be applied during lectures. Students will be expected to compile a Strategic Plan for a relevant business/ industry/ country. Case studies will be used as well as high level senior managers of established agribusinesses. Field visits will also be conducted to agribusinesses.

* 1. **Practical and key transferable skills**

Agribusiness Management will provide students with the skills necessary to successfully manage an agribusiness enterprise through the exposure obtained as set out above. Assignments on relevant topics will also be given and presented to the class. This will stimulate the development of communication and interpersonal skills and group dynamics**.**

* 1. **Case Studies**

Case studies on agribusiness will be provided with relevant questions. These are done in groups. The purpose is to apply relevant techniques to the case given and present it in a satisfactory form.

Annual reports of selected agribusinesses will also be discussed. These are included in the CD given.

1. **ASSESSMENT METHODS**

In order to achieve the objectives, attendance of and meaningful participation during lectures is essential. Furthermore, students are advised to embark on a wellstructured and systematic study programme, in which the module material is studied in a probing, scientific and innovative manner, rather than by simple and passive memorizing.

The course consists of four components:

* + - Lectures
    - Assignments (Strategic planning, etc.)
    - Seminar and/or practical’s
    - Case studies

Evaluation will be done formally by means of tests and an examination, class discussions, assignments and seminars. The distribution of marks will be as follows:

* + - Continuous test/ assignments/case studies 10%
    - Term test 20%
    - Term paper assignment (Strategic plan) 20%
    - Final written examination 50%

***Haramaya University***

***School of Animal and Range Sciences***

M Sc in Dairy Technology

*Collaboration with the University of Copenhagen, Technical University of Denmark and Christian Hansen A/S*

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**Course Profile**

**Course Distribution**

Table 1: Distribution of courses semester wise

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S. No | Course code | Course title | | Credit hours |
| **First Year First Semester** | | | | |
|  | DaTe 511 | | Introduction to Dairy Technology | 3 |
|  | DaTe 521 | | Dairy Microbilogy | 3 |
|  | DaTe 531 | | Dairy development policy and trade (E) | 2 |
|  | DaTe 541 | | Microbiology of Fermented Food and Beverages | 3 |
|  | DaTe 551 | | Research Methods & Experimental Design | 3 |
|  | DaTe 571 | | Food quality and safety Management (E) | 2 |
|  | DaTe 581 | | Seminar in Dairy Technology I | 1 |
| **Total** | | | | **13/17** |
| **First Year Second Semester** | | | | |
|  | DaTe 512 | | Milk processing | 4 |
|  | DaTe 522 | | Dairy Product Technology | 4 |
|  | DaTe 532 | | Dairy processing and Equipment | 3 |
|  | DaTe 562 | | Milk in Human Nutrition (E) | 2 |
|  | DaTe 572 | | Dairy Business and Entrepreneurship (E) | 2 |
|  | DaTe 582 | | Seminar in Dairy Technology II | 1 |
|  | **Total**  **Second year** | | | **12/16** |
|  | DaTe 611 | | Seminar in Dairy Technology III | P/F |
|  | DaTe 621 | | MSc Thesis Research | 6 |

**Course Description**

**DaTe 511: Introduction to Dairy Technology (3)**

**Course objective**

* To enable the students to understand the basic principles and application of technologies in dairy sciences and to introduce them to basic principles dairy chemistry and microbiology.

**Course description**

This course will focus on Basic dairy chemistry; Basic dairy microbiology (microbiology of raw milk and dairy products); Quality assurance of raw material and product; Basic dairy processing: Fluid milk products, Fermented milks, Cheese, Butter, Powder, Cleaning and hygiene.

**Teaching and learning Methods**

The course is based on a series of e-learning modules from Dairy Technology program of Copenhagen University. It integrates literature studies, exercises relating to theory and case studies. E-modules are on-line learning activities which can be either questions, assignments or discussions. E-learning includes on-line discussion fora in which students interact to construct knowledge. Criteria for successful completion of each e-learning module will be defined for each module and will be based on active participation in discussions, completion of individual assignments, group work and questionnaires. Students will get feedback on their performance.

**Description of Examination:** Students will be assessed on basis of:

1. Successful completion of e-modules throughout the course (questionnaires, assignments and discussions). This accounts for 50% of the final grade.
2. A final exam conducted via internet (estimated workload 12 hours). The exam will be structured as an individual written assignment which must be completed within 48 hours. This accounts for 50% of the final grade.

Organization of Teaching: Internet based e-learning modules where all exercises are web-based. Students can follow the course from anywhere in the world, however, internet access and a webcam are required.

Professor Richard Ipsen, Copenhagen University Dairy Technology group head, is responsible for this e-learning course.

**Course Literature**

Walstra, P., Wouters, J.T.M and Geurts, T.J. (2006) 'Dairy Science and Technology', 2nd Ed, CRC Press, London.

**DaTe 521: Dairy Microbiology (3)**

**Course objective**

* To equip students with the basic principles and identification of dairy microbiology and their roles in dairy industry.

**Course description**

The course will contain lectures on: Microbiology of raw milk, market milk, cream, butter, concentrated and dried milk, fermented milk, cheese, and ice cream. Sweet dairy products microflora; Pathogenic and spoilage microflora; Primary (Lactic acid bacteria) and secondary (Yeasts, molds, propionibacterium, red smear microflora, LAB ripening cultures) starter cultures microflora; Bacteriophage and bacteriophage resistance; Role of starter culture physiology on growth and end products (aroma formation, proteolysis, glycolysis, amino acid catabolism); Non-starter lactic acid bacteria, adjunct cultures and their role in cheese ripening.

**Laboratory exercises will include:**

Raw milk microflora; Characterization of microflora in fermented dairy products using culture and culture independent techniques; Detection and propagation of bacteriophages from dairy products; Influence of starter culture propagation conditions on starter composition and activity.

**Course Literature**

S. Salminen, A. Von Wright, and A. Ouwehand. Lactic Acid Bacteria, Microbiological and

functional aspects. 3rd. ed.

Marcel Dekker 2004 (selected chapters)

Reviews and Original literature

**DaTe 531: Dairy development policy and trade (2) (E)**

**Course objectives**

* To equip students with the knowledge and skill of the current global dairy policy and trade as well as Ethiopian dairy policy and trade

**Course description**

Dairy development policy and trade will cover global and national dairy policies that make the country to participate in international dairy trade and what are the barriers and obstacles that made the country lag behind; ways to fit to international dairy policies; requirement for international trade of dairy products; livestock policy and trade, milk and milk products trade and policy; quality assurance of dairy and dairy products to meet international requirements

**Delivery methods:**

* Lecture, group work, term papers and presentations, case study

**DaTe 541: Microbiology of Fermented Food and Beverages (3)**

**Course objective**

* To equip students with basic knowledge and skill of microbiology of fermented foods and beverages including those made from milk and dairy products; roles and types of microorganisms in manufacturing of variety of fermented foods and beverages.

**Course Content**

The course will have major focus on the microorganisms involved in the processing of various fermented food and beverages. The course will deal with the taxonomy of important microorganisms such as lactic acid bacteria (LAB), other starter bacteria, yeasts and moulds including both phenotypic characteristics and molecular typing techniques for their identification. Methods for isolation including both culture and culture in-dependent techniques will be covered. This will include techniques such as DGGE, RT-PCR and high through put sequencing as well as various tools for bioinformatics. Various fermentation techniques will be introduced covering the use of starter cultures, growth yield and fermentation techniques such as back-slopping. Natural and controlled fermentation; An introduction to various fermented foods and beverages will be given including products such as cheese, bread, wine and beer as well as a number of traditional indigenous fermented foods. Focus will additionally be on microbial interactions including topics such as quorum sensing, bacteriocin formation etc.

**Teaching and learning Methods**

Lectures, theoretical and laboratory practicals. The lectures will introduce issues of importance for the understanding of microbial behavior during production of fermented food and beverages. The theoretical and laboratory practical’s will give the student practice on how to identify various microorganisms and how to use various methodologies within molecular biology.

**DaTe 551: Research Methods and Experimental Design (3)**

**Course objectives**

* The objectives of this course is to understand and practice research methods relevant to dairy technology and experimental design employed to conduct research in the field as well as analysis and interpretation of collected data and information.

**Course description**

Probability and probability distribution. Sampling and sampling distribution, testing of hypothesis based on z, t and chi-square and F distribution. Models and analysis of variance, assumptions of analysis of variance and their tests, alternatives in case of failures of assumptions. Correlation, linear regression and related tests. Rank and intra-class correlation, partial correlation, multiple regression and associated tests. Non linear regression. Principles of experimental design, C.R.D., R.C.B.D., Split plot, Latin square designs, incomplete block designs. Factorial experiment. Confounding and transformation. Matrix and generalised inverse of matrices. Regression models, variance component estimation, illustrative examples from dairy sciecne and technology experiments.

**Delivery method**

* Lecture, assignment, home take assignment, developing research proposal and experimental design.

**DaTe 571: Food quality and safety Management (2) (E)**

**Course objectives**

* After completion of this course students will be able to understand and decribe principles of food quality and safety that is fundamental for supply of safe and wholesome food including dairy food products to consumers.

**Course description**

This course has been designed to provide graduates with an insight into measures that are required to provide a supply of safe and wholesome food to consumers. A wide spectrum of food safety and quality management issues will be addressed following the 'farm to fork' approach. Topics covered include: good governance and national control systems; food inspection and testing services; legislation and private standards; and management of food safety and quality within the supply chain as well as in hotels and restaurants. Students gain an understanding of safety and spoilage characteristics of a range of commodities and food products. They also acquire knowledge of the design and implementation of food safety management systems based upon the 'Hazard Analysis Critical Control Point' concept.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment

**DaTe 581: Seminar in Dairy Technology I (1)**

**Objective**

* To enable students acquire skill of writing review artices, presenting and defending in the presence of students and instructors

**Course description**

Supervised study on advanced topics in Dairy Technology or related topics that are not discussed in the program and the title should be approved by the SGC. Critical review of current research publicatins in dairy technology. Students present seminars based on literature review so that they are exposed to the methodology of preparation and presentation of scientific papers.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment

**DaTe 512: Milk Processing (4)**

**Course objective**

* To enable students to acquire knowledge, skill and attitude about quality milk production, physical chemistry of milk processing, effect of heat treatment and separation processing.

**Course description**

The course primarily deals with milk production and functionality of milk constituents. **Milk production:** Influence of housing and feeding regime, Milking and its influence on raw milk quality, Organic production of milk, Feed quality and legislation, Animal ethics in dairy production,

The physical chemistry of milk processing: Milk as a colloidal system (physical-chemical aspects), the effect of heat treatment on milk, Separation processes (chromatographic techniques, ion exchange), the effects of homogenization on milk. **Functionality of milk constituent:** Solubility, Interfacial properties, Gelation properties, Functional milk fat, Uses of lactose and minerals, Health functionality/bioactivity.

**Teaching and learning Methods**

The course is based on a series of lectures and tutotials providing an overview of milk quality and processing. Laboratory practical’s dealing with aspects of milk as a colloidal system and milk protein functionality are also included.

**Course Literature**

Fox, P.F. & McSweeney, P.L.H. 1998: Dairy Chemistry and Biochemistry, Blackie Academic & Professional

**DaTe 522: Dairy Product Technology (4)**

**Course objectives**

* To enable students to acquire the basic and advanced dairy processing technology with detail theoretical and practical knowledge and skill as well as attitudes.

**Course description**

The course is an advanced dairy technology course and level of knowledge equivalent to the course 'Introduction to dairy technology' is expected. The course 'Milk processing' is recommend before taking this course. This covers fluid milk products: pasteurized milk and cream products, including flavoured milks, UHT milk and other dairy products, Recombined milk, Fermented milks, effect of fermentation on milk components, Structure formation in acidified milk gels, Processing of specific fermented milks. **Cheese:** Milk treatment for cheese making, renneting of milk, production of different cheese types, ripening of cheese. **Dried and concentrated milks:** Influence of processing on the properties of condensed milks, milk powder, dried whey products and caseinates. **Butter and dairy spreads:** Treatment of cream, Processing of cream into butter and spreads, Properties of final products. **Ice cream:** Ingredients and their influence, Ice cream mix, Processing and freezing of mix, Properties of final ice cream.

**Teaching and learning Methods**

The course consists of lectures as well as project work in the dairy pilot plant and laboratory. A number of lectures will be given by people from industry. The projects involve production of various products as well as analysis of the produced products. Excursions to dairy plants, organizations and manufacturers of equipment will also take place. This will be organized by Copenhagen University Dairy technology Group head Professor Richard Ipsen.

**Course Literature**

Lecture notes and scientific papers form the curriculum of the course.

Walstra, P., Wouters, J.T.M. and Geurts T.J. (2006) 'Dairy Science and Technology', CRC Presss, London, as textbook (available as ebook from LIFE's library).

**DaTe 532: Dairy Processes and Equipment (3)**

**Course objective**

* To enable students to acquire knowledge and skill about process and equipment with applications with dairy industry.

**Course description:**

Processes and equipment with applications specific to the dairy industry (e.g. equipment for homogenization, specialised heating processes, membrane filtration, cheese production, drying, freezing, slicing, dicing and shredding). The rheological properties of fluids and viscoelastic materials in dairy processing are also covered. The content concentrates on understanding the individual dairy process components and on dairy process equipment with respect to obtaining optimal processes and desired product characteristics.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment

**DaTe 562: Milk in Human Nutrition (2) (E)**

**Course objectives**

* To equip students with the knowledge, skill and attitude about the role of milk in human nutrition

**Course description**

The course is designed to impart understanding of literatures and problem solving on the fundamentals of human nutrition. Students will be able to understand the role of milk and dairy products in human nutrition. They will also be able to understand the knowledge in designing of nutritious foods processing, nutrition counselling, health promotion and prevention of diet related disorders. They will also understand and apply the knowledge and skill to solve problems of macro-and micronutrient related deficiencies and disorders with emphasis on the role of dairy products to correct nutritional deficiencies.

The course cover planning of balanced diet; Process of digestion and absorption; Digestion and absorption of major nutrients and their metabolism; Energy balance; Evaluation of daily energy requirement; Vitamins; Minerals; Water; Nutritional deficiency disorders and their prevention; Protein-energy malnutrition (caloric requirements in growth and development); Nutrition education and the nutrition policy including Ethiopian nutrition policy; and Topics on current food nutrition trends for infants, children, adults and elders.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment, case study

**DaTe 572: Dairy Business and Entrepreurship (2) (E)**

**Course objective**

* To equip students with the knowledge, skill and attitude about dairy industry business and financial management

**Course description**

Basic management principles applied to dairy technology, industrial organizational control and management, entrepreneurship principles and application in dairy technology, dairy plant design, facilities, layout, inventory control and records, planning, budgeting; financial management indairy industry.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment, case study

**DaTe 582: Seminar in Dairy Technology II (1)**

Supervised study on advanced topics in Dairy Technology or related topics that are not discussed in the program and which must be approved by the SGC. Critical review of current research publications in dairy technology. Students present seminars based on literature review so that they are exposed to the methodology of the preparation and presentation of scientific papers.

**DaTe 611: Seminar in Dairy Technology III (P/F)**

For this Seminar students will present their thesis research work result to senior academic staff and postgraduate students mainly to get feeeddback for the bettermnet of their thesis before the final open thesis defence. The thesis quality and standard will also be evaluated. This will help the students to get valuable comments and suggestions before the actual thesis defence.

**DaTe 621: MSc Thesis Research (6)**

The graduate student undertakes an independent original research on a topic relevant to Dairy Technology under the supervision of a major advisor in the field of study. The topic and plan of study is to be determined by the student and his advisor, and approved by School Graduate Council. The research is designed to include thesis presentation and open defense as a partial requirement for the MSc degree.

*School of Animal Sciences*

**M.Sc. in Animal Genetics and Breeding**

*1.4. Distribution of Courses by Year and Semester*

**Year I; Semester I**

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**Course Code Course Title Credit Hours**

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ANGB 511 Animal Genetic Resources and Conservation 2

ANGB 521 Reproductive Physiology 3

ANGB 531 Animal Genetics 4

ANGB 541 Biometrics 4

ANPR 511 Animal Nutrition (E) 3

ANPR 521 Animal Physiology (E) 3

AGEC 561 Computer Applications (E) 3

**Total 13/22**

**Year I; Semester II**

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**Course Code Course Title Credit Hours**

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ANGB 512 Population Genetics 2

ANGB 522 Quantitative Genetics 3

ANGB 532 Biotechnology in Animal Breeding 2

ANGB 542 Applied Animal Breeding 3

ANGB 552 Current Topics in Animal Genetics and Breeding 1

ANPR 522 Meat Production (E) 3

ANPR 532 Milk Production (E) 3

ANPR 552 Poultry Production (E) 3

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**Total 11/20**

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(E) Elective course: Each semester one of the ANPR elective course is compulsory depending on the species of animals on which thesis is based

**Year II**

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**Course Code Course Title Credit Hours**

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ANGB 611 Seminar in Animal Genetics and Breeding P/F

ANGB 612 M.Sc. Thesis Research 6

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*Course Description*

**ANGB 511 Animal Genetic Resources and Conservation (2)**

Evolution & history of domestication of livestock. Livestock population & development trend in the country & the world. Animal genetic resources of indigenous breeds. Necessity & principles of characterizing, documenting & assessing the diversity. Techniques for analysis & characterization. Genetic erosion: natural & artificial. Extincting & endangering species. Collection & conservation of animal genetic resources–*in situ* & e*x situ*. Utilization of animal genetic resources. National & international patenting & laws.

**ANGB 521 Reproductive Physiology (3)**

Reproductive systems- male and female reproductive systems of cattle, sheep, goat, equines and poultry. Reproductive process - oestrus cycle, ovigenesis spermatogenesis, fertilisation, implantation, pregnancy, gestation and parturition. Artificial insemination - semen collection and processing, evaluation of sires based on semen quality. Altering the reproductive process: synchronisation, super ovulation and embryo transfer technology. Oestrus control and controlled breeding. Reproductive failure–genetic, anatomical and physiological causes. Reproductive efficiency- recent advances in improving the reproductive efficiency. Evaluation of reproductive efficiencies in male and female livestock.

**ANGB 531 Animal Genetics (4)**

Eukaryotic chromosomes-ultra structure, number & replication. Karyotyping & identification. Chromosomal aberration with special reference to fertility, production & health of farm animals. Application of Cytogenetics to livestock improvement. Biochemical basis of heredity-DNA, RNA & their replication, protein synthesis. Gene structure, expression & regulation of expression. Molecular basis of replication of genes, mutation & development.

**ANGB 541 Biometrics (4)**

Probability and probability distribution. Sampling and sampling distribution, testing of hypothesis based on z, t and chi-square and F distribution. Models and analysis of variance, assumptions of analysis of variance and their tests, alternatives in case of failures of assumptions. Correlation, linear regression and related tests. Rank and intra-class correlation, partial correlation, multiple regression and associated tests. Non linear regression. Principles of field experimentation, C.R.D., R.C.B.D., Split plot, Latin square designs, incomplete block designs. Factorial experiment. Confounding and transformation. Different animal models used in analysis of variance. Analysis of non orthogonal animal data, planning of animal experiments. Matrix and generalized inverse of matrices. Regression models, variance component estimation, illustrative examples from animal science experiments.

**ANPR 511 (E)[[2]](#footnote-2) Animal Nutrition (3)**

See in Animal Production Graduate Program

**ANPR 521 (E) Animal Physiology (3)**

See in Animal Production Graduate Program

**AGEC 561 Computer Applications (E) (3)**

See in Agricultural Economics Graduate Program

**ANBG 512 Population Genetics (2)**

Genetic nature of differences between the groups at population level; dynamic population, large random mating population. Application and extension of equilibrium law- multiple alleles, sex linked genes and two or more loci. Factors that change gene frequency. Small population - effects of sampling and inbreeding. Ideal and effective population. Values and means- population mean, average effect, breeding value, dominance and interaction deviations.

**ANGB 522 Quantitative Genetics (3)**

Polygenic inheritance and continuous variation. Variance-components and partitioning of variance. Resemblance between relatives. Genetic parameters and methods of their estimation in farm animals. Genetic and environmental correlation. Selection methods- direct selection, indirect selection, simultaneous selection for more than one trait. Construction of selection index and index selection. Selection for specific and general combining ability and for threshold traits. Correlated response, Selection response and experimental results in livestock. Mating systems -inbreeding and out breeding. Genetic and physiological basis of inbreeding depression and heterosis. Results of breeding programs in farm animals.

**ANGB 532 Biotechnology in Animal Breeding (2)**

Molecular technology- finger printing techniques to graphically characterise individual DNA. Restricted Fragment Length Polymorphism. Methods of gene isolation. Insertion of foreign DNA and gene transfer. Evaluation and dissemination of transgenics in animal production. Polymorphism- biochemical and DNA polymorphism in variation analysis and parentage determination. Quantitative trait loci. Marker genes. Methods of gene mapping and analysis. Marker assisted selection and breeding. Embryonic manipulation– splitting, cloning and sexing of embryo. Promoting twin and multiple offsprings. Embryonic stem cells and their use in Animal Breeding.

**ANGB 542 Applied Animal Breeding (3)**

Constraints in livestock breeding in tropics in relation to -Environment, Production Systems and Socio-economic condition. Reproduction, fertility, sterility and their genetic basis. Growth, milk, eggs and meet production and their genetic basis. Field and modern recording systems for growth, egg, milk, meat production and their application. Native breeds performance, scope and methods of improvement. Introduction of improved exotic breeds- choice of breed, selection criteria, interpretation of performance records of different countries. Precautions and procedure of importation. Breeding plans for tropics- production environment, objective, traits, structure, organisation, peoples participation and constraints. Village breeding schemes. Group breeding program. Nucleus herd breeding. New breed formation. Hereditary defects. Breeding for disease resistance, heat tolerance and adaptation.

**ANGB 552 Current Topics in Animal Genetics and Breeding (1)**

Supervised study on advanced topics of current importance in Animal Breeding or related topics that are not discussed in the program and which must be approved by the DGC. Students present seminars based on library research so that students will be exposed to the methodology of the preparation and presentation of scientific papers.

**ANPR 522 (E) Meat Production (3)**

See in Animal Production Graduate Program

**ANPR 532(E) Milk Production (3)**

See in Animal Production Graduate Program

**ANPR 552(E) Poultry Production (3)**

See in Animal Production Graduate Program

**ANGB 611 Seminar in Animal Genetics and Breeding (P/F)**

Progress report on thesis research presented in the form of a seminar.

**ANBR 612 M.Sc. Thesis Research (6)**

Research conducted by graduate students under the advice of graduate faculty on national priority problem areas in animal breeding to culminate in M.Sc. Thesis.

**M.Sc. in Animal Production**

*Distribution of Courses by Year and Semester*

**Year I; Semester I**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Course Code Course Title Credit Hours**

ANPR 511 Animal Nutrition 3

ANPR 521 Animal Physiology 3

ANPR 531 Biochemistry 3

ANGB 541 Biometrics 4

ANRM 511 Forage Production and Range Management 3

AGEC 561 Computer Applications (E) 3

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**Total 16/19**

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**Year I; Semester II**

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**Course Code Course Title Credit Hours**

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ANPR 512 Feed Evaluation and Budgeting (E) 2

ANPR 522 Meat Production 3

ANPR 532 Milk Production 3

ANPR 542 Farm Animal Diseases and Management (E) 3

ANPR 552 Poultry Production 3

ANPR 562 Current Topics in Animal Production 1

ANGB 542 Applied Animal Breeding 3

PHTC 642 Processing of Animal Product (E) 2

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**Total 13/20**

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***(E****) Elective course: At least one elective course must be taken during the second semester.*

**Year II**

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**Course Code Course Title Credit Hours**

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ANPR 611 Seminar in Animal Production P/F

ANPR 621 MSc. Thesis Research 6

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*Course Description*

**ANPR 511 Animal Nutrition (3)**

Concept of food chain. Nutritional quality of feed staff. Refractory and inhibitory substances in livestock feed. Environment and forage quality. Anatomy, function and microbes of rumen and lower gut. Kinetics of digestion and metabolism. Intermediary metabolism. Regulation of nutrient utilization for various animal products. Nutrient specification and least cost ration for different classes of livestock. Voluntary intake and its regulation. Unconventional feeds. Biotechnology for enhancement of nutritive value and utilization of nutrients. Technology of complete feed production and feed conservation. Feed crises mitigation, animal performance and forage supply.

**ANPR 521 Animal Physiology (3)**

Physiology of circulatory, digestive, respiratory, urinary, neuro-muscular, and reproductive systems of important domestic animals. The direct and indirect effects of physical factors on physiological process and productivity of animals. Bio-climatic effect on growth, production and reproduction of livestock. Fluid and electrolyte balance, acid-base balance. Thermoregulation, acclimation and acclimatisation to different environmental conditions. Analysis of mechanisms of adaptation to direct and indirect environmental stress of animals.

**ANPR 531 Biochemistry (3)**

Animal cell, ultra structure of the cell, cell membrane, structure and function of biomolecules (protein-hemoglobin; lipids-membranes; carbohydrate-peptidoglycans; etc.). Metabolism, (carbohydrate, protein, lipid); including photosynthesis and organ specialisation. Integration of carbohydrate, protein and lipid metabolism and regulation. Vitamins, enzymes, coenzymes and mineral metabolism. Biosynthesis of macromolecules. Rumen metabolism. Fate of different nutrients in the rumen. Milk synthesis. Metabolic diseases (ketosis, milk fever, pregnancy toxaemia etc.).

**ANGB 541 Biometrics (4)**

See in Animal Genetics and Breeding Graduate Program

**ANRM 511 Forage Production and Range Management (3)**

See in Rangeland Ecology and Management Graduate Program

**AGEC 561 Computer Applications (E) (3)**

See in Agricultural Economics Graduate Program

**ANPR 512 Feed Evaluation and Budgeting (E)(2)**

Methodology for the evaluation of feed resources; assessment of nutritive value through chemical analysis, degradability tests, digestibility, feeding and production trials; the Weende (Proximate) analysis method; the detergent (Van Soest) method of analysis; other analytical procedures used in the determination of feed components; the estimation of nutritive value from chemical analysis data; the estimation of digestibility; and the summative system; recent advances in feed analysis and prediction of nutritive value. Feed Budgeting-estimation and forecasting of requirement; conservation, preservation and storage of feed and fodder. Feeding during scarcity and drought period.

**ANPR 522 Meat Production (3)**

Diversity of meat sources and consumption; description and evaluation of various meat production systems. Constraints for improvement of meat production in tropics. Improvement through range, feedlot, nutrition, management and breeding of cattle, camel, sheep and goat. Physical evaluation of slaughter animals. Carcass and meat characteristics and quality evaluation. Meat as a product and factors affecting meat. Live animals, meat and meat product trade and marketing

**ANPR 532 Milk Production (3)**

Milk production - national and international situation. Role of cattle, Camel, Goat and Sheep. Milk production systems in the tropics. Recent practices of optimising immunocompetency of young stock, growth rate and puberty. Pre and post parturition practices to maximise reproduction and milk production. Principles of replacement and culling. Housing, equipment and management in warm climate. Modern milking management- milking method, milk quality, handling and marketing. Maintenance of herd health and productivity. Small and large scale commercial dairying- project proposal, establishment and expansion. Administration- technical and financial records. Efficient utilization of land, labour, feed and fodder. Technical and financial evaluation of dairy enterprise.

**ANPR 542 Farm Animal Diseases and Management (E)(3)**

General epidemiology chains of disease, the aetiology, source and route of infection, ways and means of disease transmission and ways of exit and impact on the host. Aetiology, epidemiology, symptoms, diagnosis, prevention and control of external and internal parasite of farm animals with a special focus on ticks, mites, insects, helminthes and protozoa of tropical importance. Infectious diseases of farm animals caused by bacteria, virus and rickettsia, zoonotic diseases of public health importance. Non-infectious disease prevention and control. Health management programs in extensive and intensive farming systems; biotechnological advances in diagnosis and prevention of livestock diseases

**ANPR 552 Poultry Production (3)**

Current issues and prospects of commercial layer and broiler poultry farms in tropics. Physiology of egg formation and oviposition. Hatching eggs and hatchability. Hatchery equipment, operation, incubation and hatchery management. Commercial scale management of chicks, replacement pullets, layers and broilers. Environment, housing, equipment and waste management. Components of poultry feed, nutrient requirement and monitoring of feed. Health management - control of poultry diseases and parasites. Poultry breeding, record keeping, production of parental stock and hybrids, Chick sexing and grading. Egg as a product- quality, grading processing and marketing. Broiler birds - marketing live and processed birds. Economics of egg and broiler meat production.

**ANPR 562 Current Topics in Animal Production (1)**

Supervised study on advanced topics of current importance in Animal Production or related topics that are not discussed in the program and which must be approved by the DGC. Students present seminars based on literature review so that they are exposed to the methodology of the preparation and presentation of scientific papers.

**ANGB 542 Applied Animal Breeding (3)**

See in Animal Genetics and Breeding Graduate Program

**PHTC 642 Processing of Animal Products (E) (2)**

See in Postharvest Technology Graduate Program

**Animal product processing description**

|  |  |  |
| --- | --- | --- |
| **Department of Postharvest Technology & Food Science and Technology**  **College of Agriculture**  **HaramayaUniversity** | | |
| **Module Number** | **5 Animal Food Science and Technology** | |
| **Rationale and objective of the module** | The objectives of this module is to impart the scientific basis and technological principles and practices of animal origin foods (dairy, meat, egg and fish) processing into various shelf- stable, value added, nutritious, safe and cost effective foods and by-products; and to orient the student on literature based problem solving to be a leader and technology developer in the animal origin food technologies. | |
| **Total CP of the module** | **7** | |
|  | | |
| **Courses of the Module** | | |
| **Course Number** | **Course Name** | **CP** |
| **FSTC 632** | Dairy Science and Technology | **4** |
| **FSTC 642** | Meat Science and Technology | **3** |

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| **Department of Postharvest Technology & Food Science and Technology**  **College of Agriculture**  **HaramayaUniversity** | | | | | |
| Course Number | FSTC 632 | | | | |
| **Course Title** | **Dairy Science and Technology** | | | | |
| Degree Program | M.Sc in Food Science and Technology | | | | |
| **Module** | **5 Animal Food Science and Technology** | | | | |
| Module Coordinator | N.N. | | | | |
| Lecturer | N.N. | | | | |
| ECTS Credit Points | 4 | | | | |
| Contact Hours (per week) | Lectures | Tutorials &  Seminars | Laboratory | Home Study | Total |
| 3 | 0 | 3 | 2 | 8 |
| Course Objectives & Competences to be Acquired | The course is aimed to acquaint students with Market Milk Industry, processing of milk and milk products, Quality, food safety, Sanitation and CIP system related to dairy equipments in order to build up confidence in students so they may start their entrepreneurship. | | | | |
| Course Description/Course Contents | * Market Milk Industry: Introduction, Definition, Advancements, Safe guarding milk supply, Clean milk production, Cooling and transportation of milk, Cleaning and sterilization of dairy equipments, Judging and grading of milk, Flavor defects in milk, their causes and prevention. * Physico-chemical properties of milk and its constituents: Definition, composition, function and importance of fat, protein, lactose, minerals, vitamins and enzymes. Physical properties of milk: Color, Specific gravity, Freezing point, Viscosity, Surface tension, Refractive index, Red ox-Potential, Specific heat, Specific conductance. * Fermentation: Definition, Importance, Types role of fermentation in fermented dairy products, Lactic acid fermentation, Citric acid fermentation, Prop ionic acid fermentation, Butyric acid fermentation, Acetic acid fermentation and anaerobic fermentation. * Starter culture technology: Definition, Types, requirements, classification, propagation, maintenance and preservation techniques. * Manufacture of yoghurt: Definition, Classification, Propagation of yoghourt cultures, Manufacture of different types of yogurt, recent developments in yogurt technology, Biochemical changes during manufacture and storage of yogurt, Defects and their remedies. * Cheese: Definition, Principles of cheese making, Classification, Basic steps in cheese making, Manufacture of Cheddar cheese, Cottage cheese and Mozzarella cheese. Additives in cheese making, defects in cheese, their causes and prevention. * Butter: Definition, classification, composition, methods of manufacture, Theories, Packaging, Storage, Over-run, losses in butter making, Judging and grading, Defects in butter, their causes and Prevention, * Ice cream: Definition, classification, Composition, Role of constituents, Method of manufacture, Packaging, Hardening, Storage, over run in Ice-cream, Defects in Ice-cream, their causes and prevention. * Cleaning and Sanitation of dairy plant: Importance, Definitions, Detergents, Sanitizers, Functions of constituents in cleaning and   Sanitization, CIP system, Cleaning procedure of dairy  equipments.  **Practical:**   * Sampling of milk and milk products * Determination of quality control tests –Fat %, Specific gravity, COB test, Alcohol test etc. * Determination of titrable acidity of milk and cream * Separation pf cream * Manufacture of Yogurt and Cheddar cheese * Visit to Dairy Processing Plant. | | | | |
| Pre-requisites | - | | | | |
| Semester | 2nd | | | | |
| Status of Course | Compulsory | | | | |
| Teaching & Learning Methods | lectures, tutorials, lab exercises and assignments | | | | |
| Assessment/Evaluation &Grading System | - written (mid-semester examination-35%;Final examination-45% and  Practical-20%)  - Continuous assessment on practical- 20%   * Seminar presentation, 10%   Laboratory records-10% and laboratory exam10% | | | | |
| Attendance Requirements | 80% | | | | |
| Literature | *References*  Walstra,P., Geurts, T.J.,Noomen,A., Jellema,A and Van Boekel,M.A. 1999. Dairy Technology. Marcel Dekker In., New York.  Sukumar De 2001. Outlines of Dairy Technology, New Delhi: OxfordUniversity Press.  Robinson,R.K. 1993. Modern Dairy Technology.Blakie Academic and Professional,London  Abstracts  Food Science and Technology Abstracts (FSTA); CAB International; Biological and Chemical Abstracts; Science Citation Indexes  Journals  Journal of Dairy Research; Journal of Dairy Science; Journal of Food Biotechnology; Journal of Food Processing and Preservations; Journal of Food Protection; Journal of Food Science;  and review of other relevant journals. | | | | |
| Date approved by senate |  | | | | |

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| --- | --- | --- | --- | --- | --- |
| **Department of Postharvest Technology & Food Science and Technology**  **College of Agriculture**  **HaramayaUniversity** | | | | | |
| Course Number | FSTC 642 | | | | |
| **Course Title** | **Meat Science and Technology** | | | | |
| Degree Program | M.Sc. in Food Science and Technology | | | | |
| **Module** | **5 Animal Food Science and Technology** | | | | |
| Module Coordinator | N.N. | | | | |
| Lecturer | N.N. | | | | |
| ECTS Credit Points | 3 | | | | |
| Contact Hours (per week) | Lectures | Tutorials &  Seminars | Laboratory | Home Study | Total |
| 2 | 0 | 2 | 2 | 6 |
| Course Objectives & Competences to be Acquired | The objective this course is to impart the scientific and technological principles and practice of meat, poultry, fish and egg processing into various shelf- stable, value added, nutritious, safe and cost effective foods and by-products; and to orient the student on literature based problem solving to be a leader and technology developer in the meat food technologies. | | | | |
| Course Description/Course Contents | Meat, poultry, fish and egg technology   * Meat, poultry, fish and egg processing and equipment. * Meat emulsion, curing, dehydration and fermentation technology * Preservation and storage. Packaging. Legislation. Quality control and hygiene. * Effect of processing on the nutritional value of meat products. Practical work: Manufacturing of dried, cured, fermented and emulsion type products. * Visits to processing factories.   Practical   * Sampling of meat and meat products * Determination of meat quality * Various meat preservation practical techniques * Meat sausage processing practical * Visit to meat Processing Plant. | | | | |
| Pre-requisites | - | | | | |
| Semester | 2nd | | | | |
| Status of Course | Compulsory | | | | |
| Teaching & Learning Methods | Lectures, Laboratory exercisesandassignments | | | | |
| Assessment/Evaluation & Grading System | - written (mid-semester examination-35%;Final examination-45% and  Practical-20%)  - Continuous assessment on practical- 20%   * Seminar presentation, 10%   Laboratory records-10% and laboratory exam10% | | | | |
| Attendance Requirements | 80% | | | | |
| Literature | *References*  Kerry J. and Leward D. 2002, Meat Processing; Improving Quality, Woodhead Publishing, Cambridge, UK  Hui Y.J, Nip W.K Rogers R. Yuog O.A 2001, Meat Science and Applications, Marcel and Dekker Inc. New York  Abstracts  Food Science and Technology Abstracts (FSTA); CAB International; Biological and Chemical Abstracts; Science Citation Indexes  Journals  Journal of meat science, journal of meat technology, Journal of Food Biotechnology; Journal of Food Processing and Preservations; Journal of Food Protection; Journal of Food Science;  and review of other relevant journals. | | | | |
| Date approved by senate |  | | | | |

**ANPR 611 Seminar in Animal Production (P/F).**

Progress report on thesis research presented in the form of a seminar.

**ANPR 612 M.Sc. Thesis Research (6)**

Research conducted by graduate students under the advice of graduate faculty on national priority problem areas in Animal Production to culminate in M.Sc. Thesis.

**MSc Curriculum Range Ecology and Biodiversity”**

***Course Breakdown by year and semester***

**Year I: Semester I**

|  |  |  |  |
| --- | --- | --- | --- |
| **SN** | **Course Code** | **Course title** | **Cr. Hr.** |
| **1.** | REBD 511 | Range Feed Resources Characterization and Forage Development | 3 |
| **2.** | REBD 521 | Range Ecology and Management | 3 |
| **3.** | REBD 531 | Pastoralism and Livestock Production Systems | 2 |
| **4.** | REBD 541 | Biodiversity Conservation and Management | 3 |
| **5.** | REBD 551 | Ecological Methods and Designs | 3 |
| **6.** | REBD 561 | Plant Taxonomy (E) | 2 |
| **7.** | REBD 571 | Wildlife Ecology and Management | 2 |
| **8.** | REBD 581 | Ecological Economics (E) | 2 |
|  | **Subtotal** | | **16/18/20** |

E = Elective course, and MSc students can register to one elective course per semester

**Year I: Semester II**

|  |  |  |  |
| --- | --- | --- | --- |
| **SN** | **Course Code** | **Course title** | **Cr. Hr.** |
| **1.** | REBD 512 | Restoration Ecology | 3 |
| **2.** | REBD 522 | Sustainable Land and Watershed Management | 3 |
| **3.** | REBD 532 | Current Topics in Range Ecology and Biodiversity | 1 |
| **4.** | REBD 542 | Climate Change Adaptations and Mitigations in Rangelands | 2 |
| **5.** | REBD 552 | GIS and Remote Sensing | 2 |
| **6.** | REBD 562 | Plant (Feed), Soil and Water Analysis | 2 |
| **7.** | REBD 572 | Fire Ecology and Management (E) | 2 |
| **8** | REBD 582 | Political Ecology and Natural Resource Management (E) | 2 |
|  | **Subtotal** | | **13/15** |

**Year II**

|  |  |  |  |
| --- | --- | --- | --- |
| **SN** | **Course Code** | **Course title** | **Cr. Hr.** |
| **1.** | REBD 611 | Seminar in Rangeland Ecology and Biodiversity | P/F |
| **2.** | REBD 612 | M.Sc. Thesis Research | 6 |
|  | Subtotal |  | 6 |

**Course Descriptions**

**REBD 511: Range Feed Resources Characterizations and Forage Development (3 Cr. Hr.)**

**Course Descriptions:** Characterizations of available feed resources under various agro-ecological zones in Ethiopia; Constraints of Livestock productions; the need of improved (cultivated) pasture species (grasses; herbaceous and tree legumes) in the farming systems; difference between native and improved grasslands; the potential and role of forage production; major taxonomic classifications of pasture plants; relationships between forage quantity, quality and maturity versus animal output; production versus forage utilization; procedures of improved pasture crops introduction and evaluation procedures; Most important and adaptable forage crops (cereals, grain legumes, forage grasses, forage legumes, trees/shrub legumes) in various agro-ecologies of Ethiopia; factors affecting the yield (biomass) and nutritional qualities of pasture crops; biological potential and economical viability of grass: legume associations; methods and strategies of pasture establishment and utilization under smallholder conditions in Ethiopia; principles and procedures of forage seed production.

**REBD 521: Range Ecology and Management (3 Cr. Hr.)**

**Course Descriptions:** Principles of range and grassland sciences, geographical distribution of grassland and rangelands worldwide; rangeland management paradigms such as the concept of rangeland success theory, range condition and trend analyses, rangeland equilibrium, disequilibrium theories and stable states and transition models, range and grassland population, community and ecosystem ecology, interaction between plant – animal – and soil under the influence of biotic and abiotic factors, nutrient cycling (island of fertility) in rangelands, effect of trees/shrubs and herbaceous/grass species on rangeland vegetation dynamics, causes and mechanisms of bush encroachment in semi-arid rangelands.

**REBD 531: Pastoralism and Livestock Production Systems (2 Cr. Hr.)**

**Course Descriptions:** Historical perspectives of pastoralism in Ethiopia and worldwide, types of pastoral livelihoods (nomadism, transhumance, sedentary pastoralism), trends of pastoral livelihoods at present and in the future, indigenous knowledge in pastoral systems for the management of rangeland resources (grazing lands), water and livestock, conflict resolution and management; communal grazing management systems in Ethiopia and eastern Africa; Concept, characterization and classifications of livestock production systems in the tropics and in Ethiopia to develop viable opportunities for sustainable livestock agriculture and natural resource management, socio-economics of commercial (group ranches) and pastoral livestock productions systems in Ethiopia and other parts of the world (e.g. Kenya, Australia); constraints of livestock production; evolution and future pathways of livestock production system in relation to human population and land use changes; extension approaches on livestock and rangeland technologies in dryland areas.

**REBD 541: Biodiversity Conservation and Management (3 Cr. Hr.)**

**Course Descriptions: C**oncepts of biodiversity and its importance, characterization of biodiversity at genetic, species and ecosystem level, threats and loss of biodiversity and its impact, conservation biology, biodiversity conservation tools and techniques: (*in-situ and ex-situ*); management plan for biodiversity conservation, biodiversity resource assessment techniques, the role of local people in biodiversity conservation (local knowledge and its importance in biodiversity conservation), conservation incentives and incentive provision approaches, community participation and levels of participation in biodiversity, convention on the biological diversity ( the significance of the conventions, major contents of the convention, intellectual property right, significance of CBD for biodiversity owners), policy and institutional aspect in biodiversity conservation, major biodiversity resources of Ethiopia and Biodiversity conservation strategy and challenges of Ethiopia

**REBD 551: Ecological Methods and Designs (3 Cr. Hr.)**

**Course Descriptions: A**spects of sampling design, methods and sampling procedures, field investigations and analysis of ecological field data on plants, animals, and their environment, appropriate choice and application of statistical techniques for the analysis of ecological data; sample size estimation; sampling procedures and methods of vegetation and wildlife; the logical structure of an experiment; experimental designs commonly used in ecological research; special issues about pseudoreplications; fixed and random factors in ecological and rangeland research, data explanation and some common cases in which statistics are misapplied; spatial and temporal pattern measurement of populations; multivariate analysis of communities.

**REBD 561: Plant Taxonomy (E) (2 Cr. Hr.)**

**Course Descriptions:** Basic and contemporary taxonomic and systematic principles and methods as applied to plants, including classification, identification skills, molecular approaches, and surveys of important families of plants; field identification, plant morphology, principles of classification and taxonomy, and concepts in evolutionary research, nomenclature, phylogenetics, and morphological evolution, historical and contemporary botany. Students are expected to achieve the following objectives after successfully completing the course: describe a plant using botanical terms, identify a plant using the key mechanics, name and publish a new species, recognize large and common families of plants, interpret plant relationships depicted on phylogenetic trees with proper terms, exhibit basic knowledge in molecular approaches applied to systematics, demonstrate knowledge in the current understanding of angiosperm phylogeny and evolution.

**REBD 571: Wildlife Ecology and Management (2 Cr. Hr.)**

**Course Descriptions:** Concepts and principles of wildlife ecology and explores the application of those principles to the management and conservation of wildlife species. Topics covered will include: wildlife population analysis, population estimation methods, population dynamics and regulation, population models, animal behavior, wildlife ecosystem and its productivity, habitat use, methods of range assessment and evaluation, carrying capacity, efficient management of wildlife population and the rangeland, process of wildlife losses and threats, wildlife management types, species interaction, the relation between human and wildlife, principles, wildlife-livestock-people interface, community participation, conservation-development linkages, livelihood analysis, stakeholders in conservation of wildlife, conflict management, types of wildlife conservation, wildlife harvest and economics and policy of wildlife.

**REBD 581: Ecological Economics (E) (2 Cr. Hr.)**

**Course Descriptions:** Exhaustible and non-exhaustible natural resources, stock and flow of non-exhaustible natural resources, determination of prices of natural resources, the economics of use of natural resources and ecosystem services, rangeland and biodiversity resources utilization in dry land ecosystems, the demand for rangeland resources and its environmental quality, the sources of rangeland problems, causes, effects and consequences of rangeland degradation on pastoral livelihoods and sustainable development, environmental externalities in arid and semi-arid rangeland ecosystems, principles and techniques of impact assessment in rangeland areas, rangeland and biodiversity conservation strategies, policies and law.

**REBD 512: Restoration Ecology (3 Cr. Hr.)**

**Course Descriptions:** Concepts of land degradation and desertification in global and local context; causes, effects and consequences of land and vegetation degradation on economic, social and sustainable development; assessment methodology of degradation; principle and essence of ecosystem restoration; ecological attributes of restored ecosystems; types of ecological restoration; concepts of holistic ecological restoration; guidelines for developing and managing ecological restoration projects; challenges in restoration ecology; methods and practices of restorations of degraded ecosystems; restoration of various degraded ecosystems; community involvement in the management of restoration areas; the roles of soil micro-organisms and soil seed banks in ecological restoration.

**REBD 522: Sustainable Land and Watershed Management (3)**

**Course Descriptions**: Approaches and components of rangeland and watershed management, Relationship of soil and vegetation; soil survey; water and wind erosion; surface water hydrology and movement; managements of rangelands for the conservation of biodiversity and sustainable development, soil conservation practice; grazing land management strategies, watershed management; regional requirements for water; ground water resources; runoff measurement; construction of ponds or reservoirs; water quality standards; perennial and seasonal sources; organization and management of supplies; water development; energy and water use in pastoral systems; land use planning.

**REBD 532: Current Topics in Rangeland Ecology and Biodiversity (1 Cr. Hr.)**

**Course Descriptions**: Supervised study on advanced topics of current importance in Range Ecology and Management or related topics that are not discussed in the program and which must be approved by the DGC. Students present seminars based on literature review so that they are exposed to the methodology of the preparation and presentation of scientific papers.

**REBD 542: Climate Change Adaptation and Mitigation in Rangelands (2 Cr. Hr.)**

**Course Descriptions:** Typical features of dryland ecosystems; patterns of rainfall and temperature in arid and semi-arid rangeland ecosystems; relationship of rainfall and vegetation growth, biomass and nutritional quality; impacts of drought on rangeland vegetation (herbaceous species and wood vegetation), livestock population and production; recovery of vegetation and livestock population and productivity after the onset of drought; drought and indigenous livestock species; typical features of disequilibrium ecosystems in relation to rainfall variability and temperature; impacts of rainfall variability and grazing regimes on growth, survival and extinction of grass species; relationship of climate change and invasive species and bush encroachment; pastoralists adaptation, coping and mitigation strategies under changing climate.

**REBD 552: GIS and Remote Sensing (2 Cr. Hr.)**

**Course Descriptions:** Principles of remote sensing (electromagnetic radiation, spectral signatures, atmospheric effects; brightness, temperature); characteristics of satellite images; resolution of satellite data (spatial, spectral and temporal considerations); visual and digital image interpretation and analysis; Remote sensing application in natural resources and environmental management; mapping of forests, crops, water body, soils, minerals and rangeland. Geographical information systems; basic components of a GIS; GIS software: Database management system, cartographic (mapping), computer aided design, image processing, digitizing programs, contouring and surface modeling; and geographical entities. Data format: digital databases, maps (topographic and thematic maps); raster and vector data; rational databases. GIS data input, analysis, display and management (validation and editing); sources of error and error management; New trends in GIS; evolution of polar orbiting and geostationary satellites; data processing capability. Principles of aerial photography and aerial surveillance: airborne videography and use of aircraft for agricultural purposes.

**REBD 562: Plant (Feed), Soil and Water Analysis (2 Cr. Hr.)**

**Course Descriptions:** It is based on field and laboratory activities consisting of sample collection, drying, and storage for laboratory analysis, determination of physical (texture, particle size and bulk densities, porosity, field capacity, permanent wilting point, and available water holding capacity), chemical (Soil pH, electrical conductivity, exchangeable acidities, organic matter content, total nitrogen, available phosphorus, available potassium, exchangeable bases, cation exchange capacity, and micronutrients) and biological properties of soil samples, analysis and determination of chemical composition (DM, CP, ether extract, fiber fraction, macro and micro nutrients) and *in-vitro* digestibility of feed resources and plant parts. The course also includes analyses of water for various macro – and micro nutrients.

**REBD 572: Political Ecology and Natural Resource Management (E) (2 Cr. Hr.)**

**Course Descriptions:** Protection rangeland resource and biodiversity in dryland areas of Ethiopia; regulation and policies of pastoral and communal grazing lands; Communally owned vegetation (forests) in rangeland ecosystems; establishment of the national parks (wildlife parks) and protected areas in rangeland ecosystems; the conservation of wildlife and aquatic resources in rangeland areas; use rights for rangeland resources, ownership, scientific management, decision making, community-based approaches, governance, sustainability, and professionalism; integrated land use planning for proper grazing land management, conservation of biodiversity (water, wildlife and fish, vegetation) in rangeland and protected areas in Ethiopia and eastern Africa.

**REBD 582: Fire Ecology and Management in Rangelands (E) (2 Cr. Hr.)**

**Course Descriptions:** Distribution and ecology of fire worldwide and in Ethiopia, principles of fire ecology in rangelands, fire behavior, cause, effects and consequences of fire in rangeland vegetation, soil, livestock and biodiversity, prescribed fire in rangelands, the use of fire in rangeland vegetation dynamics and bush encroachment, the relationships of fire with vegetation growth, production (biomass) and nutritional quality, international and national policies in relation to wild and prescribed fire.

**REBD 611: Seminar in Range Ecology and Biodiversity (P/F)**

**Course Descriptions:** Progress report or part of the MSc thesis research presented in the form of a seminar.

**REBD 612: M.Sc. Thesis Research (6 Cr. Hr.)**

**Course Descriptions:** Research conducted by graduate students under the advice of the graduate faculty on national priority problem areas in the field of Rangeland Ecology and Biodiversity to culminate in M.Sc. Thesis.

**M. Sc in Animal Nutrition**

*Distribution of Courses by Year and Semester*

**Year I; Semester I**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Course Code Course Title Credit Hours**

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AGEC 561 Computer applications (E) 3

ANGB 541 Biometrics 4

ANPR 521 Animal Physiology 3

ANPR 531 Biochemistry 3

ANRM 511 Forage Production and Range Management 3

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**Total 13/16**

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**Year I; Semester II**

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**Course Code Course Title Credit Hours**

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ANNT 512 Monogastric Nutrition 3

ANNT 522 Ruminant Nutrition 3

ANNT 532 Feed Processing Technology 3

ANNT 542 Feed Evaluation and Feeding Standards 2

ANPR 552 Poultry Production (E) 3

ANPR 522 Meat Production (E) 3

ANPR 532 Milk Production (E) 3

ANNT 552 Current Topics in animal nutrition 1

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**Total 12/21\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(E) = Elective course: Students are required to take at least two elective courses

**Year II**

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**Course Code Course Title Credit Hours**

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ANNT 611 Graduate Seminar 1

ANNT621 MSc Thesis Research 6

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**Total 7**

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*Course Description*

**AGEC 561 Computer Applications (3) (E)**

See Agricultural Economics Graduate Program

**ANGB 541 Biometrics (4)**

See Animal Genetics and Breeding Program

**ANPR 531 Biochemistry (3)**

See Animal Production Program

**ANPR 521 Animal Physiology (3)**

See Animal Production Program

**ANRM 511 Forage Production and Range Management (3)**

See in Range Ecology and Management Graduate Program

**ANNT 522** **Ruminant Nutrition (3)**

The ruminant and its environment; anatomy and function of ruminant GIT; microbes in the gut; voluntary feed intake, rumen fermentation of carbohydrates, nitrogen, lipids and products; kinetics of rumen function; methanogenesis, effects and control; interrelations between feeding and productivity of ruminants; Nutritional disorders in ruminants.

**ANNT 512 Monogastric nutrition (3)**

Comparative gastro-intestinal digestion and metabolism of nutrients in poultry, pig, horse, and rabbit; measurement of energy value; energy requirement; role of protein quality and requirements; role of vitamins, mineral, enzymes feed additives for monogastrics; feed resources and formulation of rations for monogastric animals; feeding methods for the different classes of poultry, pig, horse and rabbit.

**ANNT 532 Feed Processing Technology (3)**

Definition, procurement, storage and care of raw materials, identification of feed adulterants, methods of feed processing (chemical, physical, biotechnological); feed preservation techniques (silage making hay making etc.); preserving roots and tubers; formulation of least cost rations; feed laws and regulations; quality control of raw and finished products.

**ANNT 542 Feed Evaluation and Feeding Standards (2)**

Classification, feed value and properties of foodstuffs, feed conservation and feed analysis, (Proximate, Van Soest); digestibility studies (*in vitro, in situ, in vivo* techniques), factors influencing feed composition and quality, problems of feed storage and feed planning; biotechnology in improving nutritive value.

**ANNT 552** **Current Topics in Animal Nutrition (1)**

Supervised study on advanced topics of current importance in animal nutrition or related topics that are not discussed in the program.

**ANPR 522 Meat Production (E)(3)**

See in Animal Production Graduate Program

**ANPR 532 Milk Production (E) (3)**

See in Animal Production Graduate Program

**ANPR 552 Poultry Production (E)(3)**

See in Animal Production Graduate Program

**ANNT 611** **Graduate Seminar (1)**

Presentation of a seminar on current topics related to the thesis research by preparation and delivery using visuals including overheads, slides, posters, and computer generated presentations.

**ANNT 612 MSc Thesis Research (6)**

The graduate student undertakes an independent original research on a topic relevant to Animal Nutrition under the supervision of a major advisor in the field of study. The topic and plan of study is to be determined by the student and his advisor, and the research is designed to include thesis presentation and open defense as a partial requirement for the MSc degree.

**MSc Dairy Science**

***Course Distribution by Year and Semester***

**Year I Semester I**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| DSC 511 | Dairy Animal Nutrition | 3 |
| DSC 521 | Dairy Production and Management | 3 |
| DSC 531 | Reproductive and Lactation Physiology | 3 |
| ANPR 531 | Biochemistry | 3 |
| ANGB 541 | Biometrics | 4 |
| FLEN 501 | Academic Writing for Graduate Students (E) | 2 |
| **Total** | | **16 (18)** |

E = Elective course.

**Year I Semester II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| DSC 512 | Dairy Chemistry and MicrobiologyReproductive and Lactation Physiology | 3 |
| DSC 522 | Dairy Herd Health Management (E) | 2 |
| DSC 532 | Genetics and Breeding of Dairy Animals | 3 |
| DSC 542 | Dairy Business Planning and ManagementDairy Business Planning and Management (E) | 2 |
| DSC 552 | Dairy Products Technology | 3 |
| DSC 562 | Current Topics in Dairy Scienceurrent Topics in Dairy Science | 1 |
| **Total** | | **12 (14)** |

E = Elective course.

**Year II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| DSC 572 | MSc Thesis Research | 6 |

**Course Description**

**DSC 511. Dairy Animal Nutrition (3)**

Principles of dairy cattle nutrition and management and their application to economical feeding practices and computerized ration formulation. Current nutritional concepts pertaining to dairy animals. Scientific rationale for nutrient requirements. Feedstuff evaluation and recommended feeding practices along with integration of biological models with economic principles and practical applications. Practice in ration formulation procedures manually and by computer. Feeding systems for dairy animals at different ages with different physiological status. Metabolic profile of dairy animals, Energy and protein concept of dairy animals.

**DSC 521: Dairy Production and Management (3)**

This course covers diary production system, opportunities and constraints of dairy production and milk consumption pattern in Ethiopia. Temperate and tropical Dairy breeds of cattle. Calf and replacement stock rearing and cow management. Dairy reproduction, milk production, efficiency and culling. Lactation curve. Bull selection and handling. Judging techniques and body condition scoring of dairy cows. Housing and dairy farm management. Record keeping.

**DSC 531. Reproductive and Lactation Physiology (3)**

Anatomy, physiology and endocrinology of the mammary gland emphasizing factors affecting milk yield and composition. Mechanisms of milk component secretion, including protein, lactose and fat metabolism. Disorders of the mammary gland (mastitis) and control strategies. Reproductive systems - male and female reproductive systems of farm animals. Hormonal control of reproductive process-estrus cycle ovigenesis, spermatogenesis, fertilization, implantation, pregnancy, gestation and parturition. Artificial insemination-semen collection and processing, evaluation of male based on semen quality.

***ANGB 541. Biometrics (4)***

See in Animal Genetics and Breeding Graduate Program.

***ANPR 531. Biochemistry (3)***

See in Animal Production Graduate Program.

**FLEN 501. Academic Writing for Graduate Students (2) (E)**

**Course objectives:**

Upon completion of the course, students will be able to:

* implement the conventions of writing research papers in English;
* use effectively the discourse patterns of academic English;
* differentiate the features of academic language and style;
* incorporate the work of other authors in their own writing; and
* practice presentation skills.

**Description**

The Academic Writing course focuses on preparing students for the academic writing and communication required in graduate level courses. The course develops academic writing skills of students by raising their awareness of the conventions of written texts. In addition, the course will help the students become familiar with genres and enhance skills related to critique, argumentation and research-based writing. Students will also acquire an awareness of and ability to use effectively the discourse patterns of academic English typically required for writing and reporting research activities, course assignments, field reports, lab reports, term papers, and book reviews. Students will also learn how to incorporate the work of other authors into their own writing according to existing requirements of academic practice. In addition, they will receive instruction in grammar, rhetorical conventions, and oral communication.

**DSC 512. Dairy Chemistry and Microbiology (3)**

Composition, structure and properties of milk and milk products. Chemistry of milk and its components. Chemical changes that occur during processing, storage, distribution and utilization of dairy products. Analytical methods (quantitative and qualitative) in dairy chemistry. Microbiological aspects of preservation, processing, quality, safety and shelf-life of dairy products. Methods for isolation, detection, characterization and quantitative determination of microbial populations in dairy products and the dairy farm and plant environment as well as factors influencing growth and survival of spoilage pathogenic organisms in food.

**DSC 552. Dairy Products Technology (3)**

The introduction of scientific principles including chemistry and microbiology to the processing of fluid milk and milk products and their control. Basic processing operations. Dairy products processing principles and techniques. Manufacture of various processed dairy products such as cheese, butter, ice cream, yogurt, etc. Dairy products quality assurance, factors affecting the quality of dairy products. The organization of quality control of dairy products with emphasis on HACCP (Hazard Analysis Critical Control Points).

**DSC 532. Genetics and Breeding of Dairy Animals (3)**

Constraints of livestock breeding in the tropics in relation to: environment, production systems and socio-economic conditions. Native breeds performance, scope and methods of improvement. Introduction of improved exotic breeds. Introducing the basic principles of inheritance. Quantitative genetic principles underlying the performance of animals. Genetic parameters and methods of their estimation. Phenotypic, genetic and environmental correlations. Growth, milk, and reproduction traits and their genetic basis. Breeding dairy animals with special reference to fertility, production & disease resistance. Application animal breeding to livestock improvement. Selection methods- direct selection, indirect selection, simultaneous selection for more than one trait. Systems of mating. Field and modern recording systems. Breeding plans.

**DSC 542. Dairy Business Planning and Management (2)**

Basic management principles applied to the dairy industry. Industrial organization and control. Dairy farm/plant design, facilities, layout. Inventory control and records. Planning and budgeting. Financial management in the dairy industry.

**DSC 522. Dairy Herd Health Management (2) (E)**

General epidemiology chains of disease, the aetiology, source and route of infection, ways and means of disease transmission and ways of exit and impact on the host. Aetiology, epidemiology, symptoms, diagnosis, prevention and control of external and internal parasite of dairy animals with a special focus on ticks, mites, insects, helminthes and protozoa of tropical importance. Infectious diseases of dairy animals caused by bacteria, virus and rickettsia. Zoonotic diseases of public health importance. Prevention and control of mastitis in dairy herds. Non-infectious disease prevention and control in dairy animals.

**DSC 562. Current Topics in Dairy Science (1)**

Supervised study on advanced topics of current importance in Dairy Science or related topics and which must be approved by the DGC. That is, presentation and critical review of current research publications in dairy science and technology, methodological advances and applications in dairy food systems. Students present seminars based on library research so that students will be exposed to the methodology of preparation and presentation of scientific papers.

**DSC 572. MSc Thesis Research (6)**

Independent research conducted by graduate students under the supervision of senior staff on national priority problem areas in dairy science and technology. Thesis research work will include problem identification, significance, methods, data analysis, and conclusion.

**M Sc in Dairy Technology**

***Course Distribution***

Table 1: Distribution of courses semester wise

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S. No | Course code | Course title | | Credit hours |
| **First Year First Semester** | | | | |
|  | DaTe 511 | | Introduction to Dairy Technology | 3 |
|  | DaTe 521 | | Dairy Microbilogy | 3 |
|  | DaTe 531 | | Dairy development policy and trade (E) | 2 |
|  | DaTe 541 | | Microbiology of Fermented Food and Beverages | 3 |
|  | DaTe 551 | | Research Methods & Experimental Design | 3 |
|  | DaTe 571 | | Food quality and safety Management (E) | 2 |
|  | DaTe 581 | | Seminar in Dairy Technology I | 1 |
| **Total** | | | | **13/17** |
| **First Year Second Semester** | | | | |
|  | DaTe 512 | | Milk processing | 4 |
|  | DaTe 522 | | Dairy Product Technology | 4 |
|  | DaTe 532 | | Dairy processing and Equipment | 3 |
|  | DaTe 562 | | Milk in Human Nutrition (E) | 2 |
|  | DaTe 572 | | Dairy Business and Entrepreneurship (E) | 2 |
|  | DaTe 582 | | Seminar in Dairy Technology II | 1 |
|  | **Total**  **Second year** | | | **12/16** |
|  | DaTe 611 | | Seminar in Dairy Technology III | P/F |
|  | DaTe 621 | | MSc Thesis Research | 6 |

***Course Description***

**DaTe 511: Introduction to Dairy Technology (3)**

**Course objective**

* To enable the students to understand the basic principles and application of technologies in dairy sciences and to introduce them to basic principles dairy chemistry and microbiology.

**Course description**

This course will focus on Basic dairy chemistry; Basic dairy microbiology (microbiology of raw milk and dairy products); Quality assurance of raw material and product; Basic dairy processing: Fluid milk products, Fermented milks, Cheese, Butter, Powder, Cleaning and hygiene.

**Teaching and learning Methods**

The course is based on a series of e-learning modules from Dairy Technology program of Copenhagen University. It integrates literature studies, exercises relating to theory and case studies. E-modules are on-line learning activities which can be either questions, assignments or discussions. E-learning includes on-line discussion fora in which students interact to construct knowledge. Criteria for successful completion of each e-learning module will be defined for each module and will be based on active participation in discussions, completion of individual assignments, group work and questionnaires. Students will get feedback on their performance.

**Description of Examination:** Students will be assessed on basis of:

1. Successful completion of e-modules throughout the course (questionnaires, assignments and discussions). This accounts for 50% of the final grade.
2. A final exam conducted via internet (estimated workload 12 hours). The exam will be structured as an individual written assignment which must be completed within 48 hours. This accounts for 50% of the final grade.

Organization of Teaching: Internet based e-learning modules where all exercises are web-based. Students can follow the course from anywhere in the world, however, internet access and a webcam are required.

Professor Richard Ipsen, Copenhagen University Dairy Technology group head, is responsible for this e-learning course.

**Course Literature**

Walstra, P., Wouters, J.T.M and Geurts, T.J. (2006) 'Dairy Science and Technology', 2nd Ed, CRC Press, London.

**DaTe 521: Dairy Microbiology (3)**

**Course objective**

* To equip students with the basic principles and identification of dairy microbiology and their roles in dairy industry.

**Course description**

The course will contain lectures on: Microbiology of raw milk, market milk, cream, butter, concentrated and dried milk, fermented milk, cheese, and ice cream. Sweet dairy products microflora; Pathogenic and spoilage microflora; Primary (Lactic acid bacteria) and secondary (Yeasts, molds, propionibacterium, red smear microflora, LAB ripening cultures) starter cultures microflora; Bacteriophage and bacteriophage resistance; Role of starter culture physiology on growth and end products (aroma formation, proteolysis, glycolysis, amino acid catabolism); Non-starter lactic acid bacteria, adjunct cultures and their role in cheese ripening.

**Laboratory exercises will include:**

Raw milk microflora; Characterization of microflora in fermented dairy products using culture and culture independent techniques; Detection and propagation of bacteriophages from dairy products; Influence of starter culture propagation conditions on starter composition and activity.

**Course Literature**

S. Salminen, A. Von Wright, and A. Ouwehand. Lactic Acid Bacteria, Microbiological and

functional aspects. 3rd. ed.

Marcel Dekker 2004 (selected chapters)

Reviews and Original literature

**DaTe 531: Dairy development policy and trade (2) (E)**

**Course objectives**

* To equip students with the knowledge and skill of the current global dairy policy and trade as well as Ethiopian dairy policy and trade

**Course description**

Dairy development policy and trade will cover global and national dairy policies that make the country to participate in international dairy trade and what are the barriers and obstacles that made the country lag behind; ways to fit to international dairy policies; requirement for international trade of dairy products; livestock policy and trade, milk and milk products trade and policy; quality assurance of dairy and dairy products to meet international requirements

**Delivery methods:**

* Lecture, group work, term papers and presentations, case study

**DaTe 541: Microbiology of Fermented Food and Beverages (3)**

**Course objective**

* To equip students with basic knowledge and skill of microbiology of fermented foods and beverages including those made from milk and dairy products; roles and types of microorganisms in manufacturing of variety of fermented foods and beverages.

**Course Content**

The course will have major focus on the microorganisms involved in the processing of various fermented food and beverages. The course will deal with the taxonomy of important microorganisms such as lactic acid bacteria (LAB), other starter bacteria, yeasts and moulds including both phenotypic characteristics and molecular typing techniques for their identification. Methods for isolation including both culture and culture in-dependent techniques will be covered. This will include techniques such as DGGE, RT-PCR and high through put sequencing as well as various tools for bioinformatics. Various fermentation techniques will be introduced covering the use of starter cultures, growth yield and fermentation techniques such as back-slopping. Natural and controlled fermentation; An introduction to various fermented foods and beverages will be given including products such as cheese, bread, wine and beer as well as a number of traditional indigenous fermented foods. Focus will additionally be on microbial interactions including topics such as quorum sensing, bacteriocin formation etc.

**Teaching and learning Methods**

Lectures, theoretical and laboratory practicals. The lectures will introduce issues of importance for the understanding of microbial behavior during production of fermented food and beverages. The theoretical and laboratory practical’s will give the student practice on how to identify various microorganisms and how to use various methodologies within molecular biology.

**DaTe 551: Research Methods and Experimental Design (3)**

**Course objectives**

* The objectives of this course is to understand and practice research methods relevant to dairy technology and experimental design employed to conduct research in the field as well as analysis and interpretation of collected data and information.

**Course description**

Probability and probability distribution. Sampling and sampling distribution, testing of hypothesis based on z, t and chi-square and F distribution. Models and analysis of variance, assumptions of analysis of variance and their tests, alternatives in case of failures of assumptions. Correlation, linear regression and related tests. Rank and intra-class correlation, partial correlation, multiple regression and associated tests. Non linear regression. Principles of experimental design, C.R.D., R.C.B.D., Split plot, Latin square designs, incomplete block designs. Factorial experiment. Confounding and transformation. Matrix and generalised inverse of matrices. Regression models, variance component estimation, illustrative examples from dairy sciecne and technology experiments.

**Delivery method**

* Lecture, assignment, home take assignment, developing research proposal and experimental design.

**DaTe 571: Food quality and safety Management (2) (E)**

**Course objectives**

* After completion of this course students will be able to understand and decribe principles of food quality and safety that is fundamental for supply of safe and wholesome food including dairy food products to consumers.

**Course description**

This course has been designed to provide graduates with an insight into measures that are required to provide a supply of safe and wholesome food to consumers. A wide spectrum of food safety and quality management issues will be addressed following the 'farm to fork' approach. Topics covered include: good governance and national control systems; food inspection and testing services; legislation and private standards; and management of food safety and quality within the supply chain as well as in hotels and restaurants. Students gain an understanding of safety and spoilage characteristics of a range of commodities and food products. They also acquire knowledge of the design and implementation of food safety management systems based upon the 'Hazard Analysis Critical Control Point' concept.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment

**DaTe 581: Seminar in Dairy Technology I (1)**

**Objective**

* To enable students acquire skill of writing review artices, presenting and defending in the presence of students and instructors

**Course description**

Supervised study on advanced topics in Dairy Technology or related topics that are not discussed in the program and the title should be approved by the SGC. Critical review of current research publicatins in dairy technology. Students present seminars based on literature review so that they are exposed to the methodology of preparation and presentation of scientific papers.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment

**DaTe 512: Milk Processing (4)**

**Course objective**

* To enable students to acquire knowledge, skill and attitude about quality milk production, physical chemistry of milk processing, effect of heat treatment and separation processing.

**Course description**

The course primarily deals with milk production and functionality of milk constituents. **Milk production:** Influence of housing and feeding regime, Milking and its influence on raw milk quality, Organic production of milk, Feed quality and legislation, Animal ethics in dairy production,

The physical chemistry of milk processing: Milk as a colloidal system (physical-chemical aspects), the effect of heat treatment on milk, Separation processes (chromatographic techniques, ion exchange), the effects of homogenization on milk. **Functionality of milk constituent:** Solubility, Interfacial properties, Gelation properties, Functional milk fat, Uses of lactose and minerals, Health functionality/bioactivity.

**Teaching and learning Methods**

The course is based on a series of lectures and tutotials providing an overview of milk quality and processing. Laboratory practical’s dealing with aspects of milk as a colloidal system and milk protein functionality are also included.

**Course Literature**

Fox, P.F. & McSweeney, P.L.H. 1998: Dairy Chemistry and Biochemistry, Blackie Academic & Professional

**DaTe 522: Dairy Product Technology (4)**

**Course objectives**

* To enable students to acquire the basic and advanced dairy processing technology with detail theoretical and practical knowledge and skill as well as attitudes.

**Course description**

The course is an advanced dairy technology course and level of knowledge equivalent to the course 'Introduction to dairy technology' is expected. The course 'Milk processing' is recommend before taking this course. This covers fluid milk products: pasteurized milk and cream products, including flavoured milks, UHT milk and other dairy products, Recombined milk, Fermented milks, effect of fermentation on milk components, Structure formation in acidified milk gels, Processing of specific fermented milks. **Cheese:** Milk treatment for cheese making, renneting of milk, production of different cheese types, ripening of cheese. **Dried and concentrated milks:** Influence of processing on the properties of condensed milks, milk powder, dried whey products and caseinates. **Butter and dairy spreads:** Treatment of cream, Processing of cream into butter and spreads, Properties of final products. **Ice cream:** Ingredients and their influence, Ice cream mix, Processing and freezing of mix, Properties of final ice cream.

**Teaching and learning Methods**

The course consists of lectures as well as project work in the dairy pilot plant and laboratory. A number of lectures will be given by people from industry. The projects involve production of various products as well as analysis of the produced products. Excursions to dairy plants, organizations and manufacturers of equipment will also take place. This will be organized by Copenhagen University Dairy technology Group head Professor Richard Ipsen.

**Course Literature**

Lecture notes and scientific papers form the curriculum of the course.

Walstra, P., Wouters, J.T.M. and Geurts T.J. (2006) 'Dairy Science and Technology', CRC Presss, London, as textbook (available as ebook from LIFE's library).

**DaTe 532: Dairy Processes and Equipment (3)**

**Course objective**

* To enable students to acquire knowledge and skill about process and equipment with applications with dairy industry.

**Course description:**

Processes and equipment with applications specific to the dairy industry (e.g. equipment for homogenization, specialised heating processes, membrane filtration, cheese production, drying, freezing, slicing, dicing and shredding). The rheological properties of fluids and viscoelastic materials in dairy processing are also covered. The content concentrates on understanding the individual dairy process components and on dairy process equipment with respect to obtaining optimal processes and desired product characteristics.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment

**DaTe 562: Milk in Human Nutrition (2) (E)**

**Course objectives**

* To equip students with the knowledge, skill and attitude about the role of milk in human nutrition

**Course description**

The course is designed to impart understanding of literatures and problem solving on the fundamentals of human nutrition. Students will be able to understand the role of milk and dairy products in human nutrition. They will also be able to understand the knowledge in designing of nutritious foods processing, nutrition counselling, health promotion and prevention of diet related disorders. They will also understand and apply the knowledge and skill to solve problems of macro-and micronutrient related deficiencies and disorders with emphasis on the role of dairy products to correct nutritional deficiencies.

The course cover planning of balanced diet; Process of digestion and absorption; Digestion and absorption of major nutrients and their metabolism; Energy balance; Evaluation of daily energy requirement; Vitamins; Minerals; Water; Nutritional deficiency disorders and their prevention; Protein-energy malnutrition (caloric requirements in growth and development); Nutrition education and the nutrition policy including Ethiopian nutrition policy; and Topics on current food nutrition trends for infants, children, adults and elders.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment, case study

**DaTe 572: Dairy Business and Entrepreurship (2) (E)**

**Course objective**

* To equip students with the knowledge, skill and attitude about dairy industry business and financial management

**Course description**

Basic management principles applied to dairy technology, industrial organizational control and management, entrepreneurship principles and application in dairy technology, dairy plant design, facilities, layout, inventory control and records, planning, budgeting; financial management indairy industry.

**Delivery methods:**

* Lecture, labratory practicals, term papers and assignment, case study

**DaTe 582: Seminar in Dairy Technology II (1)**

Supervised study on advanced topics in Dairy Technology or related topics that are not discussed in the program and which must be approved by the SGC. Critical review of current research publications in dairy technology. Students present seminars based on literature review so that they are exposed to the methodology of the preparation and presentation of scientific papers.

**DaTe 611: Seminar in Dairy Technology III (P/F)**

For this Seminar students will present their thesis research work result to senior academic staff and postgraduate students mainly to get feeeddback for the bettermnet of their thesis before the final open thesis defence. The thesis quality and standard will also be evaluated. This will help the students to get valuable comments and suggestions before the actual thesis defence.

**DaTe 621: MSc Thesis Research (6)**

The graduate student undertakes an independent original research on a topic relevant to Dairy Technology under the supervision of a major advisor in the field of study. The topic and plan of study is to be determined by the student and his advisor, and approved by School Graduate Council. The research is designed to include thesis presentation and open defense as a partial requirement for the MSc degree.

**School of Natural Resource Management and Environmental Sciences**

**Master of Science (MSc) Degree in Agroforestry**

**List and Distribution of Courses by Year and Semester**

**Year I; Semester I (Core Courses)**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| AFNR 511 | Silviculture of multipurpose trees and shrubs | 3 |
| AFNR521 | Management and productivity of agroforestry systems | 3 |
| AFNR 531 | Integrated Soil fertility and water management in agroforestry | 3 |
| AFNR 541 | Remote sensing and GIS | 3 |
| AFNR 551 | Experimental design | 3 |
| **Total** | | **15** |

**Year I; Semester II (Core Courses)**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| AFNR 512 | Socio-Economics of agroforestry systems | 3 |
| AFNR 522 | Land use planning and watershed management | 3 |
| AFNR 532 | Soil, water and plant analytical techniques | 3 |
| AFNR 542 | Ecological basis of agroforestry | 3 |
| AFNR 552 | Graduate Seminar in agroforestry | 1 |
| **Total** | | **13** |

**Year II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| AFNR 611 | M Sc Thesis Research | 6 |

**Elective Courses**:One course shall be selected from any of the following electives

|  |  |  |
| --- | --- | --- |
| **Code** | **Course Title** | **Credit Hours** |
| AFNR 561 | Soil and water conservation | 3 |
| AFNR 562 | Agroforestry Systems and Practices | 3 |
| AFNR 571 | Crop and livestock production in agroforestry | 3 |
| AFNR 572 | Medicinal and aromatic plants in agroforestry system | 3 |
| **Total** | | **12** |

**Course Description**

**AFNR 511 Silviculture of multipurpose trees and shrubs**

**Objective**: at the end of the course students’ can explain theories and methods of silviculture of single and multiple tree systems especially that of tropical forest and agroforestry systems and applyrequired silvicultural techniques to solve problems of stand regenerations and management.

**Theories:**

Use of multipurpose tree, tree selection and propagation techniques, domestication and introducing new species with high wood quality and calorific values, carbon sequestration, tree for land rehabilitation, rooting pattern and properties. various silvicultural systems, on-farm tree management techniques, biomass estimation, importance of woody elements-trees and shrubs in agroforestry systems ,their role in biomass production; nitrogen fixing trees and shrubs; choice of species for various agroclimatic zones for the production of timber, fodder, food, fuelwood, fiber, bee forage , alley cropping, windbreaks, and green manuring; role of multipurpose trees and shrubs in agroforestry.

**Practical sessions:**

Identification of agroforestry trees and shrubs, herbarium preparation, collection of samples of important diseases and insects of agroforestry trees and shrubs; chemical analysis of wood for hemicelluloses, lignin, extractives, identification of important plants especially of hilly regions. Measurement of girth, diameter, height, crown length, and width, increment, boring, computation of volume of standing and felled trees.

**AFNR 521 Management and Productivity of Agroforestry systems**

**Objective:** at the end of the course students’ able to explain in detail about agroforestry systems management, critical resources in agroforestry systems, made productivity evaluations and design agroforestry technologies to sustained and diversify yield from a land management unit.

**Theories:**

Classification of agroforestry systems ecozones and choice of systems; systems components and their integration; yield advantage of agroforestry systems, methods of yield estimation, physiological plant ecology, stress physiology in plants, resource crunch, critical resources (nutrients, water and light) in agroforestry systems, role of tree architecture and management towards production; canopy management, concept of photosynthetically active radiation, productivity potential and resource sharing; criteria for selection of agroforestry design, biological productivity evaluation of agroforestry systems, systems viability and interpretation; recent trends in agroforestry development –technologies and research with special emphasis on space time considerations and implementation of on-farm trails.

**Practical sessions:**

Measuring leaf area index, rate of photosynthesis, photosynthetically active radiations; estimation of biological yield, harvest index and land equivalent ratio, demonstration of tree roots and canopy management, etc.

**AFNR 531 Integrated Soil Fertility and Water Management in Agroforestry**

**Objective** at the end of the course students’ able to explain in detail about soil fertility and water management in agroforestry and implement agroforestry technologies to solve related problems.

**Theories:**

Introduction to the Basic Concepts of Soil and Plant nutrition; Food production and soils of world; Basic aim and objectives of soil and plant nutrition studies; Role of soil colloids in nutrient supply, exchange phenomenon and availability of ions; Movement of ions in soil (root interception, mass flow and diffusion of ions); essentiality of nutrients and levels of nutrients in soil system in relation to plant; functions and deficiency symptoms of various nutrients in plant; nutrient transformations in soil and their bioavailability; fertilizer nutrient sources and their management; Nutrients and water use efficiency; Soil organic matter (functions, availability of nutrients, effect on physical condition, erosion, buffering and exchange capacity, clay organic complexes); Use of organic manures and other organic wastes in crop production; Use of microorganisms for nutrient supply; Use of soil and plant tests, their interpretation to evaluate nutrient status of soil; methods of soil fertility evaluations; agroforestry systems for soils fertility management, water management in agroforestry systems.

**Practical sessions**:

identification of nutrients deficiency symptoms, demonstration of agroforestry systems for soil fertility management, design of the systems for soil and water management, Biofertilizers, composting, vermicomposting; application of green manure, etc.

**AFNR 541 Ecological basis of Agroforestry**

**Objective:** at the end of the course students’ able to explain in detail concepts of ecological basis of agroforestry and apply it to maintain or increase the productivity of a given agroforestry system.

**Theories:**

Introduction to population, community and ecosystem ecology, concepts of biological interactions, food chain, food web, nutrient and energy cycle in the ecosystem ; nature of components interactions in agroforestry systems; effects of interaction on productivity, resource pool temporally and spatially, resource allocation above-ground and below-ground, chemical interactions in plant community, root behavior, crown architecture including methods for minimizing unfavorable interactions; growth modeling.

**AFNR 551 Experimental design**

**Objective:** at the end of the course students’ able to factorial experiments in any design, carry out analysis of covariance and apply commonly used statistical packages.

**Theories:**

Review of probability distribution and sampling, models, assumptions and test of analysis of variance: one way and multi-way classifications, factorial experiments, designs of experiments including complete and incomplete designs. Analysis of covariance. Contingency tables. Nonparametric statistics. Application of Selected statistical packages in Agroforestry.

**AFNR 512 Socio-Economics of agroforestry systems**

**Objective:** To impart knowledge on the soicio-economic interpretations of Agroforestry products and services.

**Theories:**

Introduction to production economics in agroforestry, farm management, methods of investment analysis in agroforestry( B:C ratio, NPV, IRR, break even analysis); joint, complementary and competitive enterprises in agroforestry; risks and uncertainty in agroforestry, financial analysis, financial and economic analysis in agroforestry projects, linear programming, social concepts in agroforestry, distortion of agroforestry incentives; extension methods and adoption strategies for agroforestry technologies.

**AFNR 522 Land use planning and watershed management**

**Objective:** at the end of the course students’ able to explain basic concepts of land use planning and importance of integrated watershed management livelihood improvement and sustainable land use.

**Theories:**

The structure and function of watershed ecosystems with emphasis on the ecosystem and geomorphic processes shaping watersheds, measuring ecosystem function in watersheds, and measurement of positive and/or negative changes in ecosystems; processes shaping the structure and functioning of ecosystems and watersheds, their responses to natural and anthropogenic change and recovery to these disturbances; comparison of different ecosystems to watershed responses to anthropogenic changes and collect data from selected field sites to explore the relationship among ecosystem processes and changing climate (or other disturbances); the importance of proper ecologic functioning to the maintenance of healthy watershed systems; Land classification systems for agriculture, forestry and environmental planning; selected land uses; land resources data; approaches for managing soils and landscapes judiciously in ecosystem frame-work; controls in land use planning; modern trends in controlling land uses; soil potential rating; soil degradation and reclamation; concept and planning of watershed management, characteristics of watershed, methods of watershed management.

**Practical sessions**

Analusis of drainage pattern of watershed, demarcation of sub watersheds and watershed on top sheets, preparation of micro-plan and planning of watershed for effective implementation. Preparation of contour maps, estimation of earth work, design of check dams, conveyance and control structures, and water shed delineation.

**AFNR 532 Soil, water and plant analytical techniques**

**Objective:** at the end of the course students’ able to explain analytical techniques, operate the instruments and analyze soil, plant and water samples in laboratory.

**Theories:**

Introduction to flame photometry, atomic absorption spectrophotometer, calorimeter; Sampling and sample preparation (soil, plant and water), and principles and practices of laboratory techniques and methods of analysis of soil, water and tissue materials with emphasis on properties of agricultural and environmental significance; and analytical data processing, interpretation and reporting.

**Practical sessions:**

Collecting samples, Sample preparation, making the reagents, operating the instruments, chemical determinations of soil, water and plants parameters.

**AFNR 542 Remote Sensing and GIS**

**Objective:** at the end of the course students’ able to explain basic principles of remote sensing and apply GIS techniques for temporal and spatial analysis of feature of the interest to generate usable information to solve problems.

**Theories:**

Principles of remote sensing (electromagnetic radiation, spectral signatures, atmospheric effects; brightness, temperature). Characteristics of satellite images; resolution of satellite data (spatial, spectral and temporal considerations); visual and digital image interpretation and analysis. Remote sensing application in natural resources and environmental management. mapping of forests, crops, water body, soils, minerals and rangeland. Geographical information systems; basic components of a GIS; GIS software: Database management system, cartographic (mapping), computer aided design, image processing, digitizing programs, contouring and surface modeling; and geographical entities. Data format: digital databases, maps (topographic & thematic maps); raster and vector data; rational databases. GIS data input, analysis, display and management (validation and editing); sources of error and error management. New trends in GIS; evolution of polar orbiting and geostationary satellites; data processing capability. Principles of aerial photography and aerial surveillance: airborne videography and use of aircraft for agricultural purposes.

**Practical sessions;**

GPS navigation, data entering (geocoding, projection), visual and digital image interpretation and analysis, image processing, digitizing programs, contouring and surface modeling; and geographical entities.

**AFNR 552 Graduate Seminar in Agroforestry**

**Objective:** students’ able to independently select relevant topics in the area of agroforestry and prepare and present orally the findings to audiences in public.

**Theories:**

Briefing on how to select advanced relevant topics Student presentation of a seminar on selected topic of current advances and developments in agroforestry and other related fields.

**AFNR 611 MSc Research**

**Objective:** at the end of the course students’ able to carry out independently advanced original researches in the area of agroforestry and related fields.

**Theories:**

This requires a graduate student to undertake an independent original research on a topic relevant to under the supervision of a major professor in the field of the study. The topic and planning of the study is to be determined jointly by the student and his/her advisor, and the research is designed to include thesis presentation and open defense to be discussed as partial requirement for the MSc Degree.

**AFNR 561 Soil and water conservation**

**Objective:** at the end of the coursestudents’ able to discuss various soil and water conservation measures and design physical and biological soil and water conservation measures.

**Theories**

Major Ethiopia soil and water Conservation and management problems and solutions, mechanics, processes and forms of soil erosion by water and wind and analysis of thin effects on food production; and problems related to degradation of land and water resources, soil erodibility, climatic erosivity and prediction of runoff and soil loss, cultural, biological/agronomic and engineering measures of erosion control, watershed management and other management practices appropriate for maintenance and sustainable utilization of the land, water and biological resources; advances in soil and water conservation research and water harvesting and reclamation of degraded lands through agroforestry interventions.

**Practical sessions:**

Demonstration of soil erosion types, steps involved in soil erosion, causes of soil erosion, water harvesting, design of physical and biological soil and water conservation measures, impact of siltation on lakes, slope measurement, contour alignment.

**AFNR 562 Agroforestry systems and practices**

**Objective:** explain basic concepts of agroforestry systems, overview of global agroforestry systems, criteria for their classifications, and role of agroforestry in natural resources management.

**Theories**

Agroforestry definition, importance, potential, and impediments in implementation; concepts of agroforestry practices and systems; overview of global agroforestry systems. Classification of agroforestry systems, concepts of community forestry and social forestry. MPTs in agroforestry and herbaceous components, agroforestry systems and practices; shifting cultivation, improved fallow, alley cropping, homegarden, taungya systems, multiple and mixed cropping, shelterbelts and windbreaks, biomass transfer, and energy plantation. Socio-cultural factors in agroforestry, evaluation of agroforestry systems, diagnosis and designing of agroforestry systems. Role of trees and shrubs for integrated soil fertility improvement.

**Practical sessions**:

Preparation of database for multipurpose trees and shrub, on-farm tree management techniques, analysis of farmers’ preference to trees species, demonstration to traditional agroforestry systems and technologies, regeneration of multipurpose trees and shrubs.

**AFNR 562 Crop and Livestock Production in Agroforestry**

**Objective:** to explain characteristics of woody perennials, herbaceous crops and animals that can be integrated under suboptimal conditions that prevail in agroforestry systems.

**Theories**

Emphasis is placed upon the systems approach of managing field crops and livestock. Examination of the adaptation, growth, development, and management systems employed for producing and maintaining the major crops grown throughout the world, with special emphasis to crops grown in Ethiopia. Strategies will be evaluated that should enable producers to maintain strong crop management enterprises fully competitive in local, national, and global markets, while simultaneously preserving the integrity of the crop's growing environment. Cultural practices leading to long-term and economically viable crop yield and quality, including those impacting on soil quality, weed, insect, and disease behavior will be emphasized. Both traditional approaches and the newer molecular biology techniques associated with crop improvement will be discussed. Economic importance of each crop (production status in the World, Africa and Ethiopia); origin and history; ecological requirements; botanical description; chemical composition; pollination and seed production; cropping systems and cropping patterns of each crop; recommended agronomic practices for each crop (time of plowing, source of seeds, seed quality, seed preparation, seed rate, time of sowing, method of sowing, sowing depth, fertilization, type of fertilizer, method of fertilizer application, rate of fertilizer, time of fertilizer application, water management; cultivation and weed management; major diseases and their management; insect pests and their management in agroforestry systems; crop growth assessment ; determination of physiological maturity; harvesting; processing ; storing and handling, and improvement objectives, methods of improvement (selection, hybridization) and techniques; technologies developed for major crops in integrated combination systems will be discussed.

**AFNR 572 Medicinal and aromatic plants in agroforestry**

Studies on botanical features and ecological requirements of important species with medicinal, aesthetic and aromatic products, in-situ and ex-situ conservation of the species, cultivation of important medicinal plants in agroforestry, such as sowing, nursery raising, spacing, fertilizer requirement, diseases and pathogens, crop rotation, and suitable time of products; physiological factors affecting action and toxicity of medicinal plants extraction of valuable component drugs.

**School of Natural Resource Management and Environmental Science**

**MSc Program in Agrometeorology and Natural Risk Management**

**List and Distribution of Courses by Year and Semester**

**Year I; Semester I (Core Courses)**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| AMRM 511 | Climate dynamics and atmospheric circulation | 3 |
| AMRM 521 | Methods of measurement and observation in agrometeorology and vulnerability assessment | 3 |
| AMRM 531 | Statistical and research methods in agrometeorology and natural risk management (NRM) | 3 |
| AMRM 541 | Food security and disaster risk management | 3 |
| AMRM 551 | Soil Science and Agricultural Land Evaluation(E) | 3 |
| **Total** |  | **12/ 15** |

**Year I; Semester II (Core Courses)**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| AMRM 512 | Remote sensing and GIS for agrometeorology and NRM | 3 |
| AMRM 522 | Climate and dry land resources management | 3 |
| AMNR 532 | Modification of microclimate | 3 |
| AMRM 542  AMRM 561 | Modelling and system analysis in agrometeorology and NRM  Watershed Management (E) | 3  3 |
| AMRM 552 | Graduate seminar in agrometeorology and NRM | 1 |
| **Total** |  | **13/16** |

**Year II**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| AMRM 611 | M. Sc. Thesis Research | 6 |

**Elective Courses**:One course may be selected from any of the following electives

|  |  |  |
| --- | --- | --- |
| **Code** | **Title** | **Credit Hours** |
|  |  |  |
| AMRM 571 | Measures for flood and drought relief | 3 |
| AMRM 581 | Crop protection and climate | 3 |
| AMRM 591 | Environmental impact assessment, policy and law | 3 |
| AMRM 562 | Communication in agrometeorology and NRM | 3 |
| AMRM 572 | Crop ecology and physiology | 3 |
| AMRM 582 | Animal production systems and management in climate change | 3 |
|  | **Total** | **18** |

**Course Description**

**AMRM 511 Climate Dynamics and Atmospheric Circulation (3)**

The course explains climate history; features of the general circulation of the atmospheric; factors controlling the global climate, and climatic parameters. The content includes the general circulation of the atmosphere; climatic history of the planet earth from instrumental and proxy data sources; climate theory including global and zonal averages and energy balance models; feedback mechanisms and the Milankovitch theory. Transport processes in the atmosphere and ocean; atmosphere-ocean exchange processes; parameterization of radiative transfer, convection and ocean circulation; general circulation models and projections of future climates; sensitivity of climate models to carbon dioxide, water vapour, ozone, cloudiness and aerosols. Man's influence on climate; localized meso- and micro-climates of the agricultural and forest areas; climate prediction for agriculture. Factors (natural & anthropogenic) controlling the global climate; spatial & temporal distributions of the major climate parameters: radiation, temperature, pressure, wind, precipitation, cloudiness, evaporation, humidity; climate analogues, random variations; global circulation cells; dynamics of monsoon circulation and fluctuations and effect on agricultural production; angular momentum: meridional and vertical transport of angular momentum heat and water vapour; & atmospheric energetics.

**AMRM 521 Measurement and observation in Agrometeorology & vulnerability assessment (3)**

The course delivers the basic principles of observations and measurements; climate measurements instrumentation; and data quality control.The content includes principles of agrometeorological measurements and observations; measurements and quantifications of agrometeorological variables: Agrometeorological networks and requirements, instruments, *in situ* and remote observations. Weather data networks and requirements; *in situ* and remote observations; instruments and methods of observations; quality assurance and quality control. Measurements of air temperature; grass minimum temperature; surface temperature; soil temperature and soil heat flux; wind, radiation and sunshine, humidity, dew and leaf wetness, evaporation and evapotranspiration, state of the ground and soil moisture. Techniques for measurements of the state of a crop, and of the flow processes within and around the plants; data processing, statistical and mathematical methods, procedures for evaluating and presenting the results. Weather measurements with automatic weather stations and automatic processing of agrometeorological data. Vulnerability assessment ( with specific focuss on climate change/variability vulnerability): ecological risk assessment- problem formulation, characterization of exposure, characterization of effect and risk characterization. Methods and scenarios on climate change impacts, adaptation and vulnerability.

**AMRM 531 Statistical and research methods in Agrometeorology and NRM (3)**

The course delivers principles and practical skills required for planning, design and execution of scientific experiments following research methodology; analysis and interpretation of findings using various designs and statistical methods and packages as tools for scientific decision making; preparation/writing research reports and presentation in scientific forums. The content includes on-farm experimentation; experimental designs, and field layout; population and samples; random samples, various statistical parameters, and weather forecasting advisories in agriculture.. Probability; binomial, normal, Chi-square distribution, and student t-distribution. Sampling from a normal distribution; comparisons involving two sample means; analysis of variance: the one way classification and multi-way classification; linear correlation, multiple and partial regression curve fitting, and some uses of Chi-square; non parametric statistics; factor analysis, principal component analysis. The nature of research; the scientific methods: Physical, statistical, numerical; hypothesis formulation. Agrometeorological and agro-climatic statistics; the role of the supervisor; information retrieval; literature review; formulation of scientific research proposals; data collection; research methodology: analytical, numerical, qualitative; experimental design: Questionnaire design, modelling and simulation; data management and analysis. Dissemination of information; presentation and communication of results; oral presentation, report writing, publishing in scientific journals.

**AMRM 541. Food security and disaster risk management (3)**

The course covers access to food, nutrition; livelihood or food economy zones (e.g.: predominantly agricultural, agro-pastoral or pastoral zones; mapping of country level livelihood zones; characteristics of livelihood zones in terms of agricultural and livestock systems; agricultural yields, production and monitoring methods. Enhancing household food security; income generating strategies; food security network for the country/region; major staple foods crops in the country/region and their contribution to national/regional requirements; major livestock systems and their contribution to food security. Time series and forecasting; food security equation; analysis of hotspots (number and location) of the population likely to experience food insecurity; current and anticipated food security at the end of a stipulated period; crop and food security assessment missions and infant nutrition rates,. Availability of inputs; markets supplies for staples, price levels and trends, Period and relative importance of weather/climate to the next harvest; food security status relative to expected weather situation. Timeline for the crucial phases of crop production calendar; food security contingency plans; national food security policy analysis; common hazard coping strategies. Disaster risk management: disaster management (Preparedness, Early Warning, Contingency planning and finance, Responding to shocks in a way that “builds back better”, Safety net tackles chronic food insecurity) and disaster risk reduction (Risk mapping, Integrating risk info into development planning, Better targeting of development efforts to reduce chronic food insecurity and vulnerability).

**AMRM 512 Remote Sensing and GIS for Agrometeorology and NRM (3)**

Principles of remote sensing (electromagnetic radiation, spectral signatures, atmospheric effects; brightness, temperature). Characteristics of satellite images; resolution of satellite data (spatial, spectral and temporal considerations); visual and digital image interpretation and analysis. Remote sensing application in agriculture (crop type classification, crop condition assessment); crop yield estimation. Soil moisture content, mapping of soil characteristics and soil management practices and other environmental aspects (land use, forestry, rangelands, oceans and weather). Geographical information systems; basic components of a GIS; GIS software: Database management system, cartographic (mapping), computer aided design, image processing, digitizing programs, contouring and surface modelling; and geographical entities. Data format: tables, photographs, textural material, diskettes, charts, books, digital databases, maps (topographic & thematic maps); raster and vector data; rational databases. GIS data input, analysis, display and management (validation and editing); sources of error and error management. New trends in GIS; eEvolution of polar orbiting and geostationary satellites; data processing capability. Principles of weather radar: weather observation; precipitation measurements; observations of winds and related phenomena associated with agricultural operations; principles of aerial photography and aerial surveillance: airborne videography and use of aircraft for agricultural purposes.

**AMRM 522 Climate and Dry Land Resources Management (3)**

Growth and development of natural vegetation in dry land areas; vegetation composition, germination and establishment in dry land. Rainfall and vegetation production; primary production in relation to soil fertility and the length of the growing period; water balance.; communities of species and short and long-term dynamics. The influence of rainfall, bush and range land fires, and exploitation on communities. Productivity of perennial grasses and trees. Climate variability in arid and semiarid regions; eco-climatic zones; influence of climate on: range; ecosystem components and functions; plant biodiversity; range forage production; range livestock production; and range wildlife management; influence of climate variability on range production systems; calculation of the average production of natural dry land, and the relation between production and rainfall.

**AMRM 532 Modification of Microclimate (3)**

Windbreaks and shelter belts: wind and turbulence effects. Climatic effects and applications: microclimate and crop yields. The influence of shelter belts and wind breaks on airflow. The influence of shelter belts on heat and water balances. The influence of shelter belts on the chemical composition of soil and air. Glass house climate. Biological effects of shelter belts. Planting, care and maintenance of shelter belts. Definition and types of mulching. Mulching effects on: plant, soil moisture; erosion and soil physics; pests and diseases growth and yield of plants; plant microclimate and yield; and weed suppression. Internationally modified climates for the control of albedo, soil moisture, frost protection; radiation, soil heat, latent heat, sensible heat and fog. Mulching for different types of crops. Thermo-regulations provided by buildings.

**AMRM 542. Modeling and System Analysis in Agrometeorology and NRM (3)**

he course aims to deliver the concepts of computer programming and ICT in Agrometeorology; simulation and forecasting models, advance statistical packages in analysis of Agrometeorology. The content includes concepts of computer programming in agrometeorology; and use of information and communications technology (ICT) in agrometeorology. Advanced statistical packages in analyses of Agrometeorological data; graphical and analytical packages. Modelling of weather/climate and crops; simulation modelling for crops, grazing systems and animals: Climate/weather scenarios. Outgoing long-wave radiation; rainfall estimation with cold cloud duration data obtained with satellite sensing; and downscaling of climate information and prediction products for agriculture. Early warning and monitoring remote sensing and geographical information system (GIS); physical/mathematical modelling of energy and mass exchange and agricultural ecosystem productivity. Planning and execution of applied meteorological research in agriculture; imulation models in agrometeorology and agro-forestry for yield forecasts. Methods of agrometeorological forecasting of state, development and yield formation of crop and range vegetation; phenology and phenological forecast of crop and natural range vegetation development; tree-crop interfaces; and structure and applications of agro-forestry models.

**AMRM 552 Graduate Seminar in Agrometeorology and NRM (1)**

Student presentation of a seminar on selected literature topic of current advances and developments in agrometeorology, natural risk management and other related fields.

**AMRM 611 MScThesis Research (6)**

This requires a graduate student to undertake an independent original research on a topic relevant to agrometeorology, natural risk management under the supervision of a major professor in the field of the study. The topic and planning of the study is to be determined jointly by the student and his/her advisor, and the research is designed to include thesis presentation and open defence to be discussed as partial requirement for the MSc Degree.

**AMRM 551 Soil Science and Agricultural Land Evaluation (E) (3)**

Composition of soils; soil profile; factors and processes of soil formation; physical and chemical properties: texture, structure and aggregation, colloids, soil reaction (pH), cation exchange capacity; organic matter; soil micro-organisms and biochemical processes; measurement of soil water content and water potential; water retention and energy relations; water movement: infiltration, hydraulic conductivity, capillary rise; soil temperature; soil air; fertility: macronutrients and micronutrients; nutrient flows and nutrient budgets; chemical and organic fertilizers; integrated nutrient management; soil erosion; estimation and control of soil erosion; soil tillage; soil quality; soil resilience; soil survey and classification; Food and Agriculture Organisation/United Nations Educational, Scientific and Cultural Organisation (FAO/UNESCO) system; United States Development Agency (USDA) system; main soil types in East Africa; soil analysis and interpretation; land capability/suitability classification for alternative forms of land use; planning unit; watershed planning and management

**AMRM 561** **Watershed Management System (E) (3)**

Soil and water conservation: strategies and approaches for conservation; role of canopy cover and ground cover; tillage practices and farming systems for conservation; management of crop and grazing lands for conservation of soil and water: dry land farming. Basic principles of water harvesting: definition, condition and inputs for water harvesting; designing water harvesting systems: water-soil system; infiltration and runoff; rainfall and runoff; crop water requirements and use; water harvesting techniques: contour systems; free standing systems; rainwater water harvesting techniques used in rural and urban areas. Soil water availability to plants; water balance of the plant root zone; evaluation of the water balance; principles of irrigation management; irrigation systems: surface, sprinkler, drip, channel and dam irrigation methods; irrigation scheduling; environmental aspects of irrigation development, irrigation water quality; irrigation efficiencies; irrigation structures, and legal aspects of irrigation; saline and alkaline soils; management of salt affected soils; salt balance and leaching and gypsum requirements of saline and sodic soils.

**AMRM 571** **Measures for Flood and Drought Relief (E) (3)**

The course delivers the warning system, disaster preparedness, Disaster risk reduction and management. The content includes warning systems on flood and drought; disaster preparedness, spatial planning. Non-physical flood combating: safe havens, land use changes.; structural flood protection: flood plains, embankments, (green) storage. Drought damage reduction: underground storage of excess water, crop shift, migration, anthropologic areas. Causes of floods: precipitation, thaw induced floods, dam breaks; flood intensifying factors: climate, catchment and channel network characteristics.

**AMRM** 581 Crop Protection and Climate (E) **(3)**

Introduction to yield reduction factors: weeds, pests and diseases; causes of plant injury, types of damage due to weeds, diseases and pests, losses due to weeds, pests and diseases; relationship between weed growth, plant disease and pest outbreaks and climatic factors; weed models; plant disease cycles; disease progress. Pest, disease and weed assessment; epidemiological mathematical models; plant disease forecasting; insect pest population dynamics; insect pest monitoring; modeling pest outbreaks; pest outbreak forecasting methods. Classification of weeds, pests and diseases; interaction of nutrient status with weeds, pests and diseases; effects of weather and climate on weed, pests and diseases; interaction of plants diseases with atmospheric pollutants. Control of weeds, pests and plant diseases.

**AMRM 591 Environmental Impact Assessment (EIA), Policy and Law (E) (3)**

The course explains principles and elements of environmental assessment with an interdisciplinary focus; apply theories and practices of environmental impact assessment (EIA) within the context of economic development and environmental conservation; describes key concepts, approaches and tools used to assist better decision-making in environmental management; evaluate, compare and use the various tools; describe EIA legislation, procedures and practices; link EIA results with mitigation measures and presents concepts of environmental law and its implication as a tool to sustainable environment; international environmental protocols, treaties, agreements and acts. The content includes consequences of environmental degradation; sustainable development; concepts and importance of environmental regulations used in general practice; environmental quality (EQ), EQ attributes; resources and accounts; format for envisagement; principles and elements of EIA: types of environmental assessments, when to use them, data/information required, collection analysis and communication of data/information; impact analysis checklist and network analysis; impact index; actual case study of EIA of development projects taking different exemplary cases; environmental monitoring, mitigation measures; social impact assessment, scope and state of development of social impact assessment; format of social impact assessment; forecasting methods; EIA legislation, procedures and practices.

**AMRM 562 Communication in Agrometeorology and NRM (E) (3)**

The course includes topics on the concepts on communication, tools and techniques in Agrometeorology communication; environmental issues and sustainability principles and methods of communicating. The content includes communication tools and techniques; culture, person, place and communication; communication for sustainability; communication and environmental behaviour; environmental behaviour and peoples' everyday choices; community based social marketing for sustainable behaviours; using video to interpret for the environment; environmental communication and the need for environmental communication. Principles of system sustainability - ecological integrity, economic security, democracy and community; sources survey for environmental information; tools and techniques in environmental communication; media channels for environmental communication; effective writing for the different media channel; effective speaking skills under different settings; and media ethics and environmental ethics.

**AMRM 572** **Crop Ecology and Physiology (E) (3)**

The course explains the plant-environmental factors, relations; distribution and diversity of plant species populations in natural and agroecosystems; plant community diversity and ecosystem dynamics and plant ecological processes; plant biodiversity conservation; vegetation cover classification and crop species distribution. Processes of photosynthesis, respiration, growth and development and other biochemical processes; plants reaction to different environmental stresses. The content includes climate and weather in crop production; the morphology, function and the environment of the root and shoot system; crop physiological response to stress associated with extreme of temperature, water (drought and flooding), alkalinity, salinity, and mineral nutrients. Environmental effects (biotic and abiotic) on major crop processes-photosynthesis, respiration, transpiration, absorption, movement and utilization of water and nutrients, source-sink relationships and plant growth regulators in relation to the root and shoot system growth and function; the development of yield in seed, root and tuber crops; yield analysis and the sequential determination of yield components

**AMRM 582** Animal Production Systems and Management in Climate Change

Principles and classification of animal production systems: ecological parameters; integration of animal and crop production systems; livestock industries. Ruminant (cattle, sheep and goats) and non-ruminant (pigs and poultry) production systems; herd and flock structures; breeding/production cycles and climate. Animal production systems and health; production and diseases; planning and management of production systems in relation to diseases control; herd/flock health management in relation to climate; weather effects on distribution of parasites and pathogenic microorganisms climatic effects on disease patterns and early warning systems. Animal husbandry systems in the ASAL: pastoralism, sedentary and transhumance.Direct effects of weather on animal performance; weather effects on major tropical livestock parasites and diseases and their management; forage quality and quantity. Early warning systems in relation to disease and pest indices; role of extension services in livestock production

**School of Natural Resource Management and Environmental Science**

**MSc in Environmental Science and Management**

Distribution of Courses by Year and Semester

**Core Courses**

**Year I; Semester 1**

|  |  |  |
| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| ESM 501 | Ecosystem, Biodiversity and Conservation Biology | 3 |
| ESM 511 | Environmental Statistics and Research Methods | 3 |
| ESM 521 | Environmental Pollution Control and Management | 2 |
| ESM 531 | Remote Sensing and GIS for Environmental Applications | 3 |
| ESM 541 | Waste Management | 2 |
| **Total** |  | **13** |

**Year I; Semester 2**

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| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| ESM 502 | Energy and Environment | 2 |
| ESM 512 | Earth Resources, Hazards and Risk Management | 3 |
| ESM 522 | Climate Change: Science and Management | 3 |
| ESM 532 | Environment and Sustainable Development | 2 |
| ESM 542 | Environmental Policy, Law and Advocacy | 2 |
| ESM 552 | Graduate Seminar in Environmental Topics | 1 |
| **Total** |  | **13** |

**Year II; Semester I and II**

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| --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** |
| ESM 661 | MSc Thesis | 6 |
| **Total** |  | **6** |

**Elective Courses**

**Year I; Semester 1 (**one course shall be selected)

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| --- | --- | --- |
| **Code** | **Title** | **Credit Hours** |
| ESM 551 | Restoration Ecology | 3 |
| EMS 561 | Eco-hydrology and Watershed Management | 3 |
|  | **Total** | **6** |

**Year I; Semester 2 (**one course shall be selected)

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| --- | --- | --- |
| **Code** | **Title** | **Credit Hours** |
| ESM 562 | Environmental Management and Impact Assessment | 2 |
| ESM 572 | Environmental management and Community Development | 2 |
| ESM 582 | Environmental Economics | 2 |
|  | **Total** | **6** |

Course Descriptions

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| **ESM 501** | **Ecosystem, Biodiversity and Conservation Biology** |

This course begins with the fundamentals of Ecology-meaning and scope; Ecosystems - types, structural and functional aspects; Energy flow in ecosystems, food chain, food web, trophic levels, ecological pyramids; Ecotone; Ecological niche Hydrologic cycle, Biogeochemical cycles — carbon, nitrogen, and phosphorus cycles.

As biodiversity loss is occurring nearly everywhere, it will introduce students to the science of biodiversity and to the ecological underpinnings of species extinction and conservation. In under this, the lectures fist provide a basic foundation for understanding what biodiversity is, how it is measured and where it is found. Next the course considers how human uses and pressures affect habitats and species, both directly and indirectly, leading to population decline, loss and eventual extinctions. This ecological foundation provides the basis for conservation solutions introduced in the last part of the module. From this module, students will gain an understanding of how ecological theory relates to conservation practice. It will allow them to appreciate the need for broad and critical thinking to integrate economic, legal, political, and social perspectives with biological ones in environmental management. Prior models being applied by prominent scientists in the field will be introduced to students with their application. Specific seminar topic will be given for each student for review and presentation, and with field educational excursion report and final examination, will be considered for final evaluation.

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| **ESM 511** | **Environmental Statistics and Research Methods** |

1. Introduction: Environmental Variables - Discrete and continuous; Data collection – primary and secondary; Presentation of data - spatial and non-spatial data; Basic Statistics – frequency distribution, Measures of Central Tendency and Dispersion, Moments, Skewness and Kurtosis; 2. Probability Rules and Theoretical Distributions: Basic probability rules, expectation, conditional probability; Probability distributions – Binomial, Poisson, Normal and Log-normal distributions; Fitting of probability distributions to environmental data; 3. Design of Sample survey: Population and sample, Advantages of sampling over complete census and its limitations, Different techniques of sampling –simple random sampling, stratified random sampling, systematic sampling; Relative advantages and disadvantages of different techniques; 4. Analysis of Variance: Different types of models used in AOV; Basic assumptions and its violation; One and two way classified data; Application of AOV to environmental data; 5. Sampling distribution and Test of Significance: Parameter and statistics; Sampling distribution, Standard error and its uses; Concept of t- distribution, F-distributions, Chi Square distribution without derivation and their applications; Null hypothesis and uses of t- test, F-test, Χ2-tests; Test of significance of large samples; 6. Correlation and Regression: Bi-variate data and scatter diagram; Simple (linear) correlation and regression; Coefficient of correlation and regression and their properties; Fitting of regression line; Multiple and partial correlations and regressions; 7. Theory of Attributes: Definition and classification of Attributes, Contingency Table, Independence of attributes, Yule’s coefficient of association and its properties; 8. Time series analysis: Components of time series, Models, measurement of trend, seasonal movements, cyclical movements.

Environmental scientists, environmental managers and ecologists must also monitor and evaluate the environment in order to measure and manage the effects of human activities. Designing robust monitoring schemes and experiments and handling quantitative data are essential skills for all environmental professionals and academics. The second part of the course will introduce students to commonly used methods for designing sampling schemes, managing data and performing statistical analyses. The course is taught primarily using computational software like R/SPSS, which are available freely for researchers and statisticians. It will also make students be familiar with the best practice for written and oral communication of research output; be able to analyse proposals or written papers critically; and be aware of their role in a team and the advantages and constraints of team-working.

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| **ESM 521** | **Environmental Pollution, Control and Management** |

***Introduction:*** Definition and sources of pollution; Different types of pollution and their global, regional and local aspects; ***Air Pollution:*** Types and sources of air pollutants; Reaction of pollutants in air forming smog, PAN, Acid rain; Atmospheric diffusion and stack performance; Transport of pollutants; Effects of air pollutants on flora and fauna; Sinks of atmospheric gases; ***Water Pollution :*** Sources of water and their contamination; Types of pollutants, various industrial effluents such as pulp and paper mills, oil exploration and refinery, , petrochemicals, iron and steel industries, domestic wastes ,organic debris, agricultural wastes, pesticides; Treatment of water and waste water. Eutrophication – causes and effects and control measures; ***Soil pollution and solid waste pollution:*** Causes of soil pollution; Effects of Fungicides and weedicides on soil components, residual toxicity and pollution. Different kinds of synthetic fertilizer (N, P, K), and their interactions with different components of soil, their toxicity and pollution. Industrial effluents and their interactions with soil components, Contamination by radio-nuclides. Solid waste pollution : sources, nature, classification and environmental effects; ***Radiation Pollution :*** Radioactive decay; Interaction of radiation with matter; Biological impact and health hazards associated with radiation, Units of radioactivity and radiation dose; Protection against ionizing isotopes and their applications in waste water and air pollution analysis and treatment; Radioactive waste disposal; ***Noise Pollution :*** Basic properties of sound waves – plane and spherical waves, sound pressure, loudness and intensity levels, decibel; Sources of Noise Pollution –Measurement and analysis of sound, Measures to control noise pollution; ***Thermal pollution:*** Definition and sources, Chemical and biological effects of thermal pollution, Effect on marine life, bacteria and water quality and other aquatic biota; Thermal pollution from power plants and their control; 8. ***Oil pollution*** : Oil pollution and marine ecology, sources of oil pollution, factors effecting fate of oil after spillage movement, spreading, evaporation, emulsification, dispersion, remote sensing in water quality monitoring.

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| **ESM 531** | **Remote Sensing and GIS for Environmental Applications** |

**Remote sensing**: Principles of Remote Sensing-Concepts of Remote Sensing, Electromagnetic spectrum; effects of atmosphere, Physics of remote sensing, Principle of scanner and CCD array, Spectral reflectance of earth’s surface features in different wavelength region of electromagneticspectrum: spectral characteristics of surface features (rocks, soils, vegetations, water). Space Imaging - Landsat, SPOT, IRS, NOAA, Seasat, ERS, RADARSAT, INSAT satellites and their sensors, geometry and radiometry, Orbital characteristics, Data products. (a) Thermal and remote sensing: Basic principles, Radiation laws, Sensing radiant energy, Thermal sensors, characteristics of image and their uses. (b) Microwave remote sensing: Basic definitions and principles, advantages, Types of microwave systems - RADAR, SLAR, SAR; General characteristics, spectral resolution and interpretation. Digital Image Processing: Principles, Image Rectification and restoration, Image enhancement and Mosaicing. Image classification - Supervised, Unsupervised, Ground truth data and training set manipulation, Classification accuracy assessment. Aerial Photographs and Satellite Imageries: Fundamentals of photogrammetry, areal cameras, planning of areal photography, principle of stereophotography, parallax and measurement of height & slope; characteristics of aerial photographs; Elements of image interpretation - visual interpretation of aerial photographs and satellite imageries, instruments used in interpretation; Path and Row Index Maps; selecting and ordering images; Interpretation of photographs and images for environmental analysis.

**Geographical Information System (GIS):** Basic principles and terminologies, Raster and vector data, Map projection, Topology creation, Overlay analysis, Data structure and Digital cartography; Software used in GIS. Surveying: Leveling, Triangulation, Geodetic survey; Global Positioning System (GPS) – Basic principles, Applications to environmental studies. Application of Remote Sensing and GIS in Environmental Management: Applications of Remote Sensing and GIS in environmental monitoring and action plan development of environmental fragile area; Natural resource management - forest resources, water resources, land resources and mineral resources; Hazard and disaster mapping and management. The theoretical explanation of both remote sensing and GIS will be supported by practical exercise in the GIS-lab available in the university.

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| **ESM 541** | **Waste Management** |

**Wastewater management**: 1) Introduction: Disposal standards for wastewater in normal water course and on land, estimation of sewage quantity, flow variations, sewage characterisation, BOD growth curve and analysis, estimation of BOD rate constant by Thomas slope method. 2) Status of Water Quality in Ethiopia: Assessment of causal factors responsible for the deterioration in water quality, status of surface and ground water quality in Ethiopia, National river action plan. 3. Water Purification in Natural Streams: Self-purification of waste in streams, zones of purifications, eutrophication of lakes. 4. Sewage Treatment: Conventional sewage treatment plant flow sheet, variations in flow sheet for different flow conditions, Description of various units in sewage treatment plant. 5. Treatment Technologies: Physical processes - Screen chamber, Grit chamber, primary settling tanks, secondary settling tank, sludge drying beds, filter press, vacuum filtration, and belt press. Low Cost Treatment Technologies - Septic tank; Imhoff tank; Oxidation ponds; Aerobic lagoons. 6. Biological treatment: Biology of sewage treatment, biological growth and biological oxidation, kinetics of biological growth; process description of aerobic and anaerobic processes. Operational Principles and Design of – activated sludge process, extended aeration, Step aeration etc. 7. Anaerobic Treatment Technologies: Upflow anaerobic sludge blanket clarifier, anaerobic fixed film fixed bed reactor, anaerobic fluidised bed reactor; anaerobic digestors for sludge stabilization.

**Solid waste management:** 1. Introduction: Types and sources of solid wastes - Municipal, solid waste, Industrial solid wastes, Bio-medical wastes and Hazardous wastes; Recycling of wastes and waste minimization techniques; Disposal of solid wastes; Present scenarios of municipal and industrial waste management in Ethiopia. 2. Properties of Solid Wastes: Physical and chemical composition of municipal solid wastes, waste generation rates, factors effecting waste generation rates. 3. Management of Solid Wastes in Ethiopia: Prevalent SWM practices and deficiencies - Storage of waste at source, segregation of wastes, Primary collection of waste, transportation of waste, disposal of wastes, institutional deficiencies. 4. Engineered Systems of Solid Waste Management: Design specifications of primary waste collection tools, waste storage bins, transportation vehicles, route selection and provision of transfer stations. 5. Composting and Anaerobic digestion and Incineration: Composting - Aerobic composting, Anaerobic composting, mechanical composting, vermin composting; advantages and limitations of composting technologies, Economics of composting Anaerobic digestion - Traditional digestors such as KVIC model, Deenbandhu model, emerging technologies for waste stabilization Incineration - Fuel Pellets, Refuse derived fuels, mechanical incinerators; advantages and limitations of incineration. 6. Sanitary land-filling: Site selection, rapid EIA of proposed sites, Method of preparing sanitary landfill site, land filling techniques, operation and maintenance of landfill sites including leachate collection and treatment, recovery of methane from landfill sites for power generation. 7. Hazardous Waste Management: The Hazards, Definition & classification of Hazardous Waste Hazardous Waste Management, Treatment Technologies, Land disposal, Biomedical Waste & its Management.

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| **ESM 502** | **Energy and Environment** |

**Introduction**: Energy, work and power; Different forms of energy and energy transformations; First and second law of thermodynamics, heat transfer, concept of entropy and photosynthesis. Human energy requirement, Energy use pattern in different parts of the world; Energy use pattern in Ethiopia; Resources of energy and their classification;

**Fossil Fuels and Nuclear energy**: Concept of resource and reserves; Fossil fuels – classification, energy content, composition; Fossil fuel reserves; Environmental problems associated with exploration/mining, processing, transportation and uses of fossil fuels and their management. Fission and fusion; Nuclear fuel cycle - Mining and processing, concentration, refining, enrichment, fuel fabrication; Nuclear reactors and radioactive waste; Environmental problems and management;

**Bio-energy**: Biomass composition and types; Conversion processes – pyrolysis, charcoal/briquette production, compression, gasification and liquefaction; Energy plantation; Biogas – production and uses; Environmental constrains and its management; Solid wastes management through energy production;

**Solar and Wind Energy**: Harnessing of solar energy, Solar collectors and concentrators, Solar thermal energy and electricity generation, Solar heaters, dryers, and cookers; Photovoltaic: Environmental aspects and management. Harnessing of wind energy, Power generation – wind mills, concentrators, wind characteristics and siting, environmental considerations and management; Wind energy potential in Ethiopia with special reference to Northeast Ethiopia;

**Hydropower, Tidal energy and OTEC**: Principle of generation of hydroelectric power; Mini and micro hydropower development; Hazard related to hydropower generation and distribution and its management, Management of environmental problems associated with hydropower, with specific reference to Ethiopia. Harnessing of tidal and wave energy; Environmental problems and management; Ocean thermal energy conversion (OTEC) and its environmental aspects;

**Geothermal and Hydrothermal energy**: Sources – crust, high temperature aquifers, low temperature aquifers, reserves; Harnessing of geothermal energy – problems and prospect; Geothermal energy prospect in Ethiopia; Hydrothermal energy; Tidal and wave energy, Problems, prospects and management;

**Energy Conservation and Energy Economics**: Energy efficiency at national level; Improving energy efficiency; Energy analysis; Capital recovery factor; Levelised annual cost; Economic analysis of wind electric generation and thermal power systems;

**Use of wastes/biomass and energy use pattern in Ethiopia**: Introduction, water-based biomass, Energy from Wastes, Solid Wastes, Research and Development, Biogas-an Energy from Wastes, Biogas Technology, Biogas Programs in Developing Countries, Experience with Biogas in Ethiopia, Biogas Plants, Use of Biogas, Utilization of Effluent, Cost of Installation, Annual Costs and Savings, Financial Assistance from Government, Organization of the Biogas Sector, Potential for Biogas Generation and Digester Construction, Future Energy Scenario of the World.

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| **ESM 512** | **Earth Resources, Hazards and Risk Management** |

Environmental Resources : Air, Water, Soil, Minerals, Forests and Energy resources; Concept of reserve and resources; Problems with the exploitation of resources.

Natural disasters; nature, causes and effects; cyclone, tornadoes, floods, earthquakes, avalanche, landslides, drought, diseases, fire, volcanism, case study of disasters, forecasting and warning systems of disasters, measurements of responses of disasters, community reaction to disaster, coping mechanism, classes of victims, disaster management, predisaster phase, actual disaster phase, postdisaster phase, disaster assistance: technological assistance, relief camps, organization, camp layout, food requirement, water needs, sanitation, security, information administration, fire fighting camping and tent pitching, rope, knots and their use, rescue, emergency rescue, disaster education, alternatives and new directions: conceptualizing disaster recovery, mitigation and preparedness, programme planning and management.

Occupational risk analysis survey and health evaluation, behavioural studies, occupational injury, disease reporting, investigation: monitoring and control of environmental hazards, occupationally induced illness, non-occupational illness, discomfort at work, the epidemiological approach, occupational health practice: investigation, monitoring, control, characteristics and hazards of radioactive materials, dispersion of radioactive materials, risk assessment techniques for accidental release of toxic and inflammable materials, hazard analysis, potential risk, conceivable release mechanisms and release rates, fire and explosion hazards and simplified models for their assessment, examples of occupational health hazards: nasal cancer, asbestosis, bronchitis, heart disease and occupational health services. The course will also introduce major models being used in the field with their applications.

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| **ESM 522** | **Climate Change: Science and Management** |

This course will provide students with an insight into both the science and management of climate change.

Climate Change**:** Earth’s Climate System, climate and climate change modelling; Past, Present and Future Climate; The greenhouse effect and major Greenhouse gases. Future Climate Scenarios and its impact on tropical and temperate regions. Adaptability of ecosystem to climate change. Ethiopia specific impact of climate change on different sectors. Climate Change Mitigation**:** Way and means, the concept of Carbon Sequestration.. Global Carbon Cycle: Stocks and Fluxes of Carbon in terrestrial and marine ecosystems and anthropogenic impact. Policy Perspective: UNFCC, Role and Function of IPCC, Kyoto Protocol and its implication on Developed and developing countries, operationalization of Kyoto Protocol. The Clean Development Mechanism (CDM) and its operationalization, modalities and procedures for CDM Project, National Communication to the UNFCCC (NATCOM). The Energy Perspective: National and International for Energy use and its implication on Climate Change. The Forestry Perspective: Forest: Source or Sink of Carbon, Measuring of Carbon Dioxide. The Climate Mitigation potential of Forest and its evaluation, Land use, Land use Change and Forestry (LULUCF), Evolution of LULUCF in CDM. How to develop Carbon Sequestration Projects their Modalities and Procedures.

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| **ESM 532** | **Environment and Sustainable Development** |

This course analyses environmental issues that are critical to developing countries in Africa, Asia and Latin America from a natural resource and livelihood perspective. The analysis considers global, regional and local dimensions of the issues at hand, with a focus on the relationship between the environment and the development process, changes in resource access, and adaptations to global and local environmental change. The course looks into conceptual approaches, international policy dimensions and some critical environmental problems, while reserving time for an active role of the students. The sessions on conceptual approaches are positioned at the beginning of the course. Topics include: Environmental discourses (e.g. environmental problem solving, survivalism, sustainability discourses, green radicalism); Theoretical approaches (e.g. neo-Malthusianism, ecological modernisation, political ecology / environmental political geography); With regard to international policy dimensions, we will look at how sustainable development is embedded in international policies, paying attention to:  the origins of thinking about sustainability and sustainable development and its evolution to the present day,  and the nature of policy choices about the environment and development strategies and between reformist and radical responses to the contemporary global dilemmas; and the politics of preservation.

Critical environmental problems dealt with in the course include deforestation, the deterioration of coastal regions and fish stocks, dryland degradation, climate change, and urban environmental problems. Applying insights from various ecosystems (tropical forests, coastal ecosystems, drylands and the urban environment) in Africa, Asia and Latin America, these sessions examine issues such as: The importance of resources for development / poverty alleviation; Resource constraints (including inequalities in access, geopolitical constraints and increasing scarcity); The interrelationship between environmental and development issues (how does development impact on the environment (e.g. deforestation, soil erosion, global warming, pollution, biodiversity loss) and vice versa (climate change, environmental shocks/disasters); and how can environment and development be reconciled (i.e. how can poverty and resource degradation be overcome)?

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| **ESM 542** | **Environmental Policy, Law and Advocacy** |

This course focuses on existing notions of policy formation by drawing on a range of policy theories and environmental policy case studies. It examines the relationship between public policymaking and environmental issues, and reviews major themes such as risk, complexity, evidence, expertise, technology, and institutions. This course is interdisciplinary in nature and examines a range of environmental policy studies that help to explain how environmental awareness and scientific evidence affect the policy process. An examination in the way the institutions and individuals play their roles in the outcome of selected environmental issues. An introduction to environmental law. Legal methods available to resolve environmental problems and the scope and limitations of these methods. Limits of litigation. Examination of the existing environmental legislations in the statutes. Harmonization of environmental Acts, alternative and implementable environmental law. A study of political processes at work in Ethiopia which shape the environmental decision making. Examination of environmental advocacy groups, NGOs and international organizations. Examination of view points, and interaction with guest speakers on various environmental issues.

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| **ESM 552 Graduate Seminar in Environmental Topics** |

In this course, student will apply their understanding of environmental science in the context of environmental management in an individual case study exercise. Each student will work on a specific on selected literature topic/issue/problems of current advances and developments in environmental science and management and other related fields, which they select from a list of topics provided by staff or select by their own. Each group provides both a written and an oral report on their findings.

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| **ESM 611 MSc Thesis** |

This requires a graduate student to undertake an independent original research on a topic relevant to environmental science and management under the supervision of a major professor in the field of the study. The topic and planning of the study is to be determined jointly by the student and his advisor, and the research is designed to include Thesis presentation and open defense to be discussed as partial requirement for the MSc Degree.

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| **ESM 551** | **Restoration Ecology (E)** |

Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems. Aims and strategies of restoration: Concepts of restoration, single vs. multiple end-points; ecosystem reconstructions; physical, chemical, biological and biotechnological tools of restoration. Restoration of biological diversity: Acceleration of ecological succession, reintroduction of biota. Degradation and restoration of natural ecosystems: Forests, grassland. Savanna, aquatic. Restoration of degraded soils: Restoration of contaminated soils and soil fertility, mine spoil restoration.

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| **ESM 561** | **Eco-hydrology and Watershed Management (E)** |

1. *Introduction*: Hydrologic cycle and hydrologic budget, Inventory of Earth’s water, Global Water Balance; Drainage basin – characteristics, Surface and subsurface environment; Stream classification and ordering; 2. *Precipitation*: Mechanism, forms and types of precipitation; measurement of precipitation - rain gauge, radar, satellite; analysis, presentation and interpretation of precipitation data – areal distribution, temporal variation, estimation of areal average; Precipitation characteristics in Ethiopia– seasonality, areal distribution and trend; precipitation characteristics of various agroecological zones of Ethiopia; 3. *Water Abstractions*: Different process of water abstraction in a basin; Evaporation and evapotranspiration- Mechanism, Factors affecting evaporation and transpiration, Measurement of evaporation and evapotranspiration; estimation of evapotranspiration; Infiltration and percolation - Infiltration capacity of soil, Factors influencing infiltration capacity, methods of determining infiltration capacity; 4. *Runoff and Stream flow* : Factors affecting runoff – climatic & physiographic; stream flow measurement – stage and discharge, measuring instruments; Stage-discharge relationship - rating curves and their determination; Stream flow hydrograph – elements, analysis, flow separation; Unit hydrograph – concept, assumption, construction, limitations and uses Water erosion - mechanism, type, estimation; Sediment yield of a basin; 5. *Ground water*: Definition – soil moisture, Water table, Aquifers; Geology of aquifers; Ground water flow; Abstraction of ground water; Environmental influences on ground water -fluctuations due to evapotranspiration, fluctuations due to meteorological phenomena, urbanization: Ground water recharging and rain water harvesting; 6. *Hydrological forecasting*: Frequency analysis, Probability of the N-year event, Probability; plotting, cyclical nature of hydrological phenomena; 7. *Wetland and Forest hydrology*: Wetlands – definition and classification, Hydrologic regimes –reduction of flash flood, storage of water, role in ground water recharge; Role of forests in ground water recharge, soil conservation and flood moderation; 8. *Watershed Management*: Concept, objectives, planning and measures; Land use planning for watershed management; Water harvesting and recycling; flood control and watershed management; Socioeconomic aspects of watershed management.

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| **ESM 562** | **Environmental Management and Impact Assessment (E)** |

Environmental Management, Concepts of Environmental management, aspects and approaches to Environmental Management, Ecological basis of environmental management, and agro-climatic regional planning. This course will also train students in a range of methodologies for assessing and managing impacts to the environment. Students will be introduced to the core set of assessment tools included in environmental impact assessment, environmental risk assessment, environmental audit, environmental management systems and life cycle analysis. Lectures will be supplemented with case studies from Ethiopia and practical sessions giving hands-on experience in key techniques. By the end of the course, students will understand the different approaches for assessing impacts to the environment and how to apply these to real world situations. The course will be supported by specific case examples.

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| **EVSM 572** | **Environmental Management and Community Development (E)** |

Poverty and environment, Green technology options and approaches, Sustainable Land Management, Gender, Development and environment; local knowledge systems and community-based environmental and natural resource management, approaches to community organization and collective action including conflict management, in environmental/natural resource management, implementation, monitoring and evaluation of environmental/natural resource programs; government support policies and strategies like the Growth and Transformation Plan of Ethiopia, and particularly the Climate Resilient Green Economy strategy and integrated natural resources management including the objectives, types, process, and regulatory mechanisms. In this course, particular cases studies of Ethiopia will be introduced and its environmental and development implications will be discussed.

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| **ESM 582** | **Environmental Economics (E)** |

Environmental Economics: Definition, Concept of externality, Solutions to correct externalities green economics, neoclassical economics, money; Ecological economics: Locating ecological economics, economy in the environment, environment in economics, science & ethics, Utilitarinism, sustainable development, ecological & neoclassical economics; Economics of Environmental quality: General model of target level of pollution, Abatement cost, Socially efficient level of emissions, MAC Curve to profit maximization; Environment and trade: Perspectives of trade & environmental development, International environmental management Multilateral environmental agreement, Structure of the world trade organization, Impact of economical linikages, Environmental standards & competitiveness. Banking for the environment: Forest clearances & agricultural intensification, Environmental degradation,A case studies Economics of environmental degradation, Reduced economic viability, Environmental cost benefit analysis, Banking economics & environmental accounting, Institutional environmental impact assessments. Macroeconomic accounting, Macro economical Policy, Micro level Policy. Environmental accounting: Environmental accounting disciplines, environmental management accounting, Environmental accounting model Life cycle of accounting system, environmental performance indicators, Accountabilities environmental performance reports; Environmental cost accounting: Expanding base of cost accounting, Internal & external environmental lost, Internalizing externalities, Full cost environmental assessment. Economics of Pollution control: Methods for reducing pollution, Emission charges & standards command & control regulation, Pollution rights, Global level pollution control, Kyoto protocol; Integrating environmental economics: Rural development & sustainable agriculture, Agroecology, Watershed & water quality, Biological diversity, land use & land tenure, Urbanization & migration, Conservation methods, Pollution & waste products; Guideline for performing economic analyses: Conducting economic analyses, Causes of market failure Regulatory & non-regulatory approaches, Baseline specifications, multiple rules & regulating measuring environmental policy, Performing sensitive analysis Welfare considerations, cross-cutting issues.

**School of Natural Resource Management and Environmental Sciences**

**Master of Science (MSc) Program in Irrigation Agronomy**

**List of Courses**

**Course Breakdown by Year and Semester**

**Year I, Semester I & II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** | |
| **Sem. I** | **Sem. II** |
| PLAG 511 | Biometrics | 3 | 0 |
| IRAG 521 | Soil-Water-Plant-Environmental System | 3 | 0 |
| IRAG 531 | Agroclimatology | 3 | 0 |
| IRAG 541 | Irrigation and Drainage Mnagement | 3 | 0 |
| IRAG 551 | Plant Stress Physiology | 3 | 0 |
| IRAG 561 | Current Topics in Irrigation Agronomy | 1 | 0 |
| IRAG 571 | Watershed Management (E) | 3 | 0 |
| IRAG 512 | Water Use & Irrigation Management of Agronomic Crops | 0 | 3 |
| IRAG 522 | System Analysis and Crop Modeling (E) | 0 | 3 |
| IRAG 532 | Irrigation Project Planning | 0 | 2 |
| IRAG 542 | Methods and Scheduling of Irrigation | 0 | 2 |
| IRAG 552 | Management of Irrigated Soils | 0 | 3 |
| IRAG 562 | Cropping Systems, and Fertilizer Use in Irrigation | 0 | 2 |
| IRAG 572 | Diagnostic Analysis & Performance Evaluation of Irrigation Projects | 0 | 2 |
| IRAG 582 | Graduate Seminar in Irrigation Agronomy | 0 | 1 |
|  | **Total** | **16/19** | **15/18** |

**Year II, Semester I & II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** | |
| **Sem. I** | **Sem. II** |
| IRAG 611 | M. Sc. Thesis Research | 6 | 6 |

**Course Description**

**PLAG 511 Biometrics (3)**

Applied statistics, sampling and data collection of biological samples, experimental designs and analysis of variance, covariance, correlation coefficients, regressions, multivariate analysis, interpretation and reporting of results. The course should include case studies and use of statistical software.

IRAG **521 Soil-Water-Plant-Environment Systems (3)**

Soil Physical properties affecting water retention: soil texture and particle size analysis, structure aggregate stability, clay mineralogy, bulk soil properties (densities), bulk Soil properties (densities, porosities, mass-volume relations); water Properties: use of water for plants, properties of water affecting water retention by soil (hydrogen bonding, cohesion and adhesion, capillarity; Energy state of soil water: soil moisture characteristics curve, available soil moisture; Field water regimes: Infiltration, redistribution, evaporation; Process of water absorption by plants:, water pathways in the root, active and passive water absorptions; theories of water movement (cohesion and tension theory and others; effect of moisture stress on physiological processes, direct and indirect methods of estimating crop water requirements, use of Computer programs in estimating cropwater requirements, season crop-water requirements of common crops.

IRAG **531 Agroclimatology (3)**

Elements of weather and climate: measurement, collection, quality control and processing of climatic data; introduction to agrometeorogoical fields stations: definition, concepts, measurements and computation of reference (ETo) and crop (ETc) evapotranspiration under standard and non-standard conditions, definition and calculation of dependable and effective rainfall from historical rainfall data, measurement of rainfall intensity and estimation of runoff; determination of length of growing period; weather and crop productivity; control of climatic variables, the hydrologic cycle, climate and water resources, moisture water availability; drought and drought mitigation; classification of climate and agro- climate, meaning and concept of climate change, impact of climate change on water supply for irrigation; weather relation of major crops.

IRAG **541 Irrigation and Drainage Management (3)**

Introduction: Water resources of the World and African continent, Water resources development in Ethiopia; Irrigation water management: Scheme irrigation need and supply, Estimation of critical command area, Matching scheme irrigation need with supply, Irrigation efficiencies; Surface irrigation system design: Introduction, Conveyance and distribution structures, Basics in canal design; Basics design principles; Agricultural drainage: Introduction and definitions, Need for agricultural drainage, Types of agricultural drainage.

**IRAG 551 Plant Stress Physiology (3)**

Response of plans to soil salinity stress, mechanism involved in salt tolerance of plants germination of seeds under salt stress, impact of soil pH on nutrient uptake by crop pants, mineral nutrias uptake by plants grown under saline environments, plant adaptation to nitrogen and phosphorus limited soils, nitrogen metabolisms of plants to water deficit and excess water conditions; nutrient uptake of plants under water deficit and water logged conditions; photosynthesis under biotic and a biotic stress conditions; growth, respiration and efficiency response of crop plants to temperature and light stresses; plants response to air pollution and heavy metal stresses; physiological response of plants to disease and pest damage.

IRAG **561 Current Topics in Irrigation Agronomy (1)**

Students review and present seminars on recent development and advances in irrigation Agronomy.

IRAG **571 Watershed Management (E) (3)**

Basics of Watershed Management: Concept,Principles, objectives, working size, priority delination, components and approaches. Soil survey and Land capability Classification.Hydrologic process: Hydrologic cycle, precipitation, runoff and sediment yield. Agronomic and Physical Soil Conservation Measures. Gully Erosion: stages, extent, their control, reclamation and plugging. Water Resource Management: Development of surface water resources as reservoir, ponds and tanks, development of ground water and their extraction. Water Quality Standards. Development and formulation of watershed management projects and their economic analysis.

IRAG **512 Water Use and irrigation management of various crops**

Global water availability to agriculture; Importance of water to plants; Climatic variables and other factors affecting evapotranspiration, methods of estimating evapotranspiration; crop and irrigation water requairments, effective rainfall calculation, yield response to water, water use efficiency improvement strategies; irrigation methods appropriate for different crops.

IRAG **522 Systems Analysis and Crop Modeling (E) (3)**

Climatic factors in crop production; micro-climatology such as radiation interception, energy balance and transpiration; Philosophy and terminologies in simulation; basic elements of dynamic simulation; analysis of simple systems; developing simulation models for such systems; models of crop growth; quantitative calculations of the processes involved in crop growth and implementing them into a simple model; crop/weather models; utilization of weather data in crop growth simulation; running and studying existing crop growth models.

IRAG **532 Irrigation Project Planning (2)**

Definition, objective and necessity of irrigation project planning; planning steps; factors affecting planning; Irrigation project planning process: statement of objectives, collection of data, project formulation and evaluation, social, political and environmental considerations in planning; economic analysis/cost-benefit analysis of irrigation project; system analysis/ recourse management techniques; common pitfalls in irrigation project planning. Soil, water and land suitability analysis for irrigation.

IRAG **542 Methods and Scheduling of Irrigation (2)**

Methods of Irrigation; Soils and soil profile, Soil physical properties, Soil moisture estimation; Method of measuring Soil moisture, Lateral and vertical soil-water movements; Installation, calibration and Operation of irrigation different equipments; Principles of Irrigation scheduling, Methods of irrigation scheduling; Flow measurement.

IRAG **552 Management of Irrigated Soils (3)**

The course deals with description, properties, classification, extent, distribution, fertility, impacts on plant growth and management of irrigated soils. More specially it is designed to cover among others, the basic physiochemical properties of soils; principles of soil classification with emphasis to arid and semi arid areas; diagnosis and classification of salt affected soils, soil reaction, sources and secondary causes of soil salinity/alkalinity, effect on plant growth; plant responses to salt affected soils, management and reclamation, salt balance, leaching, leaching requirement, water quality for irrigation, reclamation of sodic and saline sodic soils, and gypsum requirement.

IRAG **552 Cropping Systems, and Fertilizer Use in Irrigation (2)**

Introduction, Shifting cultivation, monoculture, Intercropping, Sequential multiple cropping, Multistorey cropping, Ratoon cropping, Alley cropping, Cropping system and soil management, Plant population and planting geometry, Cropping System in Ethiopia, Assessing yield advantage in multiple cropping, Soil fertillity and world food supply; fertilizer use in developed and developing countries in relation to irrigation; Nutrient requiremnts of crops in relation to genetic potential and environment; Role of soil moisture and applied water in movement of ions within the soil; fertilizer efficiency under irrigated and dryland conditions; Fertilizer management and water use efficiency, Management of nutrients losses; Nutrient, wateruse and other interactions; Soil moisture level and nutrient absorption.

IRAG **562 Diagnostic Analysis & Performance Evaluation of Irrigation Projects (2)**

Diagnostic Analysis of irrigation system: definition, concepts and objective; diagnostic analysis and management improvement program (MIP); output of diagnostic analysis; the diagnostic assessment method: system –oriented approach, problem oriented approach, water balance and accounting, rapid appraisal, questionnaire surveys. Irrigation system performance evaluation : introduction , application of performance assessment, methodologies of performance assessment, design of the performance assessment program; performance indicators: general formats, types: comparative performance indicators; different perspective in performance assessment : socio-economic, environmental and gender consideration.

IRAG **572 Graduate Seminar in Irrigation Agronomy (1)**

Current literature and irrigation agronomic developments. Presentation on selected seminar topics by a graduate student.

**IRAG** 611 **MScThesis Research (6)**

This requires a graduate student to undertake an independent original research on a topic relevant to irrigation agronomy under the supervision of a major professor in the field of the study. The topic and planning of the study is to be determined jointly by the student and his/her advisor, and the research is designed to include thesis presentation and open defence to be discussed as partial requirement for the MSc Degree

**M. Sc. in Soil Science**

**Distribution of Courses by Semester**

|  |  |  |  |
| --- | --- | --- | --- |
| Course code | Course title | Cr. Hrs and Sem | |
| Sem I | Sem. II |
| SOSC 511 | Soil Genesis, Survey & Classification | 3 | 0 |
| SOSC 522 | Soil, Water & Plant Analysis | 2 | 0 |
| SOSC 531 | Soil Physics | 3 | 0 |
| SOSC 541 | Soil Chemistry | 3 | 0 |
| SOSC 571 | Remote Sensing and GIS (E) | 3 | 0 |
| PLAG 511 | Biometrics | 3 | 0 |
| SOSC 521 | Soil Microbiology & Biochemistry | 0 | 3 |
| SOSC 552 | Soil and Plant Nutrition | 0 | 3 |
| SOSC 512 | Soil & Water Conservation | 0 | 3 |
| SOSC 542 | Land Evaluation (E) | 0 | 2 |
| SOSC 562 | Management of Arid & Salt-affected Soils (E) | 0 | 3 |
| SOSC 582 | Graduate Seminar in Soil Science | 0 | 1 |
| SOSC 611 | M.Sc Thesis Research | 0 | 6 |
| **Total** | | **14(17)** | **10(15)** |
| **SOSC 611** | **MSc Thesis Research** | **6** | |

**SOSC 511 Soil Genesis, Survey and Classification (2+1)**

(Field visit of different soils is required)

Introduction on fields of pedology; role and importance of genesis in soil science and its relations with other fields of soil science; soil as a component of the ecosystem; morphology of soils, soil composition and characterization; weathering of rocks; factors/states and processes of soil formations, modern soil classification-history, principles and methods; Definitions and concepts of soil survey: kinds and planning soil survey, types and uses of soil maps; scale, intensity and cost of soil survey; base and final maps; map units and taxonomic units; Quality control of soil survey; the FAO-Unesco (FAO-WRB) system and USDA classification structures; soil landscapes; soils of Ethiopia and their agricultural significance

**SOSC 531 Soil Physics (2+1)**

History of soil physics, soil particles: their physical and mineralogical nature, soil texture and particle size analysis; significance of soil texture. Mass-volume relationships, Soil consistency and its significance, plasticity and Atterberg limits, shear strength, compression and compaction, soil impedance and crusting, soil structure: genesis and field evaluation, tilth-tillage relationships.

Soil-water and its measurement, energy state of water in soil, soil-water potential, water retention characteristics and its measurement and significance; Fundamentals of water flow, Darcy’s law, Hydraulic conductivity and its measurement; Infiltration and its measurement, evaporation, drainage and salt distribution in soil profile. Ecological and physiological importance of water in plant life, concept of water availability and extraction/absorption by plants, factors affecting water absorption, theories of water transport through different plant organs; significance of transpiration and evapotranspiration; water deficit and plant growth, optimization of water use, concepts of water-use efficiency in relation to crop production, relationship between water-use efficiency, fertilizer-use efficiency and yield.

Soil-air: its composition and seasonal variations; renewal of soil-air, measurement of soil aeration and soil aeration management; Sources and amount of soil heat, temporal and spatial variation of soil temperature, thermal properties of soil and soil temperature management.

**SOSC 571 Remote Sensing and GIS (E) (2+1)**

Concepts and foundation of remote sensing; GIS components; Data input, verification, storage and analysis in GIS: Raster and Vector data base structures and maps production; Data sources in GIS analysis (aerialphotos, topomaps and GPS); Techniques of discrete and continuous data analysis with emphasis on earth science attributes; Projections; DEM, image scanning and processing; Interpolation with Geostatistics; digital map processing and analysis; Quality control and GIS management

**SOSC 541 Soil Chemistry (3)**

Solution and surface chemistry of soils; soil chemical interactions with water, air , plans and pollutants; ion activities, exchange and equilibrium reactions; chemistry of soil organic matter; chemistry of P, Fe, Mn, Al and other specific elements; cation exchange capacity and availability of nutrients to plants

**SOSC 521 Soil Microbiology and Biochemistry (3)**

Introduction, importance and history of soil microbiology; soil as an environment for microbes and physical-chemical properties of soil influencing microbial population and activity; major microbial groups of soil and interactions among different groups and interactions with soil solid phase; rhizosphere and phyllosphere microbiology; plant growth promoting rhizobacteria; growth and nutritional requirements of soil microbes; soil enzymes; biochemical pathways of microbial decomposition of major organic carbon compounds in organic residues (cellulose, hemicelluloses, starch, lignin, chitin and pectin); microbial transformations of nitrogen, sulfur, phosphorus, iron, manganese and some other elements and their biochemical pathways; biological nitrogen fixation (responsible microorganisms, nodulation process and genetics, biochemical pathway, measurement of biological nitrogen fixation); biodegradation of pesticides and pollutants; fate of pesticides in soil; use of microorganisms in agriculture: soil biotechnology in relation to biofertilizers; biopesticides; bioconversion etc.

**PLAG 511 Biometrics (3)**

See Graduate Program in Agronomy

**SOSC 542 Land Evaluation (E) (2)**

Land evaluation: principles and concepts, data sources for land evaluation; types of land evaluation; methods of land evaluation: FAO Method (concepts of land utilization types, land qualities, land characteristics and land use requirements); the LCC USDA Method; parametric, limitation, yield estimate and statistical methods; GIS and land evaluation; land evaluation for irrigation, forestry, grazing and engineering purposes; presentation of results; land resources information systems; land evaluation and land use planning

**SOSC 552 Soils and Plant Nutrition (3)**

Introduction to the Basic Concepts of Soil and Plant nutrition; Food production and soils of world; Basic aim and objectives of soil and plant nutrition studies; Growth and phases of growth; Genetic and environmental factors affecting plant growth; Growth expressions and equations; Role of soil colloids in nutrient supply, exchange phenomenon and availability of ions; Movement of ions in soil (root interception, mass flow and diffusion of ions); Essentiality of nutrients and levels of nutrients in soil system in relation to plant; functions and deficiency symptoms of various nutrients in plant; nutrient transformations in soil (macro and micro nutrients) and their bioavailability; fertilizer nutrient sources and their management; Nutrients and water use efficiency; Soil organic matter (functions, availability of nutrients, effect on physical condition, erosion, buffering and exchange capacity, clay organic complexes); Use of organic manures and other organic wastes in agriculture; Use of microorganisms for nutrient supply; Use of soil and plant tests, their interpretation to evaluate nutrient status of soil; Sampling for soil and plant analysis; Calibration of soil tests against crop response; Nutrient use efficiency; diagnosis of fertilizer requirement and recommendation.

**SOSC 522 Soil, Water and Plant Analysis (2)**

Sampling and sample preparation (soil, plant and water), and principles and practices of laboratory techniques and methods of analysis of soil, water and tissue materials with emphasis on properties of agricultural and environmental significance; and analytical data processing, interpretation and reporting.

**SOSC 512 Soil and Water Conservation (3)**

Major Ethiopia soil and water Conservation and management problems and solutions, mechanics, processes and forms of soil erosion by water and wind and analysis of thin effects on food production; and problems related to degradation of land and water resources, soil erodibility, climatic erosivity and prediction of runoff and soil loss, cultural, biological/agronomic and engineering measures of erosion control, watershed management and other management practices appropriate for maintenance and sustainable utilization of the land, water and biological resources; advances in soil and water conservation research and water harvesting.

**SOSC 562 Management of Arid and Salt Affected Soils (E) (3)**

The use of diagnostic procedures for evaluating salt affected soils and irrigation waters of arid lands; origin, nature, properties and management of saline, saline-sodic, and sodic soils with special emphasis on their anthropogenic formation in reference to irrigation, drainage and reclamation methods; principles and practices of soil, water and crop management under arid and semi-arid conditions.

**SOSC 582 Graduate Seminar in Soil Science (1)**

Student presentation of a seminar on selected literature topic of current advances and developments in soil, water and environmental science with emphasis on Ethiopian soils and water use, management and other related aspects.

**SOSC 611 M. Sc. Thesis Research (6)**

This requires a graduate student to undertake an independent original research on a topic relevant to the soil and water resources of Ethiopia under the supervision of a professor/advisor (s) in the filed of study. The title, theme and planning of the study is to be determined jointly by the student and his advisor (s), and research is designed to include thesis presentation and open defense to be presented as partial requirement for the M. Sc. Degree in Soil Science

**DEPARTMENT OF RURAL DEVELOPMENT AND AGRICULTURAL EXTENSION**

**Master of Science in Rural Development and Agricultural Extension**

***Sub-specializations:***

* ***Agricultural Communication and Innovation for Development***
* ***Rural Development***

**Year I: Semester I (Common Courses)**

|  |  |  |
| --- | --- | --- |
| **Course code** | **Course title** | **Credit Hr.** |
| RDAE 511 | Historical Perspectives in Agricultural Extension | 2 |
| RDAE 521 | Rural Development Perspectives and Strategies | 3 |
| RDAE 531 | Research Methodology | 3 |
| RDAE 541 | Knowledge and Information Systems in Agriculture and Rural Development | 3 |
| RDAE 551 | Organization and Management of Training | 3 |
| RDAE 561 | Gender Analysis and Planning | 3 |
| Total |  | 17 |

**Year I: Semester II (Agricultural Communication and Innovation for Development Stream)**

|  |  |  |
| --- | --- | --- |
| **Course code** | **Course title** | **Credit Hr.** |
| RDAE 512 | Statistical Methods for Social Sciences | 3 |
| RDAE 522 | Ethnographic Fieldwork | 1 |
| RDAE 532 | Management Information Systems and Information & Communication Technologies (E) | 3 |
| AC 512 | Behavior Change and Decision Making (E) | 3 |
| AC 522 | Program Planning and Evaluation in Extension (E) | 3 |
| RD 522 | Rural Development Policies and Institutions | 3 |
| AC 532 | Communication and Innovation | 3 |
| AC 542 | Graduate Seminar in Agricultural Communication | 1 |
| AC 611 | Thesis Research in Agricultural Communication | 6 |
| TOTAL |  | 20 (14 + 6) |

**Year I: Semester II (Rural Development Stream)**

|  |  |  |
| --- | --- | --- |
| **Course code** | **Course title** | **Credit Hr.** |
| RDAE 512 | Statistical Methods for Social Sciences | 3 |
| RDAE 522 | Ethnographic Fieldwork | 1 |
| RDAE 532 | Management Information Systems and Information & Communication Technologies (E) | 3 |
| RD 512 | Rural Development Project Management (E) | 3 |
| RD 522 | Rural Development Policies and Institutions | 3 |
| RD 532 | Sustainable Rural Development and Natural Resources | 3 |
| RD542 | Graduate Seminar in Rural Development | 1 |
| RD 611 | Thesis Research in Rural Development | 6 |
| TOTAL |  | 20 (14 + 6) |

**Course Descriptions**

**I. Common courses**

**RDAE 511 Historical Perspectives in Agricultural Extension 2 cr.hrs.**

Foundations of extension education; extension as discipline and profession; philosophical basis of extension, criticisms of extension, critical analysis of different extension approaches; gender issues in agricultural extension; role of extension in globalization of agriculture; successful extension experiences in the world; experiences of privatization; farmers’ participation in technology generation and dissemination; use of indigenous technology in formal research; role of NGOs in extension; extension for sustainable agriculture; Technology assessment; and communication with farmers.

**RDAE 521 Rural Development Perspectives and Strategies 3 cr. hrs.**

A brief review of the meanings and concepts of (rural) development; rural poverty analysis: dimensions, causes and extent of poverty, measurement of poverty and food insecurity; dominant models of rural development; approaches to rural development; the economic and social theory of agricultural development; differentiation and commercialization in rural life and their role in agricultural development; history and trend in rural development in Ethiopia.

**RDAE 531 Research Methodology 3 cr.hrs.**

The meaning of methodology in scientific research: positivist social sciences, interpretive social sciences, critical social sciences; designing proposal; choice of research approaches; measurements in social research; research design in quantitative research: designing survey research; sampling design, unit of observation and analysis, methods of data collection, methods of data analysis; design of quantitative content analysis; design of qualitative research: types of qualitative researches; case study research, grounded theory, action research, ethical aspect of social research; essentials of scientific report writing.

**RDAE 541 Knowledge and Information Systems in Agriculture and Rural Development 3 cr. hrs.**

An overview of development paradigms; system thinking, distinctions between hard and soft system; soft system methodology; the place of agricultural knowledge and information system in rural development; evolution of approaches in development; knowledge typologies: indigenous knowledge and social learning; indigenous knowledge and scientific knowledge; information science and information system; understanding social organization of innovation; technology and social factors; extension and natural resources management; conflict management in NRM; roles of research and extension organization in agricultural and rural development; research and extension linkages; policy and policy making in agricultural and rural development.

**RDAE 551 Organization and Management of Training 3 cr.hrs.**

The role of training: competition through people; human resources development; models for training; the process of training: training and the organization; training and the individual; performance appraisal; training design and delivery; new approaches to measurement; managing the training function: the role of the training function; the implications for the trainer.

**RDAE 561 Gender Analysis and Planning in Rural Development 3 cr. hrs.**

Theory and practice issues in social exclusion and gender inequality; implications of inclusion and equity for rural development practice; approaches to planning; gender planning in developing countries; practical and strategic gender needs, gender issues: understanding the dynamics of gender in the community; understanding the dynamics of gender in the organization; gender-sensitive methodologies of social analysis (incorporating WID/GAD); gender and social change; management of change; the logical framework, case studies; gender planning workshop: preparation of action plans and presentation of action plans.

**RDAE 512 Statistical Methods for Social Sciences 3 cr. hrs.**

The review of basic statistical concepts; sampling – design and analysis; hypothesis testing; linear methods and estimation by least squares; regression on dummy variables; nonparametric statistics; introduction to applied multivariate techniques: factor analysis, cluster analysis and discriminant analysis.

**RDAE 522 Ethnographic Fieldwork 1 cr. hrs.**

Field-based training aimed at improving skills of designing and implementing field-based researches in agricultural communication and rural development. Students practice: field methods and techniques in ethnography (data collection, ethnographic records and notes, gaining access to research sites and relations in the field, etc); analyzing field data and writing ethnographic field report; evaluating strengths and weaknesses of ethnographic research in different settings.

**RDAE 532 Management Information Systems, and Information and Communication Technology (ICT) (E) 3 cr. hrs.**

Management information systems; management information systems and decision making; computer hardware and software for information systems; data communication systems; database management technology; project management information systems; project management information system design: understanding information users and their needs, reviewing of existing information systems, supplementary data collection and recording; integrating information system into the management structure, cost of the information system; communicating information; communicative intervention and hybrid media (the internet): modalities of the internet, functional qualities of hybrid media, internet applications for communicative intervention.

***II. SUB-SPECIALIZATION IN AGRICULTURAL COMMUNICATION AND INNOVATION FOR DEVELOPMENT***

**AC 512 Behavior Change and Decision making (E) 3 cr. hrs.**

Psychological principles and dynamics of human behavior; knowledge and perception; relationships between attitude and behavior; theories and models of decision making, and behavioral change; the field theory and practice; behavior determining factors; dynamics in decision making and group action, leadership roles in coordination and problem solving; findings and limitations of empirical research.

**AC 522 Program planning and Evaluation in Extension (E) 3 cr. hrs.**

Advantages of programming; instrumental and interactive approaches; program models; procedures in program development: problem analysis, the writing of objectives and communication plans; purpose and process of evaluation, research designs for evaluation research; information sources; criteria of efficiency; quality of measuring instruments; scale construction; reporting; participatory monitoring and evaluation.

**RD 522 Rural Development Policies and Institutions 3 cr. hrs.**

Market, state and policy; the process of policy making; globalization and national policies; policy analysis framework; the concept of institutions; institutions and development; institutional perspectives on relative roles of markets and states in (rural) development; institutional change: improving rural financial markets and farm credit, cooperative institutions and agricultural development, change in rights to the use of land; institution and natural resource management; food policy and food security; women and polices; HIV/AIDS: a policy challenge.

**AC 532 Communication for Innovation 3 cr. hrs.**

Introduction to the field; human communication: theory and practice, concept and elements of diffusion; traditions of research on diffusion; typology of diffusion research; generation of innovations;new concepts and theories of innovation; innovation development process; the adoption process and innovation decision process; predicting innovativeness; simulation of innovation diffusion; attributes of innovations and rate of adoption; concept of over adoption; opinion leadership and multi-step flow of innovation: homophily and heterophily; type of innovation decisions; consequences of innovations; communication, innovation and planned change; media influence in modernization and development; communication and prospects of innovation development; approaches to communicative intervention; changing perspectives on innovation: innovation as a process of network building, social learning and negotiation.

**AC 542 Graduate Seminar in Agricultural Communication 1 cr. hrs.**

This envisages presentation of seminar by students on the current topics related to Agricultural Communication; presentation of a concept paper or theoretical perspectives that may enable to determine the thesis topic.

***III. SUB-SPECIALIZATION IN RURAL DEVELOPMENT***

**RD 512 Rural Development Project Management (E) 3 cr. hrs.**

Character and context of development project planning; policies and projects; functional types of projects; concepts and models of planning; the project cycle; organizational and inter-organizational issues; project implementation; project finance and financial management; project management systems: project monitoring systems, the control system, project management information systems, information technology in project management; managing people in project organizations.

**RD 522 Rural Development Policies and Institutions 3 cr. hrs.**

Market, state and policy; the process of policy making; globalization and national policies; policy analysis framework; the concept of institutions; institutions and development; institutional perspectives on relative roles of markets and states in (rural) development; institutional change: improving rural financial markets and farm credit, cooperative institutions and agricultural development, change in rights to the use of land; institution and natural resource management; food policy and food security; women and polices; HIV/AIDS: a policy challenge.

**RD 532 Sustainable Rural Development and Natural Resources 3 cr. hrs.**

Natural resources and economic development; importance of sustaining natural resources for sustaining livelihoods; sustainable natural resources management: property regimes, adaptive resource management, conflict and natural resources; role of communities and the state in ensuring sustainable natural resource management; trade-offs between sustainability and productivity; land tenure investment and sustainability; relevance of discount rates; poverty-environment relationships; causal factors explaining environmental degradation; diversification strategies; country case studies.

**RD 542 Graduate Seminar in Rural Development 1 cr. hrs.**

This envisages presentation of seminar by students on the current topics related to Rural Development; presentation of a concept paper or theoretical perspectives that may enable to determine the thesis topic.

**Master of Science in Agricultural Information and Communication Management (AICM**)

**Table 1: Core courses (Common for both Thesis and Non-thesis options)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year & Semester** | **Course code** | **Course Title** | **Credit Hours** |
| Year I Semester I | AICM 510 | Fundamentals of AICM | 3 |
| AICM 511 | Database Design and Management | 3 |
| AICM 512 | Information System Analysis and Design | 3 |
| AICM 543 | Farming Systems and Rural Livelihoods | 2 |
| AICM 624 | Perspectives of Agricultural Extension | 3 |
| AICM 563 | Graduate Seminar | 1 |
|  | Total | 15 |
| Year I Semester II | AICM 513 | Management of Agricultural Information and Communication Systems | 3 |
| AICM 516 | Agricultural Knowledge Management | 3 |
| AICM 515 | Web content Design and Management | 2 |
| AICM 561 | Statistical and Research Methods in AICM | 3 |
| AICM 522 | Communication for Innovation | 3 |
| AICM 523 | Decision Support system | 3 |
|  | Total | 17 |

**Table 2: Core Courses for Non-thesis Option**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year & Semester** | **Course code** | **Course Title** | **Credit Hours** |
| Year II Semester I | AICM 541 | Agricultural Policies and AICM | 3 |
| AICM 531 | Fundamentals of agricultural journalism | 3 |
| AICM 643 | Application of Geo-informatics in Agriculture | 3 |
| AICM 616 | Information storage and retrieval (E) | 3 |
| AICM 633 | Principles of scientific communication | 3 |
|  | Total | 12(15) |
| Year II Semester II | AICM 611 | Project | 3 |
|  | Grand Total | 44(47) |
| ear II Semester I & II | AICM 611 | Thesis | 6 |

**Table 3: Remedial Coursework**

|  |  |  |
| --- | --- | --- |
| **a) Agriculture content for non-agriculture students** | | |
| Pl.Sc.382 | Crop Production and Management | 4 |
| An.Sc.202 | Livestock Production and Management | 4 |
| NRM 202 | Principles of Natural Resources Management | 3 |
| **b) ICT/ICM content for non ICT/ICM students** | | |
| AICM 552 | Fundamentals of Computer Programming | 4 |
| AICM 553 | Fundamentals of Computing and Networks | 3 |

**Course Descriptions**

***AICM 610: Fundamentals of AICM***

*Lecture: 3 hrs; Lab: NA; Prerequisite: None*

Theoretical foundations of agricultural information and communications management; overview of current development goals and trends in agriculture in Africa; drivers of investment in agriculture; innovation systems, agricultural data, information and knowledge; systems and systems approach to solving problems, current agricultural information and knowledge systems, products, services and processes; people, processes and technologies that constitute agricultural information and knowledge systems; management of agricultural information and knowledge; communication theory, role of agricultural communication, agricultural communication processes, and products; diffusion theory, communication strategies and networks; strategic frameworks for communication of agricultural information; management of agricultural communications; emerging ICT, tools, and techniques for the management of agricultural information and communications; target groups for agricultural information at international, national and organizational levels; trends in information and communication technology; impact of agricultural information on development; national, regional and international information resources, networks and policies; managing agricultural information systems; ethical and social considerations in agricultural information systems and projects.

**AICM 611: Management of Agricultural Information and Communication Systems**

*Lecture: 3 hrs; Lab: NA; Prerequisite: None*

Basic principles, concepts, theories, and techniques of management as they apply in the information and communication management; agricultural information and communication resources and services; the concepts and processes of information resource management (IRM); Information resources planning; Information users and analysis of their requirements; Implementation of agricultural information and communication products, services, and systems; communication concepts and theory; managing agricultural communication processes; development and management of communication products and services; management issues in digital content management; Acquiring and managing new information technologies; Managing AICM projects; National and international issues relating to information access, such as standards relating to electronic storage and retrieval of electronic documents (digital archiving); Ethical, social, and economic issues in the management of information and communication resources and services

**AICM 612: Information System Analysis and Design**

*Lecture: 2 hrs; Lab: 1hrs; Prerequisite: None*

Systems concepts and theories; Organizational structure and theory; Human information processing; Systems theory; Information systems; Role of the systems analyst in organizations; Gaining user commitment and fulfilling user needs; Comparison of analysis and design techniques of major information systems development methodologies; Structured analysis and modeling techniques: process modeling, data modeling, logic modeling; Object-oriented analysis and design: unified modeling language; Elicitation/fact-finding, problem analysis, decomposition, and the requirements of documents; System project planning and management; Design principles, quality factors, decomposition of complex systems, and modularization techniques; systems implementation and maintenance issues; introduction to information systems development and automation tools; Issues and trends in the analysis and design of agricultural information management systems; group project to apply skills.

**AICM 613: Database Design and Management**

*Lecture: 1 hr; Lab: 1hrs; prerequisite: Info systems analysis and design*

Fundamentals of database concepts and architecture; Data models for database systems (network model, hierarchical model, relational model, and object oriented model); Relational data models and concepts; Relational algebra; Relational calculus; Relational database systems development - multi-valued and join dependencies, fourth and fifth normal form; Information retrieval and query language, structured query language; Query processing and optimization techniques; Transaction management and concurrency control; Database security and integrity constraints; Transaction management; Query optimization and case studies; Client server database architectures, distributed databases, object-oriented databases, logic-based databases, the Web as a database application, Web databases, architecture and systems; Introduction to data mining concepts; Current issues and trends in agricultural database design and management.

**AICM 615: Web Content Design and Management**

*Lecture: 2 hrs; Lab: 1hrs; Prerequisite: None*

Information architecture and Web content management; Technology and principles of user- centered contextual design approach; Skills design and development of user-friendly Websites; Using Web development and design tools; Evaluating Websites; Scripting tools, SGML, HTML, XML and WML; Authoring tools for Web application development; Document object model; Web database architectures and systems; Searching and browsing Web databases; Session management; Writing for databases and validation; Security and authentication; Web database performance; Web programming languages, scripting languages; New technologies related to Web design; Management, development and delivery of agricultural information contents through the Web.

**AICM 616: Agricultural Knowledge Management**

*Lecture: 3 hrs; Lab: NA; Prerequisite: None*

Historical and sociological foundations for knowledge; Theories/definitions of knowledge; Introduction to the field of knowledge management; Concepts, principles, and theories of knowledge management; Information management vs. knowledge management; Applications of knowledge management in agriculture; Agricultural knowledge systems; Identification and effective management of agricultural knowledge assets; Agricultural knowledge acquisition, generation, formalization, organization, sharing, utilization, measurement and evaluation; Identification of agricultural knowledge needs of end-users; Management of indigenous knowledge; Key technologies for agricultural knowledge management; Issues in selecting agricultural knowledge systems; Design and operation of agricultural knowledge systems and technologies; Trends in agricultural knowledge management.

**AICM 723: Communication for Innovation**

*Lecture: 2 hrs; Lab: NA; Prerequisite: NA*

Human communication: theory and practice, concept and elements of diffusion; Traditions of research on diffusion; Typology of diffusion research; Generation of innovations; New concepts and theories of innovation; Innovation development process; The adoption process and innovation decision process; Predicting innovativeness; Simulation of innovation diffusion; attributes of innovations and rate of adoption; Concept of over adoption; Opinion leadership and multi-step flow of innovation: homophily and heterophily; Type of innovation decisions; Consequences of innovations; Communication, innovation and planned change; Media influence in modernization and development; Communication and prospects of innovation development; Linkage systems in dissemination of innovations; Approaches to communicative intervention.

**AICM 661: Statistical and Research Methods in AICM**

*Lecture: 2 hrs; Lab: NA; Prerequisite: None*

Role and characteristics of research in the development of scientific knowledge; Research methodologies; Quantitative and qualitative approaches to research; Research process (quantitative/qualitative); Principles of scientific writing; Structure of quantitative and qualitative research reports; Development of research proposals thesis reports; Major areas of research in AICM: agricultural information user studies, access to agricultural data, information, and knowledge, Agricultural information retrieval research; agricultural information systems research, agricultural communications research; Introduction to statistical concepts, applications and measurement in AICM; Descriptive statistical procedures; Introduction to inferential statistical procedures; Statistical application packages (SPSS, SAS, EPINFO, MINITAB, MATHLAB, MSTAT).

**AICM 643: Farming Systems and Rural Livelihoods**

*Lecture: 45 hrs total (3 credit hours) (30 hours: 15 hours practical)*

Processes of environmental, economic, and social change from the global, regional and local perspectives; Emergence of new forms of production, exchange, consumption, and governance; Impacts of global and regional trends and changes on food and agriculture. Trends affecting the structure and dynamics of agro-food systems: i) trade liberalization; ii) deregulation of foreign investment; iii) withdrawal of state from active agriculture; iv) privatization of standards and establishment of new rules which raise barriers to entry (technology, management) to trade in agricultural products in certain commodity chains; and v) ascendance of regional and global retailers even in small and relatively poor economies, which is restructuring the governance and operation of agro-food supply and value chains and driving consolidation of food processing and manufacturing. National Growth and Innovation Systems -Commercial best bets in agriculture; Foresight Process-Understanding of long-term trends and the economic vision for the country; National Growth and innovation strategy and economic goals; National budgets, projects, short-term goals, and performance.

**AICM 663: Seminar on Current Topics**

*1 Cr hr (Orientation and Seminar Presentation)*

Seminar research and presentation by students on topical and cross-cutting issues of importance to agricultural and rural development to be reviewed regularly: Gender and agriculture/development; ICT policy; globalization and agricultural development; Urban farming; Environment and development; HIV&AIDS; Organic fertilizers, Agricultural informatics; ICT and Bio-energy; ICT and Genetically Modified Organisms (GMO) and agriculture; ICT and Global Environmental Change (GE).

**AICM 756: M.Sc. Thesis Research**

*06 Cr. Hrs Supervised research project and thesis writing*

*Prerequisite: Successful completion of all prescribed courses*

Working under the supervision of a supervisor, the student will go through the sequential steps in thesis proposal development and implementation. Specific steps to be covered include: Statement of the question/problem; search of the related literature; identification of gaps in knowledge; statement of hypotheses; formulation of project objectives; development of the research/intervention methodology; data collection and analysis; thesis design and scientific

reporting.

**AICM 711: M.Sc. Project (non-thesis option)**

*03 Cr.hrs Master Project Prerequisite: Successful completion of all prescribed courses*

Working under the supervision of a supervisor, the student will go through the sequential steps in project development stages. Feasible computer based project which intends to solve agricultural information management problems are to be developed. Such project could, for example, be improving the information storage, retrieval, sharing and management of agricultural research finding; networking of agricultural based computer database; integrating information management system in agricultural education etc.

**AICM 715: Decision Support systems**

*Lecture: 2 hrs; Lab: 1 hr; Prerequisite: Agricultural Knowledge Management*

Fundamentals of decision making in agricultural systems; Concerns of decision support in both non-automated and automated environments; Focus on structures, modeling, and the application of various decision support systems in today's corporate environment. Additional emphasis is placed on the use of executive information and expert system applications. Case studies examined applications of each of these types of technology. (DSSAT and other software for lab practice)

**AICM 621: Perspectives of Agricultural Extension**

*Lecture: 3 hrs; Lab: NA; Prerequisite: None*

Extension concept, agricultural extension philosophy, scope and responsibilities, comparative study of agricultural extension systems, approaches and methods; Research-extension linkage; Communication theories and systems and factors influencing effective communication; Communication process and communication strategies for agricultural and rural development program; Importance, selection, preparation and production techniques of agricultural communication tools in extension; Development and selection of ICT-based agricultural communication tools - video production, graphic design, visual composition, desktop publishing and multimedia development; ICTs for extension management - management of extension resources, program, and monitoring extension impacts: execution of agricultural public relations; public relations and agricultural communication plans; agricultural public relations policy; ethics and moral concerns in agricultural public relations; agricultural public relations in crisis situations; management of a agricultural public relations agency/unit; emerging trends in agricultural public relations

**AICM 552: Fundamentals of Computer Programming**

*Lecture: 2 hrs; Lab: 2hrs; Pr-requisite: None*

Introduction to programming concepts and problem solving skills using the Scheme system;

Design and algorithm construction, complex types, iteration, recursion, procedural/functional/data abstraction, classes, methods, inheritance and polymorphism; simple control and data structures, basic operating system commands, sequential files, arrays, classes, recursive processes, and the use of text files; Design, code, and test programs; An introduction to a programming language.

**AICM 725: Agricultural Public Relations**

*Lecture: 3 hrs; Lab: NA; Prerequisite: Not Available*

Concept of public relations and its role in agriculture; principles of agricultural public relations; agricultural public relations challenges and opportunities; current public relations situations for an agricultural organization; media relations as they relate to agriculture, role of interpersonal relationship to public relation, organizational politics, formal and informal communication for public relations, negotiation skills for public relation, decision making and harmonization in public relation

**AICM 541: Crop Production and Management**

*4 Cr.hrs Prerequisite: Not Available*

*Crop production systems:* Types or crops-food, horticultural, industrial; Crop improvement technologies; Crop production in arid and semi-arid areas; Production constraints; Disease diagnostic tools; Management; Integrated pest management; Environmental protection; Integrated soil nutrient management; Seed system; Water and nutrient use efficiency; Post harvest technologies; Value addition/value chain; Marketing; Policy issues.

**AICM 542: Livestock Production and Management**

*4 Cr.hrs Prerequisite: Not Available*

Concept of production system; Livestock breeds - Tropical vs. Temperate, non-conventional breeds; Pasture improvement technologies; Disease diagnostic tools; Livestock production in arid and semi-arid areas; Production constraints; Pastoralism and agro-pastoralism; Livestock production and environmental health; Livestock production and green house gas emissions; Livestock policy issues.

**AICM 543: Principles of Natural Resources Manageme**nt (NRM)

*(48 hours or 3 credit hours) (40 hours: 8 hours field) Prerequisite: None*

Types of ecosystems - wetlands, arid and semi-arid lands (ASALs), forests, marine lands, agro- ecosystems; Types of natural resources, natural resources management: environment, soil and water, forests and watersheds. Conservation and sustainable management; NRM and agriculture; Elements of impact assessments and audit; Global environmental challenges; Agro- ecology and NRM; Role of agro-ecology in NRM; Resource rehabilitation ; Social dimensions of NRM; Role of indigenous technical knowledge ; Natural resources as community assets ; Participatory NRM ; International dimensions of natural resources (NR); National resource management and climate change; Review of specific NRM policies.

**AICM 553: Fundamentals of Computing and Networks**

*Lecture: 3 Hours; Lab: 1hrs; Pre-requisite: None*

Basic operation of computers; Development of computers; Data representation in computers; Computer hardware and software; Problem solving in computers; Overview of computer languages; Computer systems personnel, current topics in computer science; Concepts and architecture of computer information systems; Integrated information systems across a range of functional elements of organizations; Fundamentals of data communication and networks; Network types and technologies; Data and voice communication; Network protocols and standards, including OSI model; Inter-networking/Internet; Practical aspects of operating systems.

**AICM 633: Principles of Scientific Communication**

*Lecture: 2 hrs; Lab: NA; Prerequisite: Management of information resources and services; and agricultural extension and communication strategies and tools*

Philosophy and history of science; Need for and ways to communicate about scientific issues to general public, government officials, journalists, technical experts; Study of and practice in writing about science for audiences ranging from the general public to scientists and engineers; Role of scientific advice to the general public, officials and technical persons; Principles of scientific communication and writing; Components, structure, style and finish of scientific communication; Principles of scientific investigation; Methods of preparation of different types of science publications; Techniques of organization and clarity of writing; Writing effective technical reports, descriptions, papers and memoranda; Conveying highly complex technical information to multiple audiences, factors influencing science communication to the public, and interactions between scientists and journalists; Scientific ethics, public attitudes toward science, science-society interactions and case studies of scientific controversies; On-site experience as an accredited science reporter at a major scientific meeting, or writing and research in a University laboratory as part of science writing field research program.

**AICM 531: Fundamentals of Agricultural Journalism**

*Lecture: 3 hrs; Lab: NA; Prerequisite: None*

Meaning and function of journalism; Principles of journalism; Agricultural journalism; Trends in print media; Media policies, laws and ethics for print journalism, rural press and reporting, cover designing of different print material for agricultural development and its evaluation; Principles and techniques of writing extension publications and their evaluation. Media policies, laws and ethics for electronic journalism, trends in electronic journalism; Designing and developing electronic media for agricultural reporting; Exercises on management and reporting of interviews and local events; Agricultural advertisements: dynamics, types, story-board, designing aids; Promoting agricultural products and services in rural areas; Research in agricultural journalism and applications; Script writing, printing methods and processes for different extension publications; Budgeting for publishing jobs.

**AICM 643: Application of Geo-informatics in Agriculture**

*Lecture: 3 hrs; Lab: 1 hr Prerequisite: None*

Concepts and foundation of geo-informatics; Remote sensing; Photographic systems, thermal and multi-spectral scanning and image processing; Components and applications of a geographic information system (GIS); Characteristics of spatial data; Models of spatial information; Spatial relationships and algorithms; Spatial analysis (such as route planning, map overlay, buffer zoning, etc.); Database models for spatial data; Errors in spatial data; Sources of raster spatial data and introduction to remote sensing; Sources of vector spatial data; Ethical issues and spatial data; Cartographic communication - the display of spatial data. Coordinate systems and map projections; Remote sensing, Geo-DBMS (spatial ADT's, spatial indexing, etc), Mobile GIS" (location based services, combination with positioning, e.g. GPS, Galileo,); Examination of remote sensing and GIS applications in agriculture; Conventions and policy issues; Computer models; Laboratory assignments.

**AICM 616: Information Storage and Retrieval (IR)**

*Lecture: 2 hrs; Lab: 2 hrs; Prerequisite: Fundamentals of computer programming*

Characteristics and structure of textual records: Definition, content, structure and context; Elements of record metadata; Databases of textual records: databases as collections of textual records, categorization of database types, contrast and comparison with other types of databases, electronic record keeping principles; Textual information retrieval principles: Boolean operators, proximity operators, limit operators, truncation, inverted indexes, keyword versus phrase indexing, controlled vocabulary and thesaurus use versus uncontrolled keyword searching, retrieval command languages, set logic and construction for retrieval purposes; Construction and implementation of search strategies: search sequence diagrams, query expansion, broadening and narrowing search results, strategies to avoid information overload; Advanced retrieval features: relevance feedback, introduction to weighting and probabilistic retrieval; Information retrieval systems for specific information environments: libraries, archives, record management systems and so on ; Basic design and creation of text-based databases using information retrieval systems: data structures, documentary and management data elements and their properties, data entry or conversion requirements, data output techniques; Creation of basic information resources for delivery and access via the World Wide Web (WWW).

**M. Sc. Programs in the School of Plant Sciences**

**M. Sc. in Agronomy**

**Distribution of Courses by Year and Semester**

**Year I; Semester I**

**Course Code Course Title Credit Hours**

|  |  |  |
| --- | --- | --- |
| PLAG 501 | Crop Husbandry | 3 |
| PLAG 511 | Biometrics | 4 |
| PLAG 521 | Plant Physiology | 3 |
| PLAG 531 | Dry Land Agriculture and Irrigation Management | 3 |
| PLCP 501 | Weed Science | 3 |
| AGEC 561 | Computer Applications (E) | 3 |
| **Total** |  | **16/19** |

**Year I; Semester II**

**Course Code Course Title Credit Hours**

PLAG 502 Crop Physiology 3

|  |  |  |
| --- | --- | --- |
| PLAG 512 | Current Topics in Agronomy | 1 |
| PLAG 522 | Graduate Seminar in Agronomy | 1 |
| PLAG 532 | Crop Ecology and Cropping Systems | 2 |
| PLAG 552 | Forage and Pasture Crops Production and Management (E) | 2 |
| SOSC 552 | Soil and Plant Nutrition | 3 |
| PLAG 542 | Systems Analysis and Crop Modeling | 3 |
| PLCP 552 | Insect Pests, Diseases and Weeds of |  |
|  | Economic Importance (E) | 3 |
| PLPB 572 | Seed Technology (E) | 2 |

**Total 13/20**

**Year II**

**Course Code Course Title Credit Hours**

PLAG 611 MSc. Thesis Research 6

\*E = Elective Courses, students are required to take at least one elective course

**Course Descriptions in Agronomy**

**PLAG 501 Crop Husbandry (3)**

Origin and geographical distribution, production, classification, utilization, husbandry

and post-harvest handling of major cereals – wheat, tef, maize, sorghum, barley; legumes or pulses – haricot bean, faba bean, lentil, chickpea etc.; oilseeds – groundnut, sesame, etc, fibre crops and sugarcane. Review of current research achievements and future strategies of maximizing yield potentials of major cereals, legumes, oilseeds, fibre crops and sugarcane in Ethiopia.

**PLAG 511 Biometrics (4)**

Analysis of variance models; assumptions and their tests, alternatives in case of failures

of assumptions; principles of designs of experiments; detail discussion on the applicability, layout and randomization, analysis of variance, mean separation, interpretation of results and missing plot techniques with respect to completely randomized design, randomized completely block design, Latin squares design, youden square design, factorial experiments with confounding and fractional factorial design concepts; split plot design and strip plot design with two or more factors; compact family block design; incomplete block designs-simple and balanced lattice design, augmented randomized block designs; combined analysis of variance and its interpretation; analysis of covariance with randomized block design for adjustment; simple and multiple correlation and regression analysis; application of chi-square and non-parametrics statistics.

**PLAG 521 Plant Physiology (3)**

Growth and developmental physiology, plant hormones and growth regulators – their

biosynthesis, bioassay and mode of action, metabolic pathways – photosynthesis, photo- respiration, respiration, lipid metabolism, plant nutrition – assimilation of nitrogen including biological nitrogen fixation, and sulfate assimilation, photo-morphogenesis, physiology of diseases and post – harvest physiology, plant – water relations including stress physiology, biotechniques in plant physiology.

**PLAG 531 Dry land Agriculture and Irrigation Management (3)**

Dry climates and their classification; problems of drylands of Ethiopia; crop-water relations;

moisture-stress and its effect on crop growth, yield and quality; rain-water management; in- situ moisture conservation; controlling run-off and evaporation; water harvesting techniques; tillage methods for moisture conservation; crop adaptations to dry growing conditions; crop improvement for drought-prone areas; cropping systems in dry regions.

**PLCP 501 Weed Science (3)**

Weed biology; weed ecology; population dynamics of weeds; weed seed-bank; crop/weed

interference; physiological aspects of competition; thresholds of competition; weed/crop competition studies; descriptive models of weed/crop interference; concepts of prevention, control, eradication and management; preventive methods; physical methods; cultural methods; biological methods; chemical control, herbicide families and their characteristics; Principles of Integrated Weed Management on agronomic, horticultural, range and parasitic weeds; methods of conducting research on weeds; the status of weed problem and research in Ethiopia.

**AGEC 561 Computer Applications (E) (3)**

See in Agricultural Economics Graduate Program

**PLAG 502 Crop Physiology (3)**

Leaf canopy and root system; growth and development; phases of growth; measurement of

growth; carbon-dioxide assimilation; growth and maintenance respiration; photo-respiration; dry matter production by interception and conversion of solar radiation; radiation and heat balance; transpiration and dry matter production; source-sink relations; translocation and partitioning of assimilates; phenology of crops; yield components of crops; photo-period effects; growth regulators; crop growth limited by water; crop growth limited by nutrients; crop response to environmental stress (drought, flooding, freezing, heat, salinity, radiation).

**PLAG 512 Current Topics in Agronomy (1)**

Supervised study on advanced topics in Agronomy. A reading and conference course

designed to acquaint the advanced student with topics nor covered in other courses in agronomy. Knowledge of actual and potential cash crops that are already found in Ethiopia and those that could be introduced from other countries.

**PLAG 522 Graduate Seminar in Agronomy (1)**

Current literature and agronomic developments. Presentation on selected seminar topics by a graduate student.

**PLAG 532 Crop Ecology and Cropping Systems (2)**

Oil, climatic and biological factors as they influence the growth, production and

geographical distribution of crops; relations of ecological factors and climatic classifications to agro-ecosystems; crop seasons with emphasis to Ethiopian condition; introduction to ecological agriculture. Plant population and planting geometry; crop sequence and association; cropping pattern and cropping systems; multiple cropping; assessment of competition and yield advantages.

**PLAG 542 Systems Analysis and Crop Modelling (3)**

Climatic factors in crop production; micro-climatology such as radiation interception,

energy balance and transpiration; Philosophy and terminologies in simulation; basic elements of dynamic simulation; analysis of simple systems; developing simulation models for such systems; models of crop growth; quantitative calculations of the processes involved in crop growth and implementing them into a simple model; crop/weather models; utilization of weather data in crop growth simulation; running and studying existing crop growth models.

**PLAG 552 Forage and Pasture Crops Production (E) (2)**

All phases of forage and pasture crops production including ecology, identification, seeding,

management, use, seed production, and storage of major forage and pasture crops; potential of natural grassland of tropical and subtropical regions; development of improved forages and pastures; integrated rangeland management including integrated plant nutrient, weed and water management in rangeland; grazing management; experimental techniques for field evaluation of forage and pasture crops; designs of grazing trials and procedures for estimating yield and botanical composition of grazed and ungrazed pastures.

**PLCP 552 Insect pest, Diseases, and Weeds of Economic Importance (E) (3)**

See in Crop Protection Graduate Program

**PLPB 572 Seed Technology (E) (2)**

See in Plant Breeding Graduate Program

**SOSC 552 Soil and Plant Nutrition (3)**

Consideration of major Ethiopian soil and water conservation and management problems

and solutions; soil erodibility, climatic erosivity, and mechanics, processes and forms of soil erosion by water and wind, and analysis of their effects on food production and problems related to degradation of land and water resources; cultural, biological and/or agronomic, and engineering measures of erosion control; watershed management, land use planning and other management practices appropriate for maintenance and sustainable utilization of the land, water and biological resources.

**PLAG 611 M. Sc. Thesis Research (6)**

Independent research in Agronomy to be conducted under the supervision of a major

professor (including thesis presentation) and discussed as partial requirement for the M.Sc. degree. Research topics and plan of study to be determined jointly by student, his advisor and finally approved by School of Graduate Studies.

**M. Sc. in Plant Breeding**

**Distribution of Courses by Year and Semester**

**Year I; Semester I**

**Course Code Course Title Credit Hours**

|  |  |  |
| --- | --- | --- |
| PLPB 511 | Genetics | 3 |
| PLPB 531 | Plant Genetic Resources | 2 |
| PLPB 541 | Plant Cytogenetics | 2 |
| AGEC 561 | Computer Applications (E) | 3 |
| ANPR 521 | Biochemistry(E) | 3 |
| PLAG 511 | Biometrics | 4 |
| PLAG 521 | Plant Physiology (E) | 3 |
| PLCP 521 | Plant Pathology (E) | 3 |
| **Total** |  | **11/20** |

**Year I; Semester II**

**Course Code Course Title Credit Hours**

|  |  |  |
| --- | --- | --- |
| PLPB 502 | Current Topics in Plant Breeding | 1 |
| PLPB 512 | Plant Breeding3 |  |
| PLPB 522 | Graduate Seminar in Plant Breeding | 1 |
| PLPB 532 | Quantitative Genetics | 3 |
| PLPB 552 | Breeding for Abiotic and Biotic Stresses | 2 |
| PLPB 562 | Biotechnology for Crop Improvement | 2 |
| PLPB 572 | Seed Technology (E) | 2 |
| PLPB 582 | Breeding for quality traits (E) | 2 |
| **Total** |  | **12/16** |
| E = Elective Courses, | students are required to take at least one elective course |  |

**Year II**

**Course Code Course Title Credit Hours**

PLPB 611 M. Sc. Thesis Research 6

**Course descriptions in Plant Breeding**

**PLPB 511 Genetics (3)**

Mendelian genetics and its implication; gene concept, classical and modern;

measurement of linkages and construction of chromosome maps; environmental modification of phenotypes; mutation and mutagenic agents; mutable loci; genetic control and metabolic patterns; genetic unit its structure and function; present concept of gene organization; nature of genetic code, regulation of gene activity and development; extra- nuclear genetics; genetic counseling and eugenesis; genetic engineering; introduction to ecological, behavioral and development genetics.

**PLPB 531 Plant Genetic Resources (2)**

Genetic resources and crop improvement; genetic erosion and vulnerability; centers of

diversity of important crops and their wild relatives; exploration and collection, expedition planning and survey procedures, sampling sites, sampling techniques and sample size, details of equipment and field records, practical problems in exploration; evaluation, characterization and documentation of germplasm; computer data storage and retrieval system; maintenance of germplasm; *in situ, ex situ* and *in vitro* conservation and storage of genetic wealth; base collection, active collection and field collection of germplasm; utilization of genetic resources; national germplasm system and international network; plant quarantine regulations in relation to exchange of genetic resources; legal ownership and plant breeder's rights to germplasm. Biotechnological approaches for germplasm conservation.

**PLPB 541 Plant Cytogenetics (2)**

Chromosome theory of inheritance, chromosome structure, cytogenetical basis of linkage

and crossing-over, genetic implications of cell division, concepts in chromosome models, change in chromosome number and change in structure of chromosomes, balanced lethal systems, karyotype analysis, evolution and phylogenetic relationships, role of cytogenetics in plant breeding, polyploidy breeding - types of polyploidy and their applications in crop improvement; genome analysis; barrier in inter- and intra-generic and inter- and intra-specific hybridization.

**AGEC 561 Computer Applications (E) (3)**

See in Agricultural Economics Graduate Program

**ANPR 521 Biochemistry (E) (3)**

Plant cell, ultra structure of the cell, cell membrane, structure and function of

biomolecules (protein-hemoglobin; lipids-membranes; carbohydrate-peptidoglycans; etc.). Metabolism, (carbohydrate, protein, lipid); including photosynthesis and organ specialisation. Integration of carbohydrate, protein and lipid metabolism and regulation. Vitamins, enzymes, coenzymes and mineral metabolism. Biosynthesis of macromolecules. Rumen metabolism. Fate of different nutrients in the rumen. Milk synthesis. Metabolic diseases (ketosis, milk fever, pregnancy toxaemia etc.).

**PLAG 511 Biometrics (4)**

Analysis of variance models; assumptions and their tests, alternatives in case of failures

of assumptions; principles of designs of experiments; detail discussion on the applicability, layout and randomization, analysis of variance, mean separation, interpretation of results and missing plot techniques with respect to completely randomized design, randomized completely block design, Latin squares design, youden square design, factorial experiments with confounding and fractional factorial design concepts; split plot design and strip plot design with two or more factors; compact family block design; incomplete block designs-simple and balanced lattice design, augmented randomized block designs; combined analysis of variance and its interpretation; analysis of covariance with randomized block design for adjustment; simple and multiple correlation and regression analysis; application of chi-square and non-parametrics statistics.

**PLPB 502 Current Topics in Plant Breeding (1)**

Supervised study on advanced topics in plant breeding. A reading and conference course

designed to acquaint the graduate student with topics not covered in other courses in plant breeding and related fields.

**PLPB 512 Plant Breeding (3)**

Plant breeding, its objectives and achievements; genetic basis of breeding of self and

cross pollinated crops; nature of variability and component of variance; heritability, genetic advance and response to selection; genotype-environment interaction, concept of adaptability; gene and genotypic frequency; genetical and physiological basis of heterosis and inbreeding depression; implication of genetic components for adopting appropriate breeding methods; concept of plant ideotypes; mechanism, induction and utility of male sterility and apomixis; mechanisms and utility of self incompatibility and methods to overcome it; developments in breeding methodology in self pollinated, cross pollinated and asexually propagated crops.

**PLPB 522 Graduate Seminar in Plant Breeding (1)**

Current literature and developments in plant breeding. Presentation on selected seminar

topics by a graduate student.

**PLPB 572 Seed Technology (E) (2)**

Seed as a basic input for agricultural production; procedures of seed production and

testing of different crops; standards for maintaining seed quality; deterioration of varieties; factors determining ideal areas of seed production; pollination and reproduction in relation to seed production and varietal maintenance; release and notification of varieties; concepts in seed physiology and seed health; principles, procedures and rules of sampling, purity tests, germination and viability tests; concepts and objectives of seed certification; seed dormancy, its causes and breakage.

**PLPB 582 Breeding for Quality Traits (E) (2)**

Importance of quality traits; analytical and selection techniques for quality traits;

screening sequences; role of physico-chemical, histo-chemical and components of protein synthesis for improving protein quality and quantity; genetics of quality traits and their association with yield and other traits; biochemical and genetical aspects of the known quality mutants like opaque-2, fluory-2; anti-nutritional factors in different crops and their genetic removal; objectives, breeding approaches, achievements and prospects for the improvement of quality traits of important field crops.

**PLPB 562 Biotechnology for Crop Improvement (2)**

Biotechnology, history and development; types of biotechnology protoplast, cell tissue

and organ culture; embryo and ovule culture for wide hybridization; *in vitro* pollination and *in vitro* fertilization for overcoming incompatibility; anther and pollen culture for production of haploids; meristem culture and production of pathogen-free plants; vegetative propagation and cloning; mutagenesis in cell and tissue culture; somatic hybridization and exploitation of somatic hybrids; transformation, transgenesis and nitrogen fixation; freeze preservation of germplasm.

**PLPB 532 Quantitative Genetics (3)**

Nature and origin of continuous variation; relationship between genotype and phenotype;

separation of components of variability correlation and path analysis at the genotypic and phenotypic levels; discriminate functions; parent-offspring regression analysis; estimation of genetic effects and testing the adequacy of additive-dominance model by simple scaling and joint scaling, line x tester and diallel analysis for combining ability; North Carolina mating designs; genotype-environment interaction and models of adaptability; metroglyph analysis; concepts of triple test cross and partial diallel mating design.

**PLPB 552 Breeding for Abiotic and Biotic Stresses (2)**

Nature and characterization of environmental stresses; soil and atmospheric crop

response to different environmental stresses; adaptation; range of variability in germplasm; parameters of resistance; inheritance mechanisms; research needs and breeding strategies; components of resistance; variability in pests and pathogens; gene- for-gene concept; vertical and horizontal resistance; gene rotation and gene pyramiding; use of strong genes and multi-lines; genetic vulnerability of crops to diseases

**PLPB 611 M. Sc. Thesis Research (6)**

Organized Research in Plant Breeding including thesis presentation and defence as part

of the requirement for the Master of Science.

**M. Sc. in Horticulture**

**Distribution of Courses by Year and Semester**

**Year I; Semester I**

**Course Code Course Title Credit Hours**

|  |  |  |
| --- | --- | --- |
| PLHO 501 | Husbandry of Horticultural Crops I | 3 |
| PLHO 511 | Husbandry of Horticultural Crops II | 2 |
| PLHO 531 | Lab. Techniques in Horticulture | 2 |
| PLHO 522 | Current Topics in Horticulture | 1 |
| PLHO 541 | Landscaping and Floriculture (E) | 3 |
| AGEC 561 | Computer Applications (E) | 3 |
| ANPR 521 | Biochemistry (E) | 3 |
| PLAG 511 | Biometrics | 4 |
| PLAG 521 | Plant Physiology | 3 |
| **Total** |  | **15/24** |

**Year I; Semester II**

**Course Code Course Title Credit Hours**

PLHO 502 Post Harvest Physiology of Fruits & Vegetables 3

PLHO 512 Graduate Seminar in Horticulture 1

PLHO 532 Medicinal and Plantation Crops (E) 2

PLHO 542 Physiology of Horticultural Crops I 3

PLHO 562 Physiology of Horticultural Crops II 2

PLHO 572 Husbandry of Plantation Crops (E) 2

PLCP 552 Insect Pests, Diseases & Weed of Economic Importance (E)

3

SOSC 552 Soil and Plant Nutrition 3

**Total 12/19**

E = Elective Courses, students are required to take at least one elective course

**Year II**

**Course Code Course Title Credit Hours**

PLHO 611 M. Sc. Thesis Research 6

**Course description in Horticulture**

**PLHO 501 Husbandry of Horticulture Crops I (3)**

Importance and scope of fruit and vegetable crops in Ethiopian horticulture; origin,

importance, significance and classification; resource analysis; nursery management including production of healthy and disease-free planting material; orchard planning, lay out and management; principles of production in relation to physical and biological factors; crop improvement approaches; integrated water, nutrient and pest and disease management strategies.

**PLHO 511 Husbandry of Horticultural Crops II (2)**

Importance and scope of root and tuber vegetable crops in the Ethiopian horticulture;

origin, distribution, botanical relationship, morphology and taxonomy; principles of growing in relation to physical and biological factors; integrated water and nutrient management; commonly occurring pests and diseases, their control measures; crop improvement approaches; seed production of important tuber and root crops such as potatoes, sweet potato, colocasia, Yam, elephant foot yam etc.

**PLHO 531 Laboratory Techniques in Horticulture (2)**

Principle in handling and application of instruments in laboratories and in field, separation

or estimation of chemical compositions of fruits and vegetables; modern plant propagation techniques.

**PLHO 541 Landscaping and Floriculture (3)**

Introduction to floriculture and ornamental; woody plant materials garden and indoor

(interior) plants; basic principles of landscaping; importance and scope of landscaping in Ethiopia propagation, planting and care of ornamental plants; skill an concepts of site construction; conceptual design; plant materials landscape planning planting designs preparation and maintenance of lawns, shrubbery and herbaceous borders, rock gardens.

**AGEC 561 Computer Applications (E) (3)**

See in Agricultural Economics Graduate Program

**ANPR 521 Biochemistry (E) (3)**

Plant cell, ultra structure of the cell, cell membrane, structure and function of biomolecules

(protein-hemoglobin; lipids-membranes; carbohydrate-peptidoglycans; etc.). Metabolism, (carbohydrate, protein, lipid); including photosynthesis and organ specialisation. Integration of carbohydrate, protein and lipid metabolism and regulation. Vitamins, enzymes, coenzymes and mineral metabolism. Biosynthesis of macromolecules. Rumen metabolism. Fate of different nutrients in the rumen. Milk synthesis. Metabolic diseases (ketosis, milk fever, pregnancy toxaemia etc.).

**PLAG 511 Biometrics (4)**

Analysis of variance models; assumptions and their tests, alternatives in case of failures

of assumptions; principles of designs of experiments; detail discussion on the applicability, layout and randomization, analysis of variance, mean separation, interpretation of results and missing plot techniques with respect to completely randomized design, randomized completely block design, Latin squares design, youden square design, factorial experiments with confounding and fractional factorial design concepts; split plot design and strip plot design with two or more factors; compact family block design; incomplete block designs-simple and balanced lattice design, augmented randomized block designs; combined analysis of variance and its interpretation; analysis of covariance with randomized block design for adjustment; simple and multiple correlation and regression analysis; application of chi-square and non-parametrics statistics.

**PLAG 521 Plant Physiology (3)**

Growth and developmental physiology, plant hormones and growth regulators – their

biosynthesis, bioassay and mode of action, metabolic pathways – photosynthesis, photo- respiration, respiration, lipid metabolism, plant nutrition – assimilation of nitrogen including biological nitrogen fixation, and sulfate assimilation, photo-morphogenesis, physiology of diseases and post – harvest physiology, plant – water relations including stress physiology, biotechniques in plant physiology.

**PLHO 502 Post-harvest Physiology of Fruits and Vegetables (3)**

Importance of post harvest physiology and technology, present status, biochemical

changes after harvest of fresh fruits vegetables and flowers; Pre-treatment and post harvest treatments to cheek losses, Dehydration, drying freezing and cold storage; Techniques of chemical, biological and thermal preservation. Preservations and storage of fruits and vegetable products like in jams, jellies, marmalades and preserves, processing of pickles, Sauce and ketchup’s. Raw materials: principal spoilage microorganisms and their control measures. Containers and equipment for processing quality control.

**PLHO 512 Graduate Seminar in Horticulture (1)**

Literature review and discussion of current research in the field of Horticulture.

**PLHO 522 Current Topics in Horticulture** (**1)**

Supervised study on advanced topics in Horticulture. A reading and conference course designed to acquaint graduate students with topics not covered in other courses in Horticulture. Knowledge of actual and potential horticultural cash crops in Ethiopia and those that could be introduced from other countries.

**PLHO 532 Medicinal and Aromatic Crops (E) (2)**

Importance, classification and usage; significance, botanical description, distribution

composition; climate and soil, cultural practices, yield and chemical constituents of important medicinal and aromatic crops; conservation, micro-propagation techniques for important medicinal and aromatic crops and commercial exploitation including extraction of active ingredients with particular reference to Ethiopian situations.

**PLHO 542 Physiology of Horticultural Crops 1 (3)**

Growth and development of important fruit and vegetable crops of importance to Ethiopia;

history, extraction, biosynthesis, structure, mode of action, metabolic and morphogenetic effects of auxins, gibberellines, cytokinins, ethylene, inhibitors, growth and retardants and bioassay; role of growth hormones in developmental processes and production of important horticultural crops including physiological responses of crops to horticultural operations (root stocks, training and pruning and soil-water-plant relationship).

**PLHO 562 Physiology of Horticultural Crops II (2)**

Influence of light, temperature and moisture on the production of important tuber and root

crops for market and seed with special reference to Ethiopian context; response of crops to environmental stresses interaction between plant population, fertility status and moisture regimes; factors influencing flowering, fruit set, growth, development (tuberization, maturity and ripening); macro -–climatic factors influencing the growth and performance.

**PLHO 572 Husbandry of Plantation Crops (E) (2)**

Importance of plantation crops like coffee, tea and spices in the Ethiopian context; origin

importance and scope; botany, classification; ecological consideration, crop improvement and varieties; nursery management, principles and practices crop production and management; integrated water, nutrient and pests and diseases management and post- harvest handling.

**PLCP 552 Insect pests, Diseases and Weeds of Economic Importance (E) (3)**

See in Crop Protection Graduate Program

**SOSC 552 Soils and Plant Nutrition (3)**

Consideration of major Ethiopian soil and water conservation and management problems

and solutions; soil erodibility, climatic erosivity, and mechanics, processes and forms of soil erosion by water and wind, and analysis of their effects on food production and problems related to degradation of land and water resources; cultural, biological and/or agronomic, and engineering measures of erosion control; watershed management, land use planning and other management practices appropriate for maintenance and sustainable utilization of the land, water and biological resources.

**PLHO 611 M. Sc. Thesis Research (6)**

Organized Research in Horticulture including thesis presentation and defense as part of

the requirement for the Master of Science.

**M.Sc. in Seed Science and Technology**

**Distribution of Courses by Year and Semester**

**Year I, Semester I & II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** | |
| **Sem. I** | **Sem. II** |
| SSTC 511 | Crop Improvement | 3 | 0 |
| SSTC 521 | Seed Physiology | 3 | 0 |
| SSTC 531 | Biotechnology | 2 | 0 |
| SSTC 541 | Seed Pathology | 2 | 0 |
| PLAG 511 | Biometrics | 3 | 0 |
| SSTC 512 | Seed Production of Field Crops | 0 | 3 |
| SSTC 522 | Forest Seeds Technology (E) | 0 | 2 |
| SSTC 532 | Seed Production of Horticultural Crops | 0 | 3 |
| SSTC 542 | Seed Production of Forage and Pasture Crops (E) | 2 | 0 |
| SSTC 552 | Special Topics in Seed Technology | 1 | 0 |
| AGEC 512 | Seed Business Management | 0 | 3 |
| AGEC 542 | Seed Policies and Regulation | 0 | 2 |
| SSTC 562 | Pests of Stored Seeds | 0 | 2 |
| SSTC 572 | Seed Testing and Certification | 0 | 3 |
|  | **Total** | **17** | **16** |

**Year II, Semester I & II**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Credit Hours** | |
| **Sem. I** | **Sem. II** |
| SSTC 631 | M. Sc. Thesis Research | 6 | 6 |

**Course descriptions in Seed Science & Technology**

**SSTC 511 Crop Improvement (3 Cr. Hrs)**

Basic genetics and application of biotechnology to cultivar improvement: applicable

molecular biology, gene identification, DNA manipulation, creation of DNA markers, sequencing, and functional genomics, study of heritability; basic principles of classical genetic in improvement of crop plants and methods of cultivar development in self- pollinated and cross-pollinated crop species, marker assisted selection, phenotypic and genotypic variance, calculation and application of variances, stability, GxE interaction.

**SSTC 521 Seed Physiology (3 Cr. Hrs)**

Physiological processes essential to biomass production and seed formation, and the

limitations posed on these processes by the environment; introduction to physiology; embryogenesis; composition; impact of environmental stress during maturation; acquisition of desiccation tolerance; deterioration; dormancy; the effect of the storage environment; germination; re-hydration and water relations; oxygen consumption; cell division and DNA synthesis; energy metabolism of germination; hormones regulating germination; mobilization of stored reserves; ecology of germination; vigor and germination under field conditions.

**SSTC 531 Biotechnology (3 Cr. Hrs.)**

Nutritional requirements of tissue; organ and cell culture; different types of media;

methods for isolation of plant tissues, explants selection; techniques of culturing, media, initiation and maintenance of callus cultures of different explants of various crop specie; establishment and maintenance of cell suspension cultures, and culture systems; growth and differentiation in cultures; organ and cell suspension culture and regeneration of plants, methods of analysis of growth of in vitro cultured callus and cell suspension; in vitro mass production of plants through callus cultures and micro-propagation; isolation of virus free plants through meristem tip cultures; anther and pollen culture; Dihaploids and their significance in crop improvement, embryo and ovule culture for inter-and-intra somatic hybridization, in vitro pollination and fertilization for overcoming incomparability production of triploids protoplast culture, isolation culturing of protoplasts and plant regeneration from protoplasts, protoplasts fusion techniques of different methods, regeneration of fused protoplast.

**SSTC 541 Seed Pathology (3 Cr. Hrs.)**

Seed borne pathogens, losses due to seed borne diseases; taxonomy and classification of

seed borne micro-organisms; mechanisms of transmission of seed borne micro-organism; seed-borne disease symptoms, mode of transmission, effect on seed quality; production of disease-free seed; physiogenic seed disorders, deficiency disease, effect of temperature, humidity, and poisons on seed; pathology of stored seed, micro-organisms, predisposing conditions, aging of seeds and inactivation of inoculate; mycotoxins production in stored seeds; seed quality, loss of viability, control, epidemiology, host- parasite relationships; domestic and international quarantine regulation; forecasting losses from seed borne diseases.

**PLAG 511 Biometrics (3 Cr. Hrs.)**

Experimental procedures, methods and techniques, application to seed research,

interpretation of results. Factorial experiments, split plot design, unequal sub-class numbers, multiple and partial regression, application of chi-squares, unimodal and poisons distribution, non-parametric statistics, field layout, introduction to statistical packages and application.

**SSTC 512 Seed Production of Field Crops (3 Cr. Hrs.)**

Introduction to crop production principles for the basic agronomic crops; includes introductory concepts of plant, soil, tillage, and pest control; the basic growth requirements of plants; the function plants and crop communities; planting, flowering, and maturity dates; optimum spacing of plants; control of fertilization; and environment and managing factors that influence yield and seed quality; matching production and planting plans to drying and receiving capacity; choosing locations and growers; and managing field production; seed production unit manpower and/or other requirements.

**SSTC 522 Forest Seeds Technology (E) (2 Cr. Hrs.)**

Introduction; seed biology, development and ecology; planning and preparation of seed

collections; seed collection; fruit and seed handling between collection and processing; seed processing; phytosanitary problems and seed treatment; seed storage; dormancy and pretreatment; seed; germination and seedling establishment; seed testing; genetic implications of seed handling; microsymbiont management; seed documentation; trade and transfer of forest seed

**SSTC 532 Seed Production of Horticultural Crops (3 Cr. Hrs.)**

Adaptation, distribution, area and production, soils and seasons, seeds and sowing,

important stages of crop growth, inter-cultivation and weed control, irrigation, fertilizer schedule, nutrition and seed quality; agronomic manipulation of synchronizing flowering, harvesting, threshing, yield and yield attributes in major horticultural crops.

**SSTC 542 Seed Production of Forage and Pasture Crops (E) (2 Cr. Hrs.)**

Pasture-forage grasses and legumes and their reproduction through seeds and clonal

propagation; varietal identification, diagnostic characters of improved varieties/lines/hybrids; maintenance of genetic purity; genetic shift in relation to generation of multiplication; pollination control and development of superior pollinators, role of insects and their effect on seed yield; selection of seed production areas; influences of seasons, cultural treatments and management practices; seedbed preparation, seed weight and seed rate methods of planting, fertilizing and manuring; weed, pest and disease control and their management, factors affecting seed setting; post harvest management of seed fields; measuring seed yields, minimum seed certification standards and cost of production, etc.

**SSTC 552 Special Topics in Seed Technology (1 Cr. Hrs.)**

Assignment on special topics or laboratory problems relating to seed science and

technology completed by presentation of the work in the form of graduate seminar.

**AGEC 512 Seed Systems and Entrepreneurship (2)**

Development of seed industry in Ethiopia, formal and informal seed system production,

seed flow, status of national seed system and seed security, entrepreneurship theory; issues related to starting a new venture; financing a new venture and other related issues with particular emphasis to the Ethiopian Economic environment. Includes lectures, case analysis and individual project work to be presented in a class.

**AGEC 542 Seed Policies and Regulation (3 Cr. Hrs.)**

Regulatory environments shaping an organization's business strategy; the role of

certification schemes in facilitation of trade; and national quality regulation including truth in labeling, variety registration, certification (germination, physical purity, genetic identity, genetic purity, and moisture content); biosafety regulations including restricted testing, food safety, commercial seed use; the conventions restricting trade: International Plant Protection Convention, Convention on Biodiversity and the Protocol; intellectual property protection: trademarks; industrial secrets and contract law; plant breeders' rights and patent protection for varieties; patent protection for genetic information; patent protection for biotech processes; and the on variety development, variety testing, and the dissemination of performance information by businesses.

**SSTC 611 Pests of Stored Seed (2 Cr. Hrs.)**

Importance of stored grain /seed entomology; nature, extent and estimation of stored

grain /seed damage during storage, types of losses and extent of losses; pests associated with stored seeds /grains of cereals, pulses, vegetables (including planting material such as tubers of potato etc.), condiments and spices seeds; life history and habits of important pests; effect of abiotic factors on the production, fecundity and development; sources of infestation, seed infesting insect species, fungus feeding species, scavengers on dead plant and animal materials; methods of detecting hidden infestation in grains/seeds; methods of grain/seed storage, insect-pest control - cultural sanitation programme basic principles and practices, physical and mechanical methods of grain/seed pest control; residual sprays, protectants, fumigants; method of testing fumigants; seed treatment with chemicals; mites, birds and rodents causing damage to seed/grain and their control.

**FSPH 511 Seed drying, Processing and Storage (3 Cr. Hrs.)**

Seed drying: – justification, principles and methods of drying; seed processing: –

importance and principles, selection of processing and handling equipment; complete processing sequence of cereals, pulses oilseeds, vegetable seeds, grass, forage and legume seeds; preparing seed for processing, scalper, debearder, scarifier, sheller, dryer; seed cleaning and grading methods; use of various equipment viz, air screen cleaner, specific gravity separator, separator etc.., importance of seed treatment, methods, equipment and chemicals; layout and management of seed processing plant; general principles of seed storage; storage types, storage needs of different categories of seed; different packaging materials; introduction to controlled storage.

**SSTC 621 Seed Testing and Certification (3 Cr. Hrs.)**

Seed testing methods and procedures; seed purity analysis principles, procedures, and

rules; heterogeneity test; moisture estimation, tolerance tests; seed health; seed certification its concept objectives and role in increasing agricultural production; characteristics of good quality seeds, basic principles and methods of maintaining seed quality through seed certification; development release and notification of improved crop varieties, schemes for certified seed multiplication and distribution; training of seed growers, requirements of cultivation and handing of certified seed crops by seed growers; seed certification standards, basic assumptions in the formulation of seed certification standards; certification agency its organization.

**AGEC 611 Seed Strategy and Marketing (4 cr. Hrs.)**

Critical analysis of current practice and case studies in strategic management with an

emphasis on integrative decision-making; seed strategy formulation and implementation, investigating the context of complex business environments in seed production and marketing. Understanding human behavior in organizations, and the nature of organizations from a managerial perspective; individual differences, influence of individual and group behavior on organizations leadership and tolerance, competitiveness in today's complex business environment, firms need to coordinate marketing, production, and logistics activities not only within the firm, but with outside suppliers and customers in the supply chain; business functions concerned with the marketing and movement of goods along the supply chain with the primary goal of creating value for the ultimate seed customer.

**SSTC 631 M. Sc. Thesis Research (6 Cr. Hrs)**

Independent research in seed science, technology and business to be conducted under the

supervision of a major supervisor and discussed as partial requirement for M. Sc. degree in seed science and technology. Research topics and plan of study to be determined jointly by the student and his advisory committee.

**M.Sc. Programs in Crop Protection**

**M.Sc. in Plant Pathology**

**Distribution of Courses by Year and Semester**

|  |  |  |
| --- | --- | --- |
| **Year I; Semester I** |  | Credit Hours |
| Course Code | Course Title |
| PLCP 511 | Plant Pathology | 3 |
| PLCP 541 | Agricultural Mycology | 2 |
| PLCP 571 | Disease Diagnosis and Techniques |  |
|  | in Plant Pathology | 2 |
| AGEC 561 | Computer Application (E) | 3 |
| ANPR 531 | Biochemistry | 3 |
| PLAG 511 | Biometrics | 4 |
| **Total** |  | **14/17** |

**Year I; Semester II**

**Course Code Course Title Credit Hours**

|  |  |  |
| --- | --- | --- |
| PLCP 502 | Agricultural Pesticides |  |
|  |  | 3 |
| PLCP 512 | Integrated Pest Management | 2 |
| PLCP 532 | Plant Virology & Bacteriology | 3 |
| PLCP 542 | Postharvest Pests Management | 2 |
| PLCP 562 | Graduate Seminar in Crop Protection | 1 |
| PLCP 592 | Agricultural Nematology | 2 |
| PLPB 552 | Breeding for Abiotic and Biotic Stresses (E) | 2 |

**Total 13/15**

E = Elective Courses, students are required to take at least one elective course. Year II

**Course Code Course Title Credit Hours**

PLCP 611 M. Sc. Thesis Research 6

**Description of courses for M.Sc. Plant Pathology**

**PLCP 511 Plant Pathology (3)**

The physiology of host–parasite relationship; the genetics of plant-pathogen interaction;

epidemiology of plant disease and their management.

**PLCP 541 Agricultural Mycology (2)**

Terminology, taxonomy, isolation, handling, storage, and inoculation of fungal pathogens

of plants; classical, molecular, and population aspects of fungal genetics in both model and commercially important systems will be considered with discussion points such as genetic analysis via mitosis and meiosis, models of recombination, genetic control of fungal development, basic molecular genetics of fungi, and genetic factors affecting fungal population of structure and stability.

**PLCP 571 Disease Diagnosis and Techniques in Plant Pathology (2)**

Theory and principles, with laboratory and field practical experience in diagnosing

diseases of field and horticultural crops; Theory and principles of plant disease survey, loss assessment, and seed health testing methods; Management of plant clinics.

**AGEC 561 Computer Applications (E) (3)**

See in Agricultural Economics Graduate Program.

**ANPR 521 Biochemistry (3)**

Plant cell, ultra structure of the cell, cell membrane, structure and function of biomolecules

(protein-hemoglobin; lipids-membranes; carbohydrate-peptidoglycans; etc.). Metabolism, (carbohydrate, protein, lipid); including photosynthesis and organ specialisation. Integration of carbohydrate, protein and lipid metabolism and regulation. Vitamins, enzymes, coenzymes and mineral metabolism. Biosynthesis of macromolecules. Rumen metabolism. Fate of different nutrients in the rumen. Milk synthesis. Metabolic diseases (ketosis, milk fever, pregnancy toxaemia etc.).

**PLAG 511 Biometrics (4)**

Analysis of variance models; assumptions and their tests, alternatives in case of failures

of assumptions; principles of designs of experiments; detail discussion on the applicability, layout and randomization, analysis of variance, mean separation, interpretation of results and missing plot techniques with respect to completely randomized design, randomized completely block design, Latin squares design, youden square design, factorial experiments with confounding and fractional factorial design concepts; split plot design and strip plot design with two or more factors; compact family block design; incomplete block designs-simple and balanced lattice design, augmented randomized block designs; combined analysis of variance and its interpretation; analysis of covariance with randomized block design for adjustment; simple and multiple correlation and regression analysis; application of chi-square and non-parametrics statistics.

**PLCP 502 Agricultural Pesticides (3)**

Survey of the commonly used insecticides, fungicides, herbicides, rodenticides and related

materials as to their chemistry, mode of action, relation of structure to activity, toxicity and metabolism. The development and use of fumigants and other important chemicals, with reference to their chemistry, toxic action, compatibility, and host injury. Both environmental and chemical factors involved in pesticide usage are considered from the basic aspects. Recent research emphasized.

**PLCP 512 Integrated Pest management (2)**

Pest definition, classification and ecology; basic principles of pest management;

estimation of pest damage intensity and yield loss; determination of economic injury levels; pest sampling, monitoring and forecasting; pest outbreak, environmental impacts on pest development; management strategies; physical, cultural, chemical and biological methods of management; host -plant resistance, quarantine and legislation; integration of different methods of pest and disease control; emerging trends in pest management, interference methods, semio chemicals, sterile insect technique, genetic engineering, modeling and system analysis; pest management options-implementation and adoption; methods of design, execution and analysis of experiments in different components of pest management, socio-economic aspects of pest management.

**PLCP 532 Plant Virology and Bacteriology (3)**

Fundamental and practical aspects of plant virology including mycoplasma - like

organisms are discussed. The epidemiology, pathology and classification of viruses attacking plants are covered. Control methods of plant viruses are also dealt with. Taxonomy of plant pathogenic bacteria as well as the identification of common genera using different methods such as biochemical tests serology and others. The epidemiology of bacterial diseases and the major control practices are also discussed. Moreover, basic techniques of isolation, cultivation, inoculation, etc., are covered.

**PLCP 542 Post-harvest Pests Management (2)**

Survey of insects, rodents, and molds associated with stored crops recognition of factors

involved in their development, and distribution of pests, rodent and diseases. methods of chemicals and non-chemical control, including environmental management systems. identification, biology and behavior of stored product pests; loss assessment.

**PLCP 562 Graduate Seminar in Crop protection (1)**

Review of recent literature relating to selected topics in crop protection.

**PLCP 592 Agricultural Nematology (2)**

Fundamental and practical aspects of nematology; morphology, anatomy, physiology,

pathology and systematics of nematodes attacking plants; host-parasite relation;

management of plant pathogenic nematodes by different methods

**PLPB 552 Breeding for Abiotic and Biotic Stresses (2)**

See in Plant Breeding Graduate Program

**PLCP 531 Insect Physiology (3)**

Principles of the physiological systems of insects. comparative physiology of insects with

histological and functional aspects of organs and organ systems. Internal structure and functions of the insect body with particular reference to blood circulation, digestion, absorption, excretion, respiration, reflex action and the nervous system, and metabolism.

**PLCP 561 Insect Morphology (3)**

Gross insect morphology (eggs, immature stages & adults) and specific morphological

features in some insect groups such as body regions, exoskeleton, sensory structures like antennae and the visual organs, mouth parts, reproductive structures, respiratory organs, etc. The evolutionary development and functional modifications of the major insect structures are highlighted. Some aspects of internal insect morphology is also discussed.

**PLCP 522 Insect Taxonomy (3)**

Introduction to the principles of systematic entomology and the study of all orders and the

important families of insects. Advanced study of the systematic and phylogeny of selected insect groups, with emphasis on groups of economic importance. International rules of entomological nomenclature and their applications.

**PLCP 582 Insect Ecology and Population Dynamics (3)**

A study of fundamental factors involved in the inter relationship of insects with their

physical and biological environment; emphasis on factors affecting the dynamics for adjustment to their surroundings, distribution and abundance as population; population fluctuation, sampling insect distribution, life table and key factor analysis; application of basic ecological principles to integrated control measures

**PLCP 551 Weed Biology & Ecology (3)**

Definitions, characteristics, damages, and uses of weeds; history & recent directions in weed

science; classification and reproduction of weeds; weed seed dynamics; fundamental ecological concepts; weed/environment interaction; interference of weeds & crops; Physiological aspects of competition; thresholds of competition; methods of studying crop/weed competition; influence of humans on weed ecology; descriptive & mechanistic models of weed/crop interference; weed survey methods & data analysis.

**PLCP 572 Principles and Practices of Weed Management (3)**

Concepts of prevention, control, eradication and management; preventive methods; physical

methods; cultural methods; biological methods; chemical control, herbicide families and their characteristics; herbicide resistance; Principles of Integrated Weed Management on agronomic, horticultural, range and parasitic weeds of economic importance in Ethiopia.

**PLCP 552 Insect pest, Diseases, and Weeds of Economic Importance (E) (3)** Identification of insect pests, disease, and weeds of economic importance. Loss assessment methodology. Relative importance among the damage causing agents. Possible pest, disease, and weed management systems.

**PLAG 511 Biometrics (3)**

See in Agronomy Graduate Program

**SOSC 552 Soil and Plant nutrition (3)**

See in Soil Science Graduate Program

**PLCP 611 M. Sc. Thesis Research (6)**

Organized research in crop protection, thesis presentation, and defence as part of the

requirement for the Master of Science Degree.

**MSc in Agricultural Entomology**

**Course Distribution by Semester and Year**

**Distribution of Courses by Year and Semester**

**Year I; Semester I**

**Course Code Course Title Credit Hours**

|  |  |  |
| --- | --- | --- |
| PLCP 511 | Plant Pathology | 3 |
| PLCP 531 | Insect Physiology | 3 |
| PLCP 561 | Insect Morphology | 2 |
| AGEC 561 | Computer Applications (E) | 3 |
| ANPR 531 | Biochemistry (E) | 3 |
| PLAG 511 | Biometrics | 4 |
| **Total 12/18** |  |  |

**Year I; Semester II**

**Course Code Course Title Credit Hours**

|  |  |  |
| --- | --- | --- |
| PLCP 502 | Agricultural Pesticides | 3 |
| PLCP 512 | Integrated Pest Management | 2 |
| PLCP 522 | Insect Taxonomy | 3 |
| PLCP 542 | Post Harvest Pest Management | 2 |
| PLCP 562 | Graduate Seminar in Crop Protection | 1 |
| PLCP 582 | Insect Ecology and Population Dynamics | 3 |
| PLPB 592 | Breeding for Abiotic and Biotic Stress (E) | 2 |

**Total 14/16**

E = Elective Courses, students are required to take at least one elective course

**Year II**

**Course Code Course Title Credit Hours**

PLCP 611 M. Sc. Thesis Research 6

**Description of courses for M.Sc. Agricultural Entomology**

**PLEN 511 Insect Morphology 2 Cr. Hrs**

**Lecture**

Principles, utility and relevance of morphology; integument structure, colors, outgrowths,

appendages; process of molting; formation of new cuticle, tanning functions; tagmosis and body wall, head-origin, definitive insect head; areas and sutures of insect head; appendages, antennae and modifications; mouthparts and modifications; simple and compound eyes; tentorium; neck-sclerites; thorax sclerites, sutures, ridges, areas of tergum, sternum and pleuron, pterothorax, their modifications; wings origin, structure, developmemt of wings, modifications; venation, articulation, wing coupling; legs- structure, articulation, modifications; abdomen sclerites, pregenetial, genitial segments, appendages, genitalia, modifications; embryology and post embryonic development. **Practical**

Insect external structure; segmentations; preparation of temporary and permanent slides;

integument outgrowths, head-sclerites, sutures, areas, types, tentorium; modifications of mouthparts, dissections of the mouthparts, modifications of antennae, legs and wings; general morphology of grasshopper, honeybees, butterfly, housefly, cockroaches, thrips, beetles, bugs, caterpillars and grubs.

**PLEN 521 Insect Anatomy and Physiology 3 Cr.Hrs. Lecture**

Scope and importance of insect physiology; cuticles; insect nutrition; digestion; anatomy

and physiology of digestive systems, excretory systems, circulatory systems, respiratory systems, nervous & endocrine systems; musculatures; reproductive systems; metabolism of carbohydrates, lipids and nitrogenous compounds; embryogenesis; reproduction & postembyonic development; sensory organs and insect behavior.

**Practical**

Dissection of insects to study comparative modifications in different systems,

grasshopeer, bugs, flies, bees, beetles, moths; experiments to study gas exchange; heamolymph counts; excretory products; digestive enzymes; formulation and preparation of insect artificial diets for rearing insects.

**PLEN 531 Insect Ecology 3 Cr.Hrs.**

**Lecture**

Basic concepts- population and environment; population regulation-natural control and

current theories; characteristics of population; biotic potential and environmental resistance; population dynamics; dispersal and migration; life tables; tropism and kinesis; diapauses, hibernation, and aestivation; the niche concept and division of resources; competitions; effects of environmental factors on distribution and abundances of insects; plant-insect-parasitoid/predators interactions; food chain and ecological succession; ecological indicators; ecological aspects of pest management.

**Practical**

Measurement of microenvironment; construction of life tables; estimates of population

density; sampling methods; estimation of dispersion and migration.

**PLAG 511 Biometrics 4 Cr. Hrs**

*See Agronomy Graduate program*

**PLEN 541 Apiculture and Sericulture (E)**

**Lecture**

Apiculture-the honey bees, distribution, biology and taxonomy; ecology and behaviour of

bees; methods of communication and reproduction; queen rearing; beekeeping, bee diseases, bee products, processing and management; pollination; bee fauna in Ethiopia; history of sericulture, mulberry and non mulberry; sericulture and its components; the silk worm moth- distribution, biology, ecology and taxonomy; the silk industry; diseases of silkworms; potential of apiculture and sericulture industries in Ethiopia; integration of apiculture and sericulture technologies with national development strategies; biodiversity and conservation.

**Practical**

Visit to apiary and important bee-pasture, identification of bee species and different tools

used in bee keeping, management of live bee colony during dirth periods; mechanical honey extraction from comb and purification of honey for storage; visit to sericulture enterprise, collection of silk moth and rearing equipments, egg collection methods, feeding the larvae, collection and management of silk.

**PLPA 541 Agricultural Nematology 2 Cr. Hrs**

*Please refer to Graduate Program in Plant Pathology*

**PLCP 512 Agricultural Pesticides 3 Cr. Hrs**

*Please refer to Graduate Program in Plant Pathology*

**PLCP 522 Postharvest Pests Management 2 Cr. Hrs.**

*Please refer to Graduate Program in Plant Pathology*

**PLCP 532 Eco- and Food-Toxicology (E) 3 Cr. Hrs.**

*Please refer to Graduate Program in Plant Pathology*

**PLEN 512 Insect Taxonomy – 3 Cr. Hrs**

**Lecture**

History and importance of taxonomy, relationship between taxonomy and systematics;

zoological nomenclature and classification; current classification; taxonomy of insects pest of agricultural importance; phenetics and cladistics; concept of species, sub-species, kinds of species and taxonomic categories; intraspecific categories and biotypes; procedures in identification and kinds of taxonomic keys; principles and application of zoological nomenclature, international code of zoological nomenclature; ethics in taxonomy, taxonomic publications and description of new taxa.

**Practical**

Insect collection, preparation of insects for making illustrations; illustrating taxonomic

characters; microscopic slide preparations; photography of insects and their parts; identification of insects with the help of taxonomic keys; preparation of taxonomic keys; morphometric analysis; repository of insect collections; visits to AU insect museum.

**PLEN 522 Biological Control**

**Lecture**

Philosophy, scope, history and importance of biological control; theoretical and empirical

basis of biological control; parasitism and predatism, phases of parasitism; important parasitic and predatory groups of insects and insect pathogens; ecological principles of biological control; methods of colonization, recovery and evaluation; introduction, culture, establishment and management of natural enemy population; biological control of weeds; role of natural enemies in integrated pest management with special reference to agriculture; microbial pesticides; examples of successful studies on biocontrol.

**Practical**

Identification of common natural enemies (parasitoids, predators, pathogens and

phytophagous insects) of crop pests and weeds; rearing of eggs, egg-larval, larval and pupal parasitoids and their laboratory hosts; rearing of common predators and phytophagous natural enemies of weeds; field recovery of parasitoids; culturing and identification of common insect pathogens.

**PLEN 532 Integrated Insect Pest Management – 2 Cr. Hrs**

**Lecture**

Pest definition; ecological classification; pests and their impacts; historical development

of insect pest management; IPM tactics and strategies; socio-economic context of IPM; farming systems and its relation to IPM; ecosystems-trophic dynamics, basic food chain, carrying capacity and logistic growth, r-selected and k-selected organisms, competition and density dependant phenomena; comparative biology of pests-reproduction, fecundity, voltinity, molting and metamorphosis and life tables; pest management decisions- diagnosis of the problem, sampling, monitoring and forecasting, crop loss assessment, economic injury level and thresholds; cultural, host resistance, biological, chemical, regulatory, semio-chemical, sterile insect and transgenic control methods; IPM program planning, development and evaluation; case studies on IPM; IPM and biodiversity. **Practical**

Collection of data on different insect pest species, different developmental stages,

duration of attack on crop, sampling of pest in crop, determine intensity, assessment of natural enemies

**PLEN 542 Forest Entomology (E) Lecture**

Important insects in forest ecosystems; important insects pests of forest trees & shrubs,

their biology, ecology, classification and nature of damage, distribution and management strategies; assessments of damages by forest insect pests; ecological considerations of pest management in tropical forest.

**Practical**

Assessment of insect damage in forest trees and their products; collection, preservation,

and identification of pests of forest plants.

**PLEN 552 Graduate Seminar in Entomology – 1 Cr. Hrs**

Review of recent literature relating to selected topics in entomology.

**PLEN 611 Research, M.Sc. Thesis (6)**

Organized research in crop protection; thesis presentation, and defense as part of the

requirement for the Master of Science Degree.

**MSc Weed Science**

**Distribution of Courses by Year and Semester**

**Year I; Semester I**

**Course Code Course Title Credit Hours**

|  |  |  |
| --- | --- | --- |
| PLCP 511 | Plant Pathology | 3 |
| PLCP 551 | Weed Biology & Ecology | 3 |

|  |  |  |
| --- | --- | --- |
| AGEC 561 | Computer Applications (E) | 3 |
| ANPR 521 | Biochemistry (E) | 3 |
| PLAG 511 | Biometrics | 4 |
| PLAG 521 | Plant Physiology | 3 |
| **Total** |  | **13/19** |

**Year I; Semester II**

**Course Code Course Title Credit Hours**

|  |  |  |
| --- | --- | --- |
| PLCP 502 | Agricultural Pesticides | 3 |
| PLCP 512 | Integrated Pest Management | 2 |

PLCP 552 Insect pest, Diseases, and Weeds of Economic Importance (E) 3

PLCP 562 Graduate Seminar in Crop Protection 1

PLCP 572 Principles and Practices of Weed Management 3

PLAG 542 Systems Analysis & Crop Modelling (E) 3

PLPB 552 Breeding for Abiotic & Biotic Stresses 2

SOSC 552 Soils & Plant Nutrition 3

**Total 14/20**

E = Elective Courses, students are required to take at least one elective course

**Year II**

**Course Code Course Title Credit Hours**

PLCP 611 M. Sc. Thesis Research 6

**Description of courses for MSc Weed Science**

**PLWS 511 Weed Biology and Ecology 3 Cr. Hrs. Lecture**

Weed biology and ecology, population dynamics of weeds, weed seed bank, crop- weed

interference, physiological aspects of competition. Thresholds of competition, weed- crop competition studies, weed- environment interaction, methods conducting research on weeds and data analysis status of weed problem and research in Ethiopia, weeds in different agro-eco systems, origin of weeds, weeds of crop field, fallow lands, aquatic and parasitic weeds,

**Practical**

Collection and identification of weeds, preparation of herbarium, measurement of weed

dominance, classification, weed index, persistence index and competition studies

**PLWS 521 Principles and Practices of Weed Management 3 Cr. Hrs. Lecture**

Principles and methods of weed control, concepts of integrated weed management, weed

control through bioherbicides, mycoherbicides and allelo chemicals, herbicides- history, development and their mixtures, selectivity, adjuvant and safeners, mode of action and method of application, application equipment and its calibration, herbicide hazards and precautions in storage and handling weed management in storage and handling, weed management practices in major crops including vegetables, fruits and plantation crops, grass lands and cropping systems, major weed – shift in cropping systems, impact of herbicides on agricultural technology, research planning and procedure in weed science. **Practical**

Weed problem and survey in crops and cropping systems, calculation and preparation of

spray solution of herbicides for high and low- volume sprayers, use of various types pumps and nozzles, economics of weed control.

**PLWS 531 Parasitic, Aquatic and Invasive Weeds 2 Cr. Hrs. Lecture**

Biology and ecology of important weeds of arable and non- arable lands and water bodies

and their management strategies.

**Practical**

Collection and identification of parasitic, aquatic and non cropped land weeds study of

weed problems in various areas, practical on their control measures

**PLAG 501 Crop Husbandry 3 Cr. Hrs.**

*See Agronomy Graduate Program*

**PLAG 511 Biometrics 4 Cr. Hrs**

*See Agronomy Graduate Program*

**PLAG 531 Dryland Agriculture and Irrigation**

*See Agronomy Graduate Program*

**PLCP 512 Agricultural Pesticides 3 Cr. Hrs**

*Please refer to Graduate Program in Plant Pathology*

**PLWS 512 Mechanisms of Herbicide Action 3 Cr. Hrs. Lecture**

Historical background of herbicides, definition of herbicide usages, classification of

herbicides based on their mode of action, important herbicide families and molecules, functional features of common herbicides, mechanism of absorption and translocation, their effect on growth and development, photo synthesis, respiration and protein synthesis, factors modifying the selectivity, persistence of herbicides their residual effects, degradation of herbicides in soils and plant, metabolism of herbicides, mechanism of action of adjuvant and herbicide antidotes.

**Practical**

Familiarity with herbicides, application of herbicides with different types of mechanism

of action, study of mortality and nature of mortality of weed, mortality study of symptoms of phyto - toxicity of herbicides in crop plants, study of persistence of herbicides in soil by bioassay techniques, study of movement of herbicides in soil.

**PLAG 502 Crop Physiology**

*See Agronomy Graduate Program*

**PLAG 522 Forage and Pasture Crops Production (E)**

See Agronomy Graduate Program

**PLAG 532 Crop Ecology and Cropping Systems**

*See Agronomy Graduate Program*

**PLHO 501 Husbandry of Horticultural Crops I**

See Horticulture Graduate Program

**SOSC 522 Soil, Water and Plant Analysis**

*See Soil Science Graduate Program*

**PLWS 522 Graduate Seminar in IPM 3 Cr. Hrs.**

Review of recent literature relating to selected topics in plant pathology.

**PLWS 611 Research, M.Sc. Thesis (6)**

Organized research in crop protection; thesis presentation, and defense as part of the

requirement for the Master of Science Degree.

**MSc Integrated Pest Management**

**Course Distribution by Semester and Year**

**Code Course Title Credit hours**

**Semester I Semester II**

PIPM 511 Fundamentals of Field, Orchard and 3 0

Greenhouse Pest Management

PLEN 531 Insect Ecology 3 0

|  |  |  |  |
| --- | --- | --- | --- |
| PLWS 521 | Principles and Practices of Weed | 3 | 0 |
|  | Management |  |  |
| PLAG 511 | Biometrics | 3 | 0 |
| RDAE 541 | Knowledge and Information Systems in | 3 | 0 |
|  | Agriculture and Rural Development |  |  |
| PLCP 512 | Agricultural Pesticides | 0 | 3 |
| PLCP 522 | Postharvest Pest Management | 0 | 2 |
| PLCP 532 | Eco- and Food-Toxicology (E) | 0 | 3 |
| PLEN 522 | Biological control (E) | 0 | 2 |
| PLEN 532 | Integrated Insect Pest Management | 0 | 2 |
| PLPA 532 | Integrated Disease Management | 0 | 2 |
| PIPM 512 | Vertebrate Pests and Their Management | 0 | 2 |
| PIPM 522 | Graduate Seminar in IPM | 0 | 1 |

PIPM 611 M.Sc. Thesis Research or ‘Development **6**

Oriented Project’

**Semester total credit hr 15 12/17**

**Description of courses for MSc Integrated Pest Management**

**PLIM 511 Fundamentals of Field, Orchard and Greenhouse Crops Pest**

**Management - 3 Cr. Hrs. Lecture**

Concept of disease in plants; disease development; host-parasite interaction; principles

and practices of plant disease management; identification of diseases of major field, orchard, and greenhouse crops; biology, ecology, distribution and management of important diseases of maize, sorghum, barley, wheat, groundnut, common bean, mango, citrus, peaches, coffee, etc.; unique disease problems in greenhouses; management of soil borne and foliar diseases in the greenhouse; Economic importance of insect pests in Ethiopia; yield loss due to insect pests; insect orders of economic importance; biology, ecology, distribution and management of mites and insect pests of maize, sorghum, sugar cane, barley, wheat, tef, groundnut, sesame, cotton, noug, common bean, cow pea, faba bean, field pea, chickpea, lentil, coffee and spices, enset, sweet potato, Irish potato, tomato, cabbage, pepper, banana, citrus, papaya and mango etc..

**Course delivery**

Field visit for collection and identification of important diseases of crops; assessment of

diseases in field, orchard, and greenhouse crops; a case study and recommendation for the control of crop diseases of special interest to the industry; field visit for assessment of insect pests and crop damage, collection and identification of important insect pests of crop plants.

**PLEN 531 Insect Ecology 3 Cr.Hrs.**

*See Entomology Graduate Program*

**PLWS 521 Principles and Practices of Weed Management 3 Cr.Hrs.**

*See Weed Science Graduate Program*

**PLAG 511 Biometrics 4 Cr. Hrs**

Analysis of variance models; assumptions and their tests, alternatives in case of failures

of assumptions; principles of designs of experiments; detail discussion on the applicability, layout and randomization, analysis of variance, mean separation, interpretation of results and missing plot techniques with respect to completely randomized design, randomized completely block design, Latin squares design, youden square design, factorial experiments with confounding and fractional factorial design concepts; split plot design and strip plot design with two or more factors; compact family block design; incomplete block designs-simple and balanced lattice design, augmented randomized block designs; combined analysis of variance and its interpretation; analysis of covariance with randomized block design for adjustment; simple and multiple correlation and regression analysis; application of chi-square and non-parametrics statistics.

**RDAE 541 Knowledge and Information Systems in Agriculture and Rural**

**Development**

An overview of development paradigms; system thinking, distinctions between hard and

soft system; soft system methodology; the place of agricultural knowledge and information system in rural development; evolution of approaches in development; knowledge typologies: indigenous knowledge and social learning; indigenous knowledge and scientific knowledge; information science and information system; understanding social organization of innovation; technology and social factors; extension and natural resources management; conflict management in NRM; roles of research and extension organization in agricultural and rural development; research and extension linkages; policy and policy making in agricultural and rural development.

**PLCP 512 Agricultural Pesticides 3 Cr. Hrs**

*Please refer to Graduate Program in Plant Pathology*

**PLCP 522 Postharvest Pests Management 2 Cr. Hrs.**

*Please refer to Graduate Program in Plant Pathology*

**PLCP 532 Eco- and Food-Toxicology (E) 3 Cr. Hrs.**

*See Graduate Program in Plant Pathology*

**PLEN 522 Biological control (E) 3 Cr. Hrs.**

*See Entomology Graduate program*

**PLEN 532 Integrated Insect Pest Management – 2 Cr. Hrs**

See Entomology Graduate program

**PLPA 532 Integrated Disease Management 2 Cr. Hrs.**

*See Graduate Program in Plant Pathology*

**PLIM 512 Vertebrate Pests and their Management 2 Cr. Hrs. Lecture**

Losses and nature of damage caused by rodents and other vertebrate pests; economically

important rodents, their distribution and prevalent species; identification, biology and behaviour of rodent pest species; management of rats in human dwellings, storages and crops; major species of birds and mammals attacking crops, their distribution, ecology and habits; identification of bird pest species; chemical and non-chemical methods of management of birds and mammal pests.

**Practical**

Demonstration of damages caused by rats, identification of prevalent rodent and bird

species; chemical and non-chemical control of rats and birds.

**PIPM 522 Graduate Seminar in IPM 3 Cr. Hrs.**

Review of recent literature relating to selected topics in plant pathology.

**PIPM 611 M.Sc. Thesis 6 Cr. Hrs.**

*Option 1:* Organized research in integrated pest management. Thesis presentation and

defense as part of the requirement for the Master of Science Degree.

*Option 2:* Alternative to thesis research in the form of “Development Oriented Project” wherein students can take up assessment of problems, review the relevant literature and do some laboratory work, etc. They should come up with concrete findings and give specific recommendations suitable for an area/commercial farm, etc.

**MSc in Climate Smart Agriculture**

* 1. **Modules and Course Breakdown**

**Table 3. Description of modules, code and course breakdown**

| Module | Module name | Module code | Course Title | Course  Code | Cr. Hrs | ECTS |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Climate Smart Agricultural Production and Management | CSA-511 | Theories, Principles and Practices of Climate Smart Agriculture | CSAg-5111 | 3 | 5 |
| Biodiversity Conservation and Management | BdEM5111 | 2 | 3 |
| Climate Smart Landscape, Soil and Water Management | CSAg-5121 | 3 | 5 |
| Climate Smart Livestock and Fisheries Production and Management (E) | CSAg-5131 | 3 | 5 |
| Climate Smart Crop Production and  Management (E) | CSAg-5141 | 3 | 5 |
| Climate Smart Agro-forestry Systems (E) | CSAg-5151 | 2 | 3 |
| Integrated Pest and Disease Management (E) | CSAg-5161 | 3 | 5 |
|  |  |  | **Sub-Total** |  | **8+2/3** | **13+3/5** |
| 2 | Climate Smart Socioeconomics Perspectives | CSA-521 | Socio-economics, Policy and Gender Perspectives in Climate Smart Agriculture | CSAg-5211 | 3 | 5 |
| Agricultural Extension and Participatory Rural Appraisal | CSAg-5221 | 2 | 3 |
| Disaster Risk Reduction and Management for Livelihood Resilience | CSAg-5231 | 2 | 3 |
| Institutions, Policy and Innovations for Climate Smart Agriculture (E) | CSAg-5241 | 3 | 5 |
| Climate Change and Pastoral System (E) | CSAg-5251 | 2 | 3 |
| Postharvest Management and Value Addition of Agricultural Produces (E) | CSAg-5261 | 3 | 5 |
|  |  |  | **Sub-Total** |  | **7+2/3** | **8+3/5** |
| 3 | Tools and Techniques for CSA | CSA-532 | Statistical Techniques and Data Analysis | BdEM5312 | 3 | 5 |
| Research Methods in Climate Smart Agriculture | CSAg-5322 | 2 | 3 |
| GIS and Remote Sensing for Climate Change (E) | CSAg-5332 | 3 | 5 |
| Animal and Plant Genetics and Molecular Techniques (E) | CSAg-5342 | 2 | 3 |
| Climate Smart Agricultural Mechanization and Energy Management (E) | CSAg-5352 | 2 | 3 |
| Climate Dynamics and Modeling (E) | CSAg-5362 | 3 | 5 |
|  |  |  | **Sub-Total** |  | **5+2/3** | **8+3/5** |
| 4 | Seminars and Theses Research in CSA | CSA-  642 | Graduate Seminar | CSAg-5412 | 1 | 2 |
| MSc Thesis Research | CSAg-6411 | 6 | 10 |
|  |  |  | **Sub-Total** |  | **7** | **12** |
|  |  |  | **Total** |  | **25+6/9** | **41+9/15** |

**Table 4.Module one courses order and credit hours**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Module code | Module Name | **Course name and order in the module** | **Course Code** | **Cr. Hrs** | **ECTS** | **Mode of delivery** | **Week** | **Hours** |
| CSA-511 | Climate Smart Agricultural Production and Management | Theories, Principles and Practices of Climate Smart Agriculture | CSAg-5111 | 3 | 5 | Block | 1-3 | 48 |
| Biodiversity Conservation and Management | BdEM5111 | 2 | 3 | Block | 4-5 | 32 |
| Climate Smart Landscape, Soil and Water Management | CSAg-5121 | 3 | 5 | Block | 6-8 | 48 |
| Climate Smart Livestock and Fisheries Production and Management (E) | CSAg-5131 | 3 | 5 | Parallel | 1-8 | 48 |
| Climate Smart Crop Production and Management (E) | CSAg-5141 | 3 | 5 | Parallel | 1-8 | 48 |
| Climate Smart Agro-Forestry Systems (E) | CSAg-5151 | 2 | 3 | Parallel | 1-8 | 32 |
| Integrated Pest and Disease Management (E) | CSAg-5161 | 3 | 5 | Parallel | 1-8 | 48 |
| **Total** | | | | **8+2/3=10/11** | **13+3/5=16/18** |  |  |  |

**Table 5. Module two courses order and credit hours/ECTS**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module code** | **Module Name** | **Course name and order in the module** | **Course Code** | **Cr. Hrs** | **ETCS** | **Mode of delivery** | **Week** | **Hours** |
| CSA-521 | Climate Smart Socioeconomic Perspectives | Socio-economics, policy, and gender perspectives in Climate Smart Agriculture | CSAg 5211 | 3 | 5 | Block | 10-12 | 48 |
| Agricultural Extension and Participatory Rural Appraisal | CSAg 5221 | 2 | 3 | Block | 13-14 | 32 |
| Disaster Risk Reduction and Management for Livelihood Resilience (E) | CSAg 5231 | 2 | 3 | Parallel | 10-14 | 32 |
| Institutions, Policy, and Innovations for Climate Smart Agriculture (E) | CSAg 5241 | 3 | 5 | Parallel | 10-14 | 48 |
| Climate Change and Pastoral System (E) | CSAg 5251 | 2 | 3 | Parallel | 10-14 | 32 |
| Post-harvest management and value addition of agricultural produces (E) | CSAg 5261 | 3 | 5 | Parallel | 10-14 | 48 |
| Total |  |  |  | **8+2/3** | **13+3/5** |  |  |  |

**Table 6.Module three courses order and credit hours/ECTS**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Module Code** | **Module Name** | **Course name and order in the module** | **Course code** | **Cr. Hrs** | **ECTS** | **Mode of delivery** | **Week** | **Hours** |
| CSA-532 | Tools and Techniques in CSA | Statistical Techniques and Data Analysis | BdEM5312 | 3 | 5 | Block | 16-18 | 48 |
| Research Methods in CSA | CSAg-5322 | 2 | 3 | Block | 19-20 | 32 |
| GIS and Remote Sensing in Climate Change (E) | CSAg-5332 | 3 | 5 | Parallel | 16-20 | 48 |
| Animal and Plant Genetics and Molecular Techniques(E) | CSAg-5342 | 2 | 3 | Parallel | 16-20 | 32 |
| Climate Smart Agriculture Mechanization and Energy Management(E) | CSAg-5352 | 2 | 3 | Parallel | 16-20 | 32 |
| Climate Dynamics and Modelling(E) | CSAg-5362 | 3 | 5 | Parallel | 16-20 | 48 |
| **Total** | | | | **5+2/3=7/8** | **8+3/5=11/13** |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Module code | Module Name | **Course Name and order in the module** | **Course Code** | **Cr. Hrs** | **ECTS** | **Mode of delivery** | **Week** | **Hours** |
| CSA-642 | Seminars and Theses Research | Graduate Seminar in Climate Smart Agriculture | CSAg-5412 | 1 | 2 |  | 22-25 | 16 |
| MSc Thesis Research | CSAg-6411 | 6 | 10 |  |  |  |
| **Total** | | |  | **7** | **12** |  |  |  |

**COURSE SYLLABUS**

**MODULE 1**

**Course Title: Theories, Principles and Practices of Climate Smart Agriculture**

**Course Code: CSAg-5111**

**Credit Hours/ECTS: 3 /5**

**Pre-requisite: No**

**Course Description**

Agriculture in developing countries must undergo significant transformation if it is to meet the growing and interconnected challenges of food insecurity and climate change. A proposed means of achieving such improvements is increased use of a ‘climate-smart agriculture’ approaches through the courses like **Theories, Principles and Practices of Climate Smart Agriculture.** This course contains seven major sections: Introduction; Agriculture, Climate Change and Food Security; Background to CSA; Climate Change Adaptation, mitigation and disaster risk reduction; Perspectives of Climate Change and Energy; Capacity building and policy innovation; and future research on CSA .The course will provide students with an insight into the theories, principles and practices of Climate Smart Agriculture. It will also deal with climate change during the past, present and in the future; major causes and effects of climate change; issues related to Greenhouse Gases and their emissions, Agriculture, Climate Change, Food Security. Climate change mitigation, adaptation and resilience, Farming Systems, Concepts and principles of Climate Smart Agriculture, Climate Smart Agricultural Technologies, Indigenous Knowledge for CSA, Policy perspectives to CSA, Climate Change Adaptation, Mitigation and Disaster Risk management, the concept of carbon sequestration; Carbon Trading and REDD+, Organizations working on Climate Change and Agriculture, energy perspectives of CSA, Capacity Building and Policy Innovation, issues of Clean Development Mechanism (CDM) and development of modalities and procedure of Future research on CSA.

The course is supported with practical activities on climate change impacts on crops and on soils; Sources and sinks of GHGs; Estimating GHG emissions; Carbon monitoring and sequestration; Analysis and interpretation of climate data; modeling climate impact on crops; Farming system field analysis; soil, plant and water analysis; Animal waste management practice; Field trip and case studies .

**General Objectives of the course:**

To impart theoretical and practical Knowledge about then challenges of Agriculture due to Climate change and explore ways to enhance food security while contributing to Adaptation and mitigation to Climate Change.

**Specific Objectives of the course:**

After successful completion of the course, the students will be able to:

* discuss about the theories, principles and practices of Climate Smart Agriculture:
* identify the major causes of climate change and its effects on Agriculture;
* assess issues related to climate change mitigation, adaptation and resilience;
* explain the concept of food security, sustainable Agriculture, Conservation Agriculture, Farming systems;
* explain the concepts and components of CSA;
* discuss the synergies and Tradeoff s between CSA objectives;
* assess Indigenous Knowledge and technologies related to Climate Smart Agriculture;
* assess the policy perspectives of Climate Smart Agriculture;
* discuss on the energy perspectives of climate change and CSA;
* discuss about Carbon sequestration, Carbon Trading, REDD+, Clean Development Mechanism (CDM);
* Identify the major definitions and concepts of climate change, mitigation and adaptation;
* Identify the major barriers to adopt Climate smart Agricultural Practices;
* Analyze national and global policies related to CSA and disaster risk management;
* Identify the major renewable energy sources in line with CSA;
* To assess the capacity building and policy innovations, national and international initiatives for Climate Smart Agriculture;
* Identify and analyze the different adaptations and mitigation options for monitoring CSA
* assess Greenhouse Gas emissions and prioritizing coping mechanisms for climate change;
* climate change adaptation: adaptation and technological needs; adaptation and coping mechanisms; national and local
* Discuss the models and procedures of climate change impacts on Crops.

**Course contents:**

1. **Introduction**
   1. Climate: Past, present and future
   2. Causes and Evidences of Climate Change
   3. Major Green House Gases and their Emissions
   4. Climate Change Scenarios in Africa and Global context
2. **Agriculture, Climate Change and Food Security**
   1. Food Security
   2. Sustainable Agriculture and Food Security
   3. Climate Change; Impacts, Vulnerability and Resilience in Agriculture
   4. Climate Change, Development and Farming systems in Africa
   5. Impacts of Climate variability and change on Soil Health, Environment, and Plant -Water interactions
   6. Agricultural Impacts on Climate change
3. **Background to Climate-Smart Agriculture**

3.1 Concept and Principles of Climate-Smart Agriculture (CSA)

* 1. Components of CSA and their Assessment
  2. Synergies and Tradeoffs between CSA Objectives
  3. Climate-Smart Agriculture for future food production, Food Security and Resilience
  4. Approaches and practices of CSA
  5. Climate-Smart Agriculture Technologies
  6. Integrated farming system and Conservation Agriculture for Climate Resilience
  7. Indigenous knowledge for CSA
  8. Gender, Climate-Smart Agriculture and Climate change
  9. Development of Climate- Resilient Green Economy strategies in Ethiopia and other African countries
  10. Integrated National Policy Approaches, Strategies and Institutions related CSA

3.12 Barriers to Adoption of Climate Smart Agriculture practices

1. **Climate Change Adaptation, Mitigation, and Disaster Risk Reduction**

4.1 Mitigating greenhouse gas emissions from Agriculture

4.2 Building Adaptation and Resilience to Climate Change in Agriculture

4.3 Climate-smart agriculture: integrating adaptation and mitigation

4.4 Impacts and Response of Agriculture to Climate Change

4.5 Managing Climate Risks with development of CSA

4.6 Community-Based approaches for CSA

4.7 Over view of Climate-smart management of livestock, forestry, agro-forestry,

Fisheries and aquaculture

4.8 Clean Development Mechanism, Carbon Trading, Carbon Sequestration and

REDD+

4.9Organizations working on Climate Change and Agriculture

**5.Perspectives of Climate Change and Energy**

5.1 Management of Energy for CSA

5.2 Opportunities for synergies between CSA, REDD+ and Energy

5.3 Energy Efficiency and Renewable Energy

5.4 Moving forward-possible Energy Solutions for CSA

6. **Capacity Building and Policy Innovation in Ethiopia and other African Countries**

6.1 Capacity Development for CSA

6.2 Assessment, monitoring and Evaluation for CSA

6.3 National and International Initiatives on CSA

6.4 Mainstreaming CSA into National Policies and Programmes

**7. Future Research on Climate-Smart Agriculture**

7.1 Improving Access to Knowledge and Monitoring of CSA

7.2 Prioritizing the Climate change Adaptation and Mitigation Options

7.3 Quantifying Greenhouse Gas Emission from Crops and cropping systems

7.4 Modeling Climate Change Impacts on Crops

**Mode of Delivery:** Lecture, assignments, practical field trips, term papers, presentation, climate change video and case study.

**Methods of Assessment**

The assessment will be made mainly through Assignments and Examination.Students are also expected to review articles and present.

* Assignments (15%)
* Review articles on cases of Theories and Principles of Climate Smart Agriculture and presenation (15%)
* Reports on field visit and practical activities (20%)
* Final examination (50%)

**References:**

* FAO (2013) Climate-smart Agriculture: Sourcebook, Food and Agriculture Organization of the United Nations, p 570.
* IPCC (2014) Climate Change 2014. Fifth Assessment Synthesis Report of Inter-Governmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, USA.
* Pathak H and Chakrabarti B (2015) Climate Change and Agriculture. Technologies for Enhancing Resilience. Indian Agricultural Research Institute, New Delhi, pp. xvi + 237. ISBN No. 978-93-83168-22-4.
* FAO, 2013. Climate-Smart Agriculture Source Book. The Food and Agriculture Organization of the United Nations. 2013.

http://www.fao.org/docrep/018/i3325e/i3325e.pdf.

* WMO, (2013). A summary of current Climate Change findings and figures.ClimateChangeInfoSheet2013-03final.pdf. Accessed 15th June, 2015
* Adams, R.M, Hurd, B.H, Lenhart, S and Leary, N. 1998. Effects of global Climate change on Agriculture: An Interpretative Review. Climate Research. Clim Res. Vol. 11: 19–30.
* FAO. 2008. Climate Change and Food Security- A Framework Document.

http://www.fao.org/forestry/15538-079b31d45081fe9c3dbc6ff34de4807e4.pdf.

* Scherr , S. J , Shames, S and Friedman, R. 2012. From climate-smart agriculture to climate- smart landscapes. Agriculture & Food Security 2012, 1:12, Agriculture and Food Security. http://www.agricultureandfoodsecurity.com/content/1/1/12.
* Fellmann, T. 2012. The assessment of Climate Change-related vulnerability in the agricultural sector: reviewing conceptual frameworks. FAO/OECD Workshop. Building Resilience for Adaptation to Climate change in the Agriculture sector.
* Vincent, K., T. Cull, A. Kapoor, P. K. Aggarwal, G. D. Bhatta, C. Lau, P. Kristjanson, P. Phartiyal, G. Parvin, S. Bisht and S. Nilormee, 2013. Gender, Climate change, agriculture, and food security: A CCAFS Training-of-Trainers (TOT) Manual to prepare South Asian rural women to adapt to Climate change CGIAR Research Program on Climate Change, Agriculture.
* FAO (Food and Agriculture Organization of the United Nations). 2010a. Climate change implications for food security and natural resources management in Africa. Background paper prepared for the Twenty-sixth Regional Conference for Africa. Luanda, Angola.
* FAO. 2012. Identifying opportunities for climate-smart agriculture investments in Africa.

http://www.fao.org/docrep/015/an112e/an112e00.pdf

* FAO 2014a. Climate-Smart Agriculture: What is it? Why is it needed?

http://www.fao.org/3/a-i4226e.pdf

* FAO. 2014b. FAO Success stories on climate smart agriculture. Food and Agriculture Organization of the United Nations. http://www.fao.org/3/a-i3817e.pdf.
* Intergovernmental Panel on Climate Change. 2014. Climate Change 2014: Impacts, Adaptation and Vulnerability. IPCCWGIIAR5 Technical Summary.
* Henderson-Sellers, A. and K. McGuffie (2012). The future of the world’s climate.Other relevant IPCC reports available at [www.ipcc.ch](http://www.ipcc.ch)
* Admassu H, Getinet M, Thomas TS, Waithaka M, Kyotalimye M. 2012. East African Agriculture and Climate Change: A Comprehensive Analysis – Ethiopia. Washington, DC: International Food Policy Research Institute.
* FAO. 2010. Climate-smart agriculture: policies, practices and financing for food security, adaptation, and mitigation. Rome.
* FAO. 2013. Community for Climate Change Mitigation in Agriculture. Mitigation of climatechange in agriculture (MICCA) programme.
* McCarthy, N., Lipper, L. &Branca, G. 2011. Climate-smart agriculture: smallholder adoption and implications for climate change adaptation and mitigation. FAO, MICCA Series No. 4. Rome, FAO.
* World Bank 2010. The Hague Conference on Agriculture, Food Security and Climate Change: Opportunities and Challenges for a Converging Agenda: Country Examples. Washington, DC: World Bank.

**Course Title: Biodiversity Conservation and Management**

**Course code: BdEM5111**

**2 Cr. Hrs/ ECTS 3**

**Prerequisite course(s): No**

**Course Description:**

Basic concepts of biodiversity, characterization of biodiversity at genetic, species and ecosystem level, importance/values/benefits of biodiversity, threats and loss of biodiversity and its impact; the climate system and greenhouse effect vs. biodiversity; climate changes and its impacts on ecosystems and species distributions; biodiversity conservation tools and techniques (such as in-situ and ex-situ); qualitative and quantitative biodiversity resource assessment techniques, management plan for biodiversity conservation, the role of local people in biodiversity conservation (local/indigenous knowledge and its importance in biodiversity conservation), conservation incentives and incentive provision approaches; hotspots and mega-diverse countries, bioprospecting, biopirecy, and benefit sharing. Ethiopia centre of origin for some major crops. National and global conventions, policies and institutional aspect in biodiversity conservation and ecosystem management. The course is supported with field practical activities on qualitative and quantitative measurement of biodiversity. In addition, software programs in biodiversity informatics, national, regional and global biodiversity information databases and sources of thematic biodiversity information should be covered.

**Course Objectives:**

After completing this course, students will be able to:

* Explain the key concepts and definition of biodiversity.
* Characterize the biodiversity at any level in a systematic approach.
* Describe the major threats and challenges faced on the biodiversity.
* Understand the impacts of climate change on the biodiversity and develop knowledge on mitigation and adaptation strategies.
* Develop skill on the quantitative and qualitative measurement of biodiversity and carbon stock analysis of the various carbon pools.
* Develop knowledge on various techniques of management plan and conservation tools.
* Describe the global and national conventions, policies, and institutions of biodiversity conservation.

**Expected Competencies:**

* Characterization of the biodiversity of a given ecosystem
* Analyze the effect of climate change on ecosystems and species distributions
* Measurement of biodiversity, set priority conservation actions and advise biodiversity conservation strategies and mechanisms
* Manage and conserve biodiversity of a given ecosystem
* Teamwork in biodiversity conservation and management.
* Skills to collect, organize, analyze, and communicate biodiversity data.
* Use basic technologies, databases, and software of thematic biodiversity informatics

**Course Contents**

**1. Basics of Biodiversity**

1.1. Concepts and definitions of biodiversity

1.2. Characterization of biodiversity at genetic, species, ecosystem and cultural levels

1.3. Spatial and Temporal Patterns of Biodiversity

1.4. Structural and functional biodiversity

1.5. Importance/values/benefits of biodiversity

**2. Climate change and challenges on biodiversity**

2.1. The greenhouse gases effect vs. biodiversity

2.2. Climate changes and its impacts on ecosystems and species distributions

2.3. Threats and loss of biodiversity and its impact

**3. Biodiversity measurement and conservation methods**

3.1. Qualitative and quantitative biodiversity assessment/measurement methods

3.2. Conservation priorities

* hotspots and mega-diverse countries

3.3. Biodiversity conservation tools and techniques

* in-situ and ex-situ conservations

3.4. Management plan for biodiversity conservation

**4. Biodiversity and society**

4.1. The role of local community in biodiversity conservation

4.2. Indigenous communities and biodiversity

4.3. Indigenous knowledge in the use and conservation of biodiversity

4.4. Gender and biodiversity

4.5. Bioprospecting, bio-piracy, and benefit sharing

4.6. Conservation incentives and incentive provision approaches

**5. Overview of African biodiversity**

5.1. An overview of African biodiversity (Flora, fauna, microorganisms, and endemism)

5.2. Biodiversity hotspots and Mega-diverse countries in Africa

5.3. Overview of Ethiopian biodiversity

5.4. Ethiopia centre of origin for some major crops and wild relatives

5.5. Major biodiversity conservation challenges and opportunities

**6. Conventions, policies and institutions**

6.1. Conventions/protocols and policy instruments,

6.2. Institutional arrangements,

6.3. Regional and international cooperation to manage genetic resources

**Method of Delivery**: Lecture, assignments, term papers/independent studies, presentation, field works on quantitative measurement of biodiversity and work on Sourcesof Biodiversity information (Local to global databases,Global, regional and thematic information centres and databases and On-line sources of information).

**Assessment Methods:**

Group and individual assignments and presentations, field work reports, mid and final examinations.

**References:**

* Richard B. Primack, 2006. Essential of Conservation Biology.4th edition.Sinauer Associates, Inc., USA. (Haramaya University Library: QH bstr. 57).
* Van Dyke, F. 2008.Conservation Biology Foundations: Concepts and Applications 2nd Edition, Springer.
* Melina F. Laverty; Eleanor J. Sterling; Amelia Chiles; Georgina Cullman.2008.[Biodiversity 101](https://www.questia.com/library/120085966/biodiversity-101). Greenwood Press,
* Hube, Bernhard, Sinclair, Bradley J., Lampe, Karl-Heinz. 2005. African Biodiversity:

Molecules, Organisms, Ecosystems.Springer.

* **Monson**, Russell K. (Ed.). 2014. Ecology and the Environment. Springer.

**Course Title: Climate Smart Landscape, Soil and Water Management (3 Cr Hr.)**

**Course code: CSAg-5121**

**Credit Hours/ECTS: 3 /5**

**Pre-requisite: No**

**Course Description**

The course will familiarize students with definition of landscapes, interconnection between climate, landscape, soil and water, landscape approach for climate smart agriculture, elements of landscape approach, pressures and constraints on the land, landscape management and implementation, promoting landscapes governance for climate smart agriculture, land use and climate change, measuring and monitoring landscapes, water related impacts of climate change, water management options for climate smart agriculture, options for adaptation to climate change, vulnerability and resilience to climate change, *in-situ* and *ex-situ* water conservation systems for climate smart agriculture, soil management in the context of climate change, principles of soil health, strategies for sustainable soil management, soil carbon sequestration, soil management practices for climate-smart agriculture, restoration of degraded lands, greening economy, challenges in adoption of climate smart agriculture, finance and investment for climate smart agriculture and other related information.

**Course Objectives**

Up on completion of the course, students will be able to:

* identify the relation between climate change and landscape, soil and water management
* develop their knowledge, skills and attitudes, as well as competencies that can be used to understand, define and respond to complex problems in landscape, soil and water management related to climate smart agriculture
* Improve their ability to engage inclusively with other communities to implement options for adaptation and resilience to climate change taking the landscape, the soil and water in to consideration.
* promote landscape governance and monitor changes in landscape, soil and water due to climate change in terms relevant to climate smart agriculture
* apply sustainable landscape, soil and water management strategies relevant to climate smart agriculture
* identify the interaction between green economy and climate smart agriculture and the challenges for adoption of climate smart agriculture

**Course content:**

**1**. **Introduction**

* 1. Concepts and Definition
  2. Why Climate Smart Agriculture?
  3. Food Security and Climate Change
  4. Building the Base for Climate Smart Agriculture

**2. Agriculture in Concert with the Environment**

* 1. Agroecology
  2. Agriculture and Climate Change
  3. Landscape Ecology
  4. Soil-Water- Plant-Landscape Relationships

**3. Management of Landscapes for Climate Smart Agricultural Systems**

* 1. Landscapes and Landscape Approaches for Climate Smart Agriculture

3.1.1Impact of climate change on natural resources

3.1.2 Governing landscapes for climate smart systems in agriculture

3.1.3 The landscape approach and its principles

3.1.4 Contribution of climate smart agriculture for healthy landscape

* 1. Integrated Landscape Management

3.2.1 Elements of integrated landscape management

3.2.2. Integrating climate change adaptation and mitigation

* 1. Key Features of Climate-Smart Agricultural Landscapes

3.3.1 Climate smart practices at field and farm level

3.3.2 Land use diversity across the landscape

* + 1. Management of land use interactions at landscape scale
  1. Implementing Climate-Smart Agricultural Landscapes and Possible Challenges
  2. Examples of Successful Landscape Approaches

**4. Soils and their Management for Climate-Smart Agriculture**

* 1. Definition of Soils, Soil Health and Soil Management
  2. Key Aspects of Healthy Soil
  3. Response of Soils to Climate Change
  4. Climate-Smart Agriculture and Soil Degradation
  5. Soil Management Practices for Climate Smart Agriculture
     1. Integrated soil fertility management for climate smart agriculture
     2. Conservation agriculture
     3. Soil management for reducing greenhouse gas emissions
     4. Soil carbon sequestration and organic matter management
     5. Mitigation of land degradation and soil erosion for climate smart agriculture
  6. Soils and the Carbon Cycle

**5. Water Management for Climate-Smart Agriculture**

* 1. Water Management in Agriculture
  2. Potential Impacts of Climate Change on Water in Agriculture
     1. Impact on water supply and demand
     2. Impact on Dry land Agriculture
  3. Options for Water Management to Combat Climate Change
     1. On farm water conservation activities
     2. Enhancing soil moisture retention capacity
     3. Use of efficient cropping systems and crop diversification
     4. Integrated water resources management
     5. Improving use and efficiency of irrigation systems
  4. Integrated Watershed Management
  5. Water Harvesting for Climate Smart Agriculture

**6. Climate Smart Agriculture and Green Economy**

* 1. Green Agriculture versus Green Economy
  2. Green Economy, Climate Change and Agriculture: The Concepts
  3. Green Economy for Sustainable Development
  4. Green Economy Initiatives on Agriculture
  5. Integration of National Policies in to Climate Smart Agriculture

**7. Barriers and Challenges in the Adoption of Climate Smart Agriculture**

* 1. Policy Related Barriers
  2. Socioeconomic and Cultural Barriers
  3. Constraints to Adoption of Climate-Smart Agricultural Practices in the African Context
     1. Physical barriers
     2. Non physical barriers
  4. Mechanisms to Enhance Adoption of Climate Smart Agriculture in Africa

**8. Financing and Investment for Climate-Smart Agriculture**

* 1. Agricultural Investment Needs and Barriers
  2. Possible Sources of Financing
  3. Mechanisms of Financing
  4. Climate-smart agriculture and the potential role of climate financing in Africa

**Mode of Delivery**

* Lecture and practical
* Field trips

**Assessment and Evaluation**

The respective school and course owners will follow the progress of the students. The formal ways of assessment include:

* Exam/s
* Practical activities/ reports
* Seminars/Reports/Presentations

**Reference Materials**

* Celia A. Harvey, 2013. Climate-smart landscapes: opportunities and challenges for integrating adaptation and mitigation in tropical agriculture
* Christine Negra, 2014. Integrated National Policy Approaches to Climate-Smart Agriculture: Insights from Brazil, Ethiopia, and New Zealand
* Denier, L; Scherr, S; Shames, S; Chatterton, P; Hovani, L; Stam, N., 2015. The Little Sustainable Landscapes Book. Oxford: Global Canopy Programme.
* FAO (Food and Agriculture Organization of the United Nations). 2010. “Climate-Smart” Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation. Rome: Food and Agriculture Organization (FAO).
* FAO (Food and Agriculture Organization of the United Nations), 2013. Climate Smart Agriculture Sourcebook
* FAO (Food and Agriculture Organization of the United Nations), 2015. Barriers, incentives and benefits in the adoption of climate-smart agriculture. Lessons from the MICCA pilot project in Kenya. Background report 9
* Lesilie*et.al*., 2014. Climate-smart agriculture for food security
* Sara J Scherr, Seth Shames and Rachel Friedman, 2012. From climate-smart agriculture to climate-smart landscapes
* Second Global Conference on Agriculture, Food Security and Climate Change, 2012. Greening the Economy with Climate-Smart Agriculture
* Seth Shames, Rachel Friedman and TanjaHavemann, 2012. Coordinating Finance for

Climate-Smart Agriculture

**Course Title: Climate-Smart Livestock and Fisheries Production and Management (E)**

Course Code:**CSAg-5131**

Credit Hrs/ECTS: **3/5**

**Pre-requisite: No**

**Course Description**

The impact of climate on livestock and fish production; how animals adapt themselves to climate changes; Promoting the sustainable use of fisheries resources, breeding livestock for resilience and efficacy, Smart fisheries technologies for an efficient compliant and environmentally friendly fishing sector, permanent grassland farming system and policy, better management of grazing land or pasture, intensive farming of livestock and fisheries, changes in regional and global climate and livestock land use patterns in the mixed systems; the emerging livestock diseases, their management and zoonotic implications; GHGs and climate change, GHG emission from livestock production systems; Methane emission from enteric fermentation; feeding, breeding and livestock management strategies to minimize GHG emission; water use efficiencies and livestock productivity: different adaptation and mitigation strategies to climate change.

**Course Objectives**:

* to sustainability increase animal productivity to support equitable increases in farm income, food security and development
* to adapt and build resilience of animal agriculture and food security systems to climate change
* to reduce greenhouse gas emission from livestock and fisheries

**Course Content**

1. **Introduction**
2. **Impact of Climate Change on Animals**
   1. Impact of climate change on livestock’s
   2. Impact of climate change on fisheries
   3. Emerging animal diseases and their zoonotic implications
3. **Livestock Production**
   1. Traditional livestock management
   2. Intensive livestock production
   3. Pasture and Grazing land Management and policy
4. **Fish Production**
   1. Smart fish technology
   2. Intensive fish production
   3. Environment and fish production
5. **Animal Breeding**
   1. Breeding for disease resistance
   2. Breeding to increase environmental adaptation
6. **Land Use Pattern**
   1. Climate change and land use pattern in mixed systems
   2. Climate change and land use pattern in pastoral and agro-pastoral
   3. Climate change and livestock movement
7. **Greenhouse Gas Emission**
   1. GHG and climate change
   2. GHG from livestock and fisheries
   3. Strategies to reduce GHG emission
8. **Water Use Efficiencies and Livestock Productivity**
9. **Animal Adaptation to Climate Change**

**Mode of Delivery:**

There will be Coursework lecturing, questions, discussions, practical visit and paper presentation

**Assessment Strategy:**

The formal ways of assessment includes:

* Practical courses report
* Term paper presentations
* Quizzes
* Final exams

**Reference**

* FAO, 2016. Ethiopia Climate-Smart Agriculture Scoping Study. by Jirata, M., Grey, S. and Kilawe, E. Addis Ababa, Ethiopia
* Negra C. 2014. Integrated National Policy Approaches to Climate-Smart Agriculture. Insights from Brazil, Ethiopia, and New Zealand. CCAFS Report No. 11. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
* Building climate change resilience for African livestock in sub-Saharan Africa World Initiative for Sustainable Pastoralism (WISP): a program of IUCN - The International Union for Conservation of Nature, Eastern and Southern Africa Regional Office, Nairobi, March 2010, viii + 48pp.
* Bishaw, Badege, Henry Neufeldt, JeremiasMowo, Abdu Abdelkadir, Jonathan Muriuki, GemedoDalle, TewodrosAssefa, Kathleen Guillozet, HabtemariamKassa, Ian K. Dawson, EikeLuedeling, and CheikhMbow. 2013. Farmers’ Strategies for Adapting to and Mitigating Climate Variability and Change through Agroforestry in Ethiopia and Kenya, edited by Caryn M. Davis, Bryan Bernart, and Aleksandra Dmitriev. Forestry Communications Group, Oregon State University, Corvallis, Oregon.
* Herrero, M., Ringler, C., van de Steeg, J., Thornton, P., Zhu, T., Bryan, E., Omolo, A., Koo, J. and Notenbaert, A. 2010. Climate variability and climate change and their impacts on Kenya’s agricultural sector. Nairobi, Kenya. ILRI.

**Course Title:Climate Smart Crop Production and Management (E)**

**Course code: CSAg-5141**

**Credit Hours/ECTS: 3/5**

**Pre-requisite: No**

**Course Description**

Climate-smart crop production contributes to food security, by addressing different aspects of current and projected climate change impacts through adaptation and mitigation actions. While agriculture contributes significantly to climate change, it also provides opportunities for adapting to, and mitigating, climate change effects. Thus, this course introduces students with the impacts of climate change on crop production, sustainable crop production and management in the context of climate smart agriculture (CSA), new tools for enhancing crop adaptation to climate change, underlying principles of CSA, principles of CSA, practices and cases of CSA across the globe, challenges in adoption of CSA, and some of the strategies to enhance adoption of CSA in Africa.

**Course Objectives**

A student completing this course will be able to:

* Overview the global climate change and its projections.
* Identify the major impacts of climate change on agricultural crop production.
* Investigate the basic approaches of sustainable crop production and management.
* Introduce some of the scientific and new tools to enhance crop adaptation to the impacts of climate change.
* Acquire the underlying principles of climate smart agriculture.
* Recognize the role of natural biological processes, agro-biodiversity, conservation and organic agriculture to sustain crop production and adaptation to climate change.
* Learn the most commonly practiced principles and approaches of climate smart agriculture to sustainability and resilience to climate change.
* Indentify the contribution of agriculture to mitigate climate change through reducing greenhouse gas emissions.
* Learn common practices and case studies of climate smart agriculture in the context of African farming systems.
* Appreciate cases of climate smart agriculture and practice the principles of climate smart agriculture.
* Pinpoint common challenges of adopting climate smart agriculture and possible strategies to enhance adoption of climate smart agriculture in Africa.

**Mode of course Delivery:** Mode of course delivery will consist of lectures, class discussions, and review and presentation of scientific papers. The course will also be supported by field visits

**Assessment:**

* Assignments on selected topics (20%);
* Review articles on cases of climate smart crop production and management x 2 (10%);
* Reports on field visits and class discussions (20%);
* Final exam covering all contents of the course (40%).

**Course Content**

**1. Climate Change and Crop Production**

1.1. Introduction

1.2. Overview of Global Climate Change and Projections

1.3. Prediction of Climate Change and its Impacts on Agricultural Crop Production

1.3.1. Rising Temperature and Elevated CO2

1.3.2. Extreme Weather Events

**2. Sustainable Crop Production and Management**

2.1. Introduction

2.2. Enhancing Soil Productivity

2.3. Crop Diversification and Cropping Patterns

2.4. Efficient Utilization of Water Resources

2.5. Selecting Adapted and High-yielding Crop Varieties

2.6. Implement Integrated Pest Management Systems

**3. New Tools for Enhancing Crop Adaptation to CC**

3.1. Introduction

3.2. Biotechnology in Agriculture

3.3. GIS, RS and Crop Simulation Models

3.4. Statistical Models

**4. Underlying Principles in CSA**

4.1. Introduction

4.2. Maintaining Natural Biological Processes

4.3. Agricultural Biodiversity

4.4. Conservation Agriculture

4.5. Organic Agriculture

**5. Principles of Climate Smart Agriculture**

5.1. Introduction

5.2. Principles and Approaches of CSA

5.2.1. Sustainably increasing Agricultural Productivity

5.2.2. Adapting and Building Resilience to CC

5.2.2.1. Breeding for Abiotic and Biotic Stresses

5.2.2.2. Reducing Carbon Footprint

5.2.2.3. Expanding Carbon Sinks

5.2.2.4. Conservation Agriculture and Integrated Nutrient Management

5.2.2.5. Alternation in Cropping Patterns and Crop Diversification

5.2.3. Reducing GHG Emissions from Crop Production

**6. Practices and Cases of CSA**

6.1. Introduction

6.2. Practices and Achievements of CSA in Europe and America

6.3. Practices and Achievements of CSA in Asia

6.4. Practices and Achievements of CSA in Africa

**7. Challenges in Adoption of CSA**

7.1. Introduction

7.2. Inadequate Farm Inputs and Materials

7.3. Non-adaptable Agro-ecosystems

7.4. Inadequate CSA-relevant Information, Knowledge and Skills

7.5. Inappropriate Technologies and their Dissemination

7.6. Lack of Strong Financing Systems

7.7. Land Tenure System

**8. Strategies to Enhance Adoption of CSA in Africa**

8.1. Introduction

8.2. Input Subsidy System

8.3. Promote Land Tenure Rights and Policy Grounds

8.4. Improve Decision Support Systems

8.5. Develop Innovative Financing Schemes

8.6. Adapt Efficient Water Management Systems

8.7. Promote Agricultural Investment in the Context of CSA

**References**

* Basche, A.Diane. 2015. "Climate-smart agriculture in Midwest cropping systems: evaluating the benefits and tradeoffs of cover crops". Graduate Theses and Dissertations.Paper 14755.
* Cooper, H.D., Spillane, C. and Hodgkin, T. 2001. Broadening the genetic Base of crop production. CABI Publishingin association withFood and Agriculture Organization of the United Nations*and*International Plant Genetic Resources Institute. CABI Publishing, CAB International, Wallingford, Oxon OX10 8DE, UK.
* Corsi, S., Friedrich, T., Kassam, A., Pisante, M. and Sà, J. deM. 2012. Soil organic carbon accumulation and greenhouse gas emission reductions from conservation agriculture: A literature review. Integrated Crop Management,Vol.16-2012. Plant production and protection division. Food and agriculture organization of the united nations, Rome.
* FAO (Food and Agriculture Organization of the United Nations). 2013. Climate-smart agriculture. Source book. Food and Agriculture Organization of the United Nations, Rome, Italy. Accessed from www.fao.org/publications.
* James, B., Henry, M., Emmanuel, T. and Solomon, B. 2015. Barriers to scaling up/out climate smart agriculture and strategies to enhance adoption in Africa. Forum for Agricultural Research in Africa, Accra, Ghana.
* Maharjan, K.L. and Joshi, N.P. 2013. Climate change, agriculture and rural livelihoods in developing countries. Springer, Tokyo, Japan.
* Mavi, H.S. and Tupper, G.J. 2004. AgrometeorologyPrinciples and Applicationsof Climate Studiesin Agriculture. Food Products Press,An Imprint of The Haworth Press, Inc.New York.
* Mwongera, C., Shikuku, K.M., Winowiecki, L., Twyman, J., Läderach, P., Ampaire, E., van Asten, P. and Twomlow, S. 2015. Climate-smart agriculture rapid appraisal (CSA-RA): A prioritization tool for outscaling CSA. Step-by-step guidelines. International Center for Tropical Agriculture (CIAT). Cali, Colombia.
* National Academy of Sciences. 2010. Adapting to the Impacts of Climate Change. America’s Climate Choices:Panel on Adapting to the Impacts of Climate Change. Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies. The National Academies Press, Washington DC. Accessed from

<http://www.nap.edu/catalog/12783.html>.

* Njeru, E., Grey, S. and Kilawe, E. 2016. Eastern Africa climate-smart agriculture scoping study: Ethiopia, Kenya and Uganda. Addis Ababa, Ethiopia.
* Nyasimi, M., Amwata, D., Hove, L., Kinyangi, J. and Wamukoya, G. 2014. 'Evidence of impact: Climate-smart-agriculture in Africa'. CCAFS working Paper no. 86, Copenhagen, Denmark. Accessed from http://ccafs.cgiar.org/publications/evidence-impact-climate-smart-agriculture-africa.
* Reddy, P.P. 2010. Climate resilient agriculture for ensuring food security. Springer, Tokyo, Japan.
* Reddy, K.R. and Hodges, H.F. 2000. Climate change and global crop productivity. CABI International Publishing, Wallingford, UK.
* Reynolds, M.P. 2010. Climate change and crop production. CABI International Publishing, Wallingford, UK.
* Sengar, R.S. and Sengar, K. 2015. Climate change effect on crop productivity. CRC Press, London.
* Taneja, G., Del Pal, B., Joshi, P.K., Aggarwal, P.K. and Tyagi, N.K. 2014. Farmers' preferences for climate-smart agriculture: an assessment in the Indo-Gangetic Plain. International Food Policy Research Institute. Accessed from ifpri-copyright@cgiar.org.
* Williams, T.O., Mul, M., Cofie, O., Kinyangi, J., Zougmore, R., Wamukoya, G., Nyasimi, M., Mapfumo, P., Speranza, C.I., Amwata, D., Frid-Nielsen, S., Partey, S., Girvetz, E., Rosenstock, T. and Campbell, B. 2015. Climate smart agriculture in the African context. Background Paper. An action plan for African agricultural transformation. AbdouDiouf International Conference Center, 21-23 October 2015, Dakar, Senegal.

**Course Title: Climate Smart Agro-Forestry Systems (E)**

**Course code:** CSAg-5151

**Credit Hours/ECTS: 2/3**

**Pre-requisite: No**

**Course Description**

This course was developed to acquaint students with basics of agro-forestry, relation between climate change and agro-forestry, agro-forestry systems and practices for climate smart agriculture, forest ecosystem services, forest management for sustainable climate change mitigation, adaptation mechanisms in forestry, forest planning and management, climate change responses in forestry in terms of policy, forest ownership and climate change, carbon stock and greenhouse gas emissions, deforestation, forest area rehabilitation, vulnerability of forest ecosystems to climate change and resilient mechanisms, role of forests for agriculture and national development, sustainability issues, agro-forestry, food security and climate change effects, afforestation, reforestation, plantations, climate smart agro-forestry and biomass production, institutional involvement in climate smart agro-forestry and other issues related to climate smart agro-forestry systems.

**Course Objectives**

Up on completion of the course, students will be able to:

* identify sustainable and climate smart agro-forestry practices that can safely be applied to an agricultural system
* apply forest management activities for sustained increase in productivity of ecosystems
* suggest agro-forestry related climate change adaptation and mitigation strategies
* assess the vulnerability and possible resilient mechanisms for production systems that integrate trees
* identify the principles and contribution of agroforestry for food security and climate change effects
* elaborate the role of agroforestry for mitigation of greenhouse gas emission
* state institutional support mechanisms for agroforestry in climate smart agriculture

**Course Content**

**1**. **Background to Climate Smart Agriculture**

* 1. Relation Between Agriculture, Climate Change and Food Security
  2. Definition of Climate Smart Agriculture and Basic Concepts in Carbon Farming

**2. Agro-forestry Principles and Practices**

* 1. Agro-forestry Systems, Practices and Technology
  2. Rationale for Agro-forestry
  3. Benefits of Agro-forestry
  4. Agro-forestry Systems
     1. Components of an agro-forestry system
     2. Classification of agro-forestry systems
     3. Theory and practice of agro-forestry
  5. Common Agro-forestry Systems in Africa
  6. Basic Principles in Agro-forestry

**3. Component Interaction in Agro-forestry**

* 1. Tree-Crop Interaction and Management
  2. Tree- Animal Interaction and Management
  3. Management of Multipurpose Trees and Shrubs

**4. Contribution of Agro-forestry to Food Security and Climate Change Effects**

* 1. Climate Smart Agro-forestry
     1. Agro-forestry for food security
     2. Agro-forestry for climate change
     3. Sustainability in agro-forestry system
     4. Agro-forestry related climate change adaptation and mitigation strategies
  2. Agro-forestry on Hillsides
  3. Agro-forestry Based Watershed Management
  4. The Role of Agro-forestry for Climate Risk Adaptation

**5. Mitigation of Greenhouse Gas Emission in Agro-forestry Systems**

* 1. Combining Agro-forestry with Area Rehabilitation
  2. Carbon Sequestration Potential of Agro-forestry Systems
  3. Carbon Stocks in Agro-forestry Systems
     1. Agrisilvicultural systems
     2. Silvipastoral systems
     3. Carbon stored in block and boundary plantations
  4. Environmental Benefits of Carbon Farming
  5. Climate Smart Agriculture in Carbon Markets

**6. Afforestation and Reforestation for Climate Smart Agriculture**

* 1. Tropical Reforestation and Climate Change
  2. Reforestation for Adapting to Climate Change
  3. Afforestation for Carbon Sequestration
  4. Afforestation as Climate Smart Agricultural Practice

**7. Establishment of Plantation as Tree Crops-Tree Mixtures**

* 1. Intensification of Cropping Through Agro-forestry
  2. Opportunities for Climate Smart Tree-Based Systems

**8. Institutional Support for Climate Smart Agro-forestry Systems**

* 1. Enabling Policy Environment
     1. National policy making
     2. Coordinated international policies
  2. Information Production and Dissemination by Institutions
  3. Climate Data and Information Gaps
  4. Institutions to Improve Access, Coordination and Collective Action
  5. Payments for Environmental Services

**Mode of Delivery**

* Lecture and practical
* Field trips

**Assessment and Evaluation**

The respective school and course owners will follow the progress of the students. The formal ways of assessment include:

* Exam/s
* Practical activities/ reports
* Seminars/Reports/Presentations

**References**

* Bruno Locatelli, Carla P. Catterall, Pablo Imbach, Chetan Kumar, RodelLasco, ErikaMarín-Spiotta, Bernard Mercer, Jennifer S. Powers, Naomi Schwartz, Maria Uriarte, 2015.Tropical reforestation and climate change: beyond carbon. Opinion article. Restoration ecology. *The Journal of the Society for Ecological Restorations*, 23 (4): 337-343
* Dwivedi, A.P, 1992. Agroforestry: Principles and Practices. Oxford and Ibh Publishing Company. The University of Michigan. 365p.
* FAO (Food and Agriculture Organization of the United Nations), 2013. Climate Smart Agriculture Sourcebook. 570p.
* Joseph Mutua, Jonathan Muriuki, Peter Gachie, Mieke Bourne and Jude Capis, 2014. Conservation Agriculture with Trees: Principles and Practice. A simplified guide for Extension Staff and Farmers. Technical Manual No. 21.World Agroforestry Centre, (ICRAF) Nairobi, Kenya
* Michele Schoeneberger, Gary Bentrup, Henry de Gooijer, RajuSoolanayakanahally, Tom Sauer, James Brandle, Xinhua Zhou, and Dean Current, 2012. Branching out: Agroforestry as a climate change mitigation and adaptation tool for agriculture. *Journal of Soil and Water Conservation*, 67(5): 128A-136A
* Patra, A.K., 2013. Agroforestry: Principles and Practices. New India Publishing Agency, 260p

**Course Title: Integrated Pest and Disease Management (E)**

**Course Code: CSAg-5161**

**Credit Hours/ECTS:**

**Pre-requisite: No**

**Course description**

Upgrading the traditional way of pest and disease management methods to a high level integrated pest and disease management strategies and tactics is imperative. So that this course will improve our handy tactics in the face of the current climate and environment dynamics and associated changes in the occurrence and distribution of insect pests, plant pathogens and weeds. Therefore, the course introduces students to the general concepts and principles of IPM/IDM; the pesticide paradox and the initiatives of IPM; integrated pest management tactics (regulatory, cultural, biological, host resistance, and chemical and transgenic controls) and case studies in entomology, plant pathology and weed management; the role of emerging technologies (GIS, RS, IT, biotechnology and molecular approaches) in IPM/IDM; effects of climate change on pests and pest management systems; followed by the opportunities and challenges of IPM/IDM in relation to environmental and health impacts, decline in chemical dependency and promotion of biopesticides and constraints of IPM/IDM implementation.

**Course Objectives**

A student completing this course will be able to:

* Apply the principles of integrated pest and disease management of major insects, weeds, and plant diseases of agriculture crops.
* Develop an understanding of integrated pest management of the major insects, weeds, and plant diseases of agriculture crops.
* Apply current pest management tactics to crop production in situations where pest management is needed to reduce associated yield loss.
* Integrate the principles of pest management into the environmentally sound management of cropping systems.
* Analyze pest problems, determine if management is necessary, and make appropriate recommendations using IPM tactics.
* Familiarize with different pest management methods and tactics and their benefits and limitations.
* Increase skills in monitoring of pests and recommending treatment threshold levels using IPM tactics that focus on reduced-risk pesticides.
* Learn how to incorporate IPM concepts and methods into agricultural pest control systems.
* Identify the main benefits and constraints of implementing IPM in the agricultural production systems.

**Mod of delivery**

Mode of course delivery will consist of lectures, class discussions, lab demonstrations, and review and presentation of scientific papers. The course will also be supported by lab studies and field visits.

**Assessments**

* Assignments on selected topics (20%);
* Review articles on integrated pest and disease management x 2 (10%);
* Reports on lab studies and field visits (20%);
* Final exam covering all contents of the course (40%).

**Course Content**

**1. General Concepts and Principles in IPM/IDM**

1.1. Introduction and Definitions of IPM/IDM

1.2. Philosophy of IPM/IDM and The Origin of IMP Concept

1.3. Components of IPM/IDM

1.4. Pest Management Strategies and Tactics

1.4.1. Do-nothing Strategy

1.4.2. Reduce Pest Numbers

1.4.3. Reduce Host Susceptibility to Pest Injury

1.4.4. Combine Reduced Pest Population with Reduced Host Susceptibility

**2. The Pesticide Paradox**

2.1. Introduction

2.2. Historical Perspective of IPM

2.3. Pesticide Use in the World

2.4. Promise and Perils of Pesticides

2.5. The Paradigm Shift

2.5. IPM Initiatives

2.6. Ecological Principles of IPM/IDM

**3. Integration of Pest Management Tactics**

3.1. Introduction

3.2. Regulatory Control

3.2.1. Quarantine

3.2.2. Eradication

3.2.3. Crop-free Periods

3.2.4. Certification of Planting Material

3.3. Cultural Control

3.4. Biological Control

3.4.1. Ecological Considerations

3.4.2. Biological Control of Insects, Weeds and Plant Diseases

3.4.3. Interaction with Other IPM/IDM Tactics

3.5. Manipulation of Host Genetic Resistance

3.5.1. Source of Genetic Variation

3.5.2. Overview of Genetic Expression

3.5.3. Deployment of Resistance Genes

3.5.4. Crop Diversity in Pest Management

3.5.5. Transgenic Pest Resistance

3.6. Pesticide Control

3.6.1. Ecological Consideration

3.6.2. Pesticide Classification

3.6.3. Pesticide Resistance Management

3.6.4. Pesticide Modes of Action

3.7. IPM Tactics for Multiple Pests

**4. Integrated Pest Management in Entomology**

4.1. Introduction

4.2. Major Tactics used for IPM of Insects

4.3. Case Studies of Insect IPM in Major Field Crops

**5. Integrated Pest Management in Weed Management**

5.1. Introduction

5.2. Major Tactics used for IPM of Weeds

5.3. Case Studies of Weed IPM in Major Field Crops

**6. Integrated Pest Management in Plant Pathology**

6.1. Introduction

6.2. Major Tactics used for IPM of Plant Diseases

6.3. Case Studies of IPM in Plant Diseases of Major Field Crops

**7. Emerging Technologies in IPM/IDM**

7.1. Introduction

7.2. GIS, RS and IT in Integrated Pest and Disease Management

7.3. Biotechnology and Molecular Approaches in Integrated Pest and Disease Management

7.4. Molecular Detection in Integrated Pest and Disease Management

**8. Climate Change and Plant Pathogens, Insect Pests and Invasive Weeds**

8.1. Introduction

8.2. Climate Change and Crop Production

8.3. Climate Change and Crop Protection

8.3.1. General Concepts

3.3.2. Effects of Climate and Environment Changes on Pests and Diseases

3.3.3. Effects of Climate Change on Invasive Weeds

3.3.4. Habitat Changes and Integrated Management

**9. Opportunities and Challenges of IPM/IDM**

9.1. Introduction

9.2. Expected Profit

9.3. Environmental and Health Impacts

9.4. Overall Impact of IPM: Case Studies

9.4.1. Policy Change

9.4.2. Decline in Pesticide Use

9.4.3. Banning of Hazardous Pesticides

9.4.4. Promotion of Biopesticides

9.5. Constraints in IPM Implementation

9.5.1. Institutional Constraints

9.5.2. Information Constraints

9.5.3. Sociological Constraints

**References:**

* Koul, O., Dhaliwal, G.S. and Cuperus, G.W. 2004. Integrated Pest Management: Potential, Constraints and Challenges. CABI Publishing, Wallingford, UK.
* Dharam P. Abrol, D.P. and Shankar, U. 2012. Integrated Pest Management: Principles and Practice. CABI International, Nosworthy way, Wallingford, UK.
* Alford, D.V. 2000. Pest and Disease Management Handbook. Blackwell Science Ltd, Osney Mead, London.
* Altieri, M.A. and Nicholls, C.I. 2004. Biodiversity and Pest Management in Agroecosystems. Second Edition. Food Products Press, New York.
* Ciancio, A. and Mukerji, K.G. 2007. General Concepts in Integrated Pest and Disease Management. Springer, Dordrecht, The Netherlands.
* Horne, P. and Page, J. 2008. Integrated Pest Management for Crops and Pastures. Landlinks Press, 150 Oxford Street, Australia.
* Maredia, K.M., Dakouo, D. and Mota-Sanchez, D. 2003. Integrated Pest Management in the Global Arena. CABI Publishing, Wallingford, UK.
* Narayanasamy, P. 2013. Biological Management of Diseases of Crops. Springer, Dordrecht, New York.
* Peshin, R. and Dhawan, A.K. 2009. Integrated Pest Management: Innovation-Development Process. Volume 1. Springer.
* Radcliffe, E.B., Hutchison, W.D. and Cancelado, R.E. 2009. Integrated Pest Management: Concepts, Tactics, Strategies and Case Studies. Cambridge University Press, Cambridge, New York.

**MODULE 2**

**Course Title: Socio-Economic and Gender Perspectives in CSA**

**Course Code: CSAg-5211**

**Credit hour/ECTS: 2/3**

**Pre-requisite: No**

**Course Description**

This course is designed to equip students with the concepts and principles of socio-economic and gender perspectives in Climate Smart Agriculture management comprising: Key Issues and emerging trends of gender in CSA, gender-responsive CSA, the role of innovative technologies for gender-responsive CSA, gender and institutional aspects of CSA Practices, and socio-economic and gender analysis framework in CSA.

The major knowledge that students are required to obtain, from this course, include: Understanding the key issues and emerging trends of gender in CSA; the role of gender-responsive CSA; understanding the role of Innovative technologies for gender-responsive CSA; identify and understand the gender and institutional aspects of CSA practices; and demonstrate the socio-economic and gender analysis framework in CSA

**Course Objectives**

At the end of this course, students will be able to:

* Explain the key Issues and emerging trends of gender in CSA
* Apply the principles of gender-responsive CSA in Eastern and Southern African countries context
* Demonstrate the role of innovative technologies for gender-responsive CSA in Eastern and Southern African context
* Identify gender and institutional aspects of CSA Practices in Eastern and Southern African countries context
* Develop practical skills on socio-economic and gender analysis framework in CSA considering Eastern and Southern African countries context

**Course Contents**

**1. Key Issues and Emerging Trends of Gender in Climate Smart Agriculture**

1.1. Introduction to Gender and Climate Smart Agriculture

1.2. Gender Issues and Gender analysis in CSA approaches

1.3. Understanding Gender-Sensitive CSA initiatives

1.4. Participatory Gender-Sensitive Approaches in CSA

1.5. Gender-Sensitive Indicators of CSA performances

1.6. Gender and Adoption of CSA Practices

1.7. Gender and Climate-Smart Agricultural Practices

**2. Gender-Responsive Climate Smart Agriculture**

2.1. Gender-Responsive Approaches to CSA

2.2. Gender-Responsive CSA Indicators

2.3. Policies and institutions for Gender –responsive CSA

2.4. Gender-responsive strategies for CSA

2.5. ICT for Gender-Responsive CSA

**3. The Role of Innovative Technologies for Gender-Responsive CSA**

3.1. Gender-Responsive Approaches to CSA

3.2. Challenges to adopt Gender-responsive CSA approaches

3.3. Gender dimensions of adopting CSA innovations

3.4. Harnessing ICT for Gender-Responsive CSA

3.5. Gender-Responsive CSA Goals

1. **Gender and Institutional Aspects of CSA Practices**

4.1. Key institutions in CSA and their roles

4.2. Gender Dimensions of CSA in the context of Rural Livelihoods

4.3. Monitoring and Evaluating Gender through CSA Project Cycle

4.4. Institutions Related to CSA and Their Gendered Implications

1. **Socio-Economic and Gender Analysis Framework in CSA**

5.1. Gender Issues and Gender Analysis Approaches

5.2. Socio-Economic and Gender Context Analysis

5.3. Socio-Economic and Gender Livelihood Analysis

5.4. Socio-Economic and Gender Stakeholders Analysis

5.5. Socio-Economic and Gender Vulnerability Analysis

**Mode of course delivery:**

The mode of delivery of the course combines lectures, discussion, questioning and answering, readings, assignments, individual and /or group problem identification and presentation. Besides, the lectures will be supported by case studies that will include descriptive and applications of socio-economic and gender perspectives in CSA. Seminars and assignments will be student-led based on the reading and led by the tutor.

**Assessment Methods:**

Seminar and assignments (40%) and final exam (60%)

**References**

* Agrawal, A. 2009. Local institutions and adaptation to climate change. In Mearns R, Norton A (Eds.) Social dimensions of climate change (pp. 173-197). Washington, DC: World Bank.
* Ahmad, N., L. El-Fatal, E. Pehu, P. Poutiainen, and M. Vyzaki. 2014. Gender, Agriculture, and Climate Change. Agriculture and Environmental Services Note 6. World Bank, Washington, DC.http://documents.worldbank.org/curated/en/2014/02/18967283/gender agricultureclimate-change.
* FAO. 2014. Gender and Food and Nutrition Security e-learning course. Rome, Italy: FAO. (Available from http://www.fao.org/elearning/#/elc/en/course/FG)
* Huyer, S., Campbell , B., Hill, C. and Vermeulen, S. 2016. Gender and Social Inclusion Strategy. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).
* Otzelberger, A. 2011.Gender-Responsive Strategies on Climate Change: Recent Progress and Ways Forward for Donors. CARE/IDS/BRIDGE, Brighton.
* Terry, G. 2009. Climate change and gender justice. Oxfam GB, Oxford.
* Vermeulen, S.J. 2015. Closing the gender gap in climate smart agriculture.CCAFS Info Note. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

**Course Title: Agricultural Extension and Participatory Rural Appraisal**

**Course Code:CSAg-5221**

**Credit hour/ECTS: 2/3**

**Pre-requisite: No**

Course Description

The course is aimed at letting the students know the definition, historical background, principles and objectives of agricultural extension. It will also intended to equip students with knowledge in relation to extension approaches, extension policy and organizational issues, role of agricultural extension in sustainable agricultural development/climate smart agriculture, and the various participatory extension approaches. Moreover, the course will cover principles, techniques and tools of PRA. Challenges and potentials of PRA will also be part of the course.

Learning Objectives

At the end of the course, the students will be able to

* Explain the objectives of agricultural extension
* State the various approaches of agricultural extension
* Discuss the role of agricultural extension in climate smart agriculture
* List the different participatory approaches in agricultural extension
* Identify the principles of PRA
* Use PRA to identify problems, design, implement, monitor, and evaluate programs and projects

**Course Content**

**1. Genesis of Extension Education**

1.1. The History of Extension

1.2. Extension and Formal Education

1.3. Objectives and Principles of Extension

**2. Extension Methods and Approaches**

2.1. Evolution of Alternative Agricultural Extension Approaches

2.2. Extension goals

2.3. Extension Approaches /Extension delivery alternatives

2.4. Extension Approaches in Ethiopia

2.5. Approaches in Supporting Agricultural Innovation

2.6. National Agricultural Research Systems (NARS)

2.7. Agricultural Knowledge and Information System (AKIS)

2.8. Innovation Systems

**3. Extension Policy and Organizational Issues**

3.1. Extension Policy

3.2. Organizational Issues in Extension Agencies

3.3. Extension Staffing Issues

3.4. Extension Funding

**4. Extension's Role in Sustainable Agricultural Development**

4.1. Emerging challenges for sustainable agriculture

4.2. Resource-Conserving Technology Development and Transfer

4.3. Incorporating Farmer Experimentation

4.4. Challenges for Supportive Policy

**5. Agricultural Extension towards Climate-Smart Agriculture**

5.1. Extension and the climate change

5.2. Climate smart agriculture: what role for rural /extension advisory services?

5.3. Agro-meteorology: useful tools for extension in light of CSA

5.4. Technologies for extension services in CSA sector

**6. Participatory Approaches in Agricultural Extension**

6.1. Community Participation

6.2. Importance of Community Participation

6.3. Steps in Community participation

6.4. Participatory Approaches

**7. PRA - Participatory Rural Appraisal**

7.1. Definition of PRA

7.2. The Origins and Practice of Participatory Rural Appraisal

7.3. Principles of PRA

7.4. Role Descriptions of PRA Team Members

**8. PRA Techniques and tools**

8.1. Principles of PRA

8.2. PRA Techniques

8.3. Organization of PRA

8.4. PRA Tools

8.5. Analyzing and Reporting PRA findings

**Mode of Delivery**

Lecture, discussion, article review, seminar presentation

**Methods of assessment**

The assessment will be made mainly through assignments (individual and group) and exam. Students are also expected to review articles and present.

30%- group assignment and presentation

20%- individual assignment and presentation

20%- paper/article review

30%- final exam

**References**

* Simone Sala, Federica Rossi, Soniia David (editors), Supporting Aricultural Extension towards Climate\_Smart Agriculture: An overview of existing tools, Global Alliance for Climate-Smart Agriculture
* Amitava Mukherjee (1995) Participatory Rural Appraisal Methods and Applicatins in Rural Planning, Vishal Printers, Delhi
* Ian Christoplos (2010), Mobilizing the potential of rural and agricultural extension, Danish Institute for International Studies
* Simon Adebo (2000) Training Manual on Participatory Rural Appraisal, Addis Ababa
* William M. Rivera (2001) Agricultural and Rural Extension Worldwide: Options for Institutional Reform in the Developing Countries, FAO
* FAO (2001) Agricultural and Rural Extension Worldwide: Options for institutional reforms in the developing countries. ftp://ftp.fao.org/docrep/fao/004/y2709e/y2709e.pdf
* Burton E. Swanson (2008) Global Review of Good Agricultural Extension and Advisory Service Practices FAO Rome ftp://ftp.fao.org/docrep/fao/011/i0261e/i0261e00.pdf
* Belay, K. (2003), Agricultural Extension in Ethiopia: The Case of Participatory Demonstration and Training Extension System, Journal of Social Development in Africa, 18 (1):49-83.
* Rajalahti, R, Janssen, W. and Pehu, E. (2008), Agricultural Innovation Systems: From Diagnostic toward Operational Practices, Agricultural and Rural Development Discussion Paper 38, World Bank, Washington, DC http://www.ipms-ethiopia.org/Training-Materials
* Vince Ashworth (2005) The challenges of change for agricultural extension in Ethiopia
* MoARD (Ministry of Agriculture and Rural development) (2010) Community level participatory planning agricultural growth program, Addis Ababa
* Bishnu B. Bhandari (2003) Participatory Rural Appraisal, Institute for Global Environmental Strategies

**Course Title: Disaster Risk Reduction and Management for Livelihood Resilience (E)**

**Course Code:CSAg-5231**

**Cr. Hrs/ECTS: 2/3**

**Pre-requisite: No**

**Course Description**

This course is designed to equip students with principles and rationale to integrating gender perspectives in disaster reduction strategies, towards climate and disaster resilient development, community-based Disaster Risk Reduction and Management, the enabling framework of Disaster Risk Reduction (DRR) to support CSA, and mainstreaming disaster risk reduction and management in CSA.

The major knowledge that students are required to obtain, from this course, include: Understanding the process of integrating gender perspectives in disaster reduction strategies; role of focusing towards climate and disaster resilient development; developing and understanding community-based disaster risk reduction and management; identify the enabling framework of disaster risk reduction to support CSA; and mainstreaming disaster risk reduction and management in CSA.

**Objectives**

At the end of this course, students will be able to:

* Explain the principles and rationale to integrating gender perspectives in disaster reduction strategies
* Understand the driving forces towards climate and disaster resilient development
* Apply the principles of community-based disaster risk reduction and management
* Develop the enabling framework of Disaster Risk Reduction (DRR) to support CSA
* Demonstrate skills in mainstreaming disaster risk reduction and management in CSA

**Course Contents**

1. **Integrating Gender Perspectives in Disaster Reduction Strategies**
   1. Tools and methods for understanding gender-based vulnerability
   2. The gender issues in disaster risk reduction strategies
   3. Disaster risk and integrating gender perspectives into disaster risk reduction policy
   4. Gender-inclusive disaster risk reduction (DRR) practices
   5. Gender-balanced approach to DRR
   6. Challenges to gender-inclusive DRR

**2. Towards Climate and Disaster Resilient Development**

2.1. Building strategies for climate and disaster resilient development

2.2. Building capacity for climate and disaster resilient development

2.3. Regional integration for climate and disaster resilient development

2.4. Challenges and opportunities for climate and disaster resilient development

**3. Community-Based Disaster Risk Reduction and Management (CBDRRM)**

3.1. Concepts, tools and implementations of CBDRRM

3.2. Assessment evaluation and management of disaster risks at the local level

3.3. Innovations required for CBDRRM

3.4. Stakeholders engagement approaches for CBDRRM

**4. The Enabling Framework of DRR to Support CSA**

**5. Mainstreaming Disaster Risk Reduction and Management in CSA**

**Mode of course delivery:**

The mode of delivery of the course combines lectures, discussion, questioning and answering, readings, assignments, individual and /or group problem identification and presentation. Besides, the lectures will be supported by case studies focusing on disaster risk reduction and management for livelihood resilience in Eastern and Southern African countries context. Seminars and assignments will be student-led based on the reading and led by the tutor.

**Assessment Methods:**

Seminar and assignments (40%) and final exam (60%)

**References**

* FAO. 2013. Resilient Livelihoods: Disaster Risk Reduction for Food and Nutrition Security Framework Programme
* Handmer, J. and Dovers, S. 2007. Handbook of Disaster and Emergency Policies and Institutions (London: Earthscan)
* Smith, K. and David, N. P. 2009. Environmental Hazards: Assessing Risk and Reducing Disasters (5th Edition). DOI: 10.1111/j.1745-5871.2009.00611
* Smith, K. 2013. Environmental Hazards: Assessing Risk and Reducing Disaster. 6th edition, Routledge: New York, ISBN 978-0-415-68106-3
* Twigg, J. 2015. Disaster Risk Reduction: mitigation and preparedness in development and emergency programming (London: Overseas Development Institute, Humanitarian Practice Network, Good Practice Review no.9, 2nd edition)
* Wisner, B., Blaikie, P., Cannon, T. and Davis, I. 2004. At Risk: Natural hazards, people’s vulnerability and disasters (2nd Edition). London: Routledge
* Wisner, B., Gaillard, J.C., and Kelman, I. (eds) 2012. Handbook of Hazards and Disaster Risk Reduction (London: Routledge)
* World Bank, 2013.Building Resilience: Integrating climate and disaster risk into development. Lessons from World Bank Group experience. The World Bank, Washington DC.

**Course Title: Institutions, Policy, and Innovations for Climate Smart Agriculture (E)**

**Course Code: CSAg-5241**

**Credit hour/ECTS: 3/5**

**Course Description:**

The course starts with definition of concepts (such as climate smart agriculture, institutions and innovations) and general issues related to policy, institution and innovation in agriculture and rural development. It includes agricultural development policies, policy making processes, policy analysis frameworks, institutions and development, institutional change and innovations. The climate change scenarios and climate smart agriculture in different agro-ecological zones of Africa and issues related to policies, strategies and institutions in climate smart agriculture will be part of the course. The need for institutional and policy support to climate smart agriculture and mainstreaming climate-smart agriculture into national policies and program and the need for mainstreaming will also be discussed. Climate-smart agriculture practices and technological innovations and barriers to adoption of climate smart agriculture innovations will be part of the course. Moreover, gender in climate smart agriculture is included. This section includes topics such as gender and climate change policy, gender and adoption of CSA practices etc

**Learning Objectives**

At the end of the course, the students will be able to

* Define concepts of policies, institutions and innovations.
* Explain policies and institutions in agriculture and rural development
* Explain climate smart agriculture in the context of Africa and assess its potential to address Africa’s productivity challenges
* Describe the various effects of climate change on agriculture activities
* Discuss the technological innovations of climate smart agriculture
* Explain the factors influencing farmers to adopt/not to adopt CSA technological innovations
* Explain the major institutions/institutional structures and institutional supports in climate smart agriculture
* Discuss ways of financing and investments for climate-smart agriculture
* Explain the importance of mainstreaming climate-smart agriculture into national policies and programs
* Discuss climate change policies, adoption of CSA etc in relation to gender
* Discuss various issues related to gender in climate smart agriculture

**Course Content**

**1. Introduction**

1.1. Policies in Agriculture and Rural Development

1.1.1. Agricultural development policies

1.1.2 The process of policy making

1.1.3. Policy analysis framework

1.2 Institutions in Agriculture and Rural Development

1.2.1. The concept of institutions

1.2.2. Institutions and development;

1.2.3. Institutional change

1.3.Innovations

1.3.1. Evolution of innovation thinking

1.3.2. Guiding principles for innovation processes

**2. Climate Change and Climate Smart Agriculture in Africa**

2.1. Climate change scenarios in different agro-ecological zones of Africa

2.2. Climate Smart Agriculture in the context of Africa

2.3. Multiple contexts of smallholder agriculture and CSA in Africa

2.3.1 Human behavioral and cultural context

2.3.2 Agro-ecological context: Landscape level

2.3.3 Entire Food System context

**3. Climate-Smart Agriculture Technological Innovations**

3.1. Technological innovations for climate smart agriculture

3.2. Adoption and diffusion of technological innovations for climate-smart agriculture

3.3. Barriers to adoption of climate smart agriculture practices

3.3.1. Physical or hardware barriers to adoption of CSA

3.3.2. Non-physical or software barriers to adoption of CSA

3.4. Strategies and actions to enhance adoption of CSA in Africa

**4. Institutional and Policy Options (for CSA)**

4.1. Enabling policy environment

4.1.1 National policy-making

4.1.2 Coordinated international policies

4.2. Institutions: information production and dissemination

4.3. Climate data and information gaps

4.4. Dissemination mechanisms

4.5. Institutions to improve access, coordination and collective action

4.6. Institutions to support financing and insurance

4.6.1. Credit

4.6.2. Insurance

4.6.3. Social Safety Nets

4.6.4. Payments for environmental services

**5. Financing and Investments for Climate-smart Agriculture**

5.1 Why financing is needed

5.2 Financing gaps

5.3. How does climate change affect investment needs for agriculture?

5.3.1. The development deficit

5.3.2. Investments for adaptation

5.3.3. Including mitigation in investment analysis

5.3.4. Farmers’ investment behavior

5.3.5. Building the evidence base to support CSA

5.4. Global climate finance: catalyzing the transition towards CSA

5.4.1. The challenging landscape of international climate finance for CSA

5.4.2. The existing climate finance options for CSA

5.4.3. Prospective development in climate finance for CSA

5.5. Connecting action to financing

5.5.1 National level

5.5.2 Linking to farmers

5.5.3 Measurement, reporting and verification (MRV) Pilots

6. **Mainstreaming Climate Smart Agriculture into National Policies and Program**

6.1. Climate-smart agriculture within larger economic and policy frameworks

6.1.1. Identification of supporting policies and programs

6.1.2. Providing an enabling legal and policy environment

6.2. Improve market accessibility: policy and financial instruments

6.2.1. Role of prices and subsidies

6.2.2. Regulations for adoption of CSA

6.2.3. Incentives for CSA investments

6.3. Improving access to knowledge and monitoring: the role of implementing actors

6.3.1. Role of local institutions and participatory approaches

6.3.2. Policies to mobilize non-state actors

6.3.3. Monitoring and assessment framework

7. Gender in CSA

7.1. Gender and climate change policy

7.2. Key Issues and Emerging Trends Relating to Gender in CSA

7.3. Gender and adoption of CSA practices

7.4. The Role of Innovative Technologies for Gender-Responsive CSA

7.5. The Role of Institutions for Gender-Responsive CSA

**Teaching Methods/ Mode of Delivery**

• Lecture, discussion, article review, seminar presentation

**Methods of Assessment**

The assessment will be made mainly through assignments (individual and group) and exam. Students are also expected to review articles and present.

30%- group assignment and presentation

20%- individual assignment and presentation

20%- paper/article review

30%- final exam

**References**

* Meinzen-Dick, R., Q. Bernier, and E. Haglund (2013). The six “ins” of climate-smart agriculture: Inclusive institutions for information, innovation, investment, and insurance. CAPRi Working Paper No. 114. Washington, D.C.: International Food Policy Research Institute. http://dx.doi.org/10.2499/CAPRiWP114.
* Food and Agriculture Organization of the United Nations (2010). Climate-Smart” Agriculture Policies, Practices and Financing for Food Security, Adaptation and Mitigation, Italy
* Thomas B. Long, Vincent Blok , Ingrid Coninx (2016). Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy , Journal of Cleaner Production 112
* Robin C. and Stephen D. (2004) Institutional Change for Sustainable Development Centre for Resource and Environmental Studies, The Australian National University, Canberra, Australia Edward Elgar Publishing
* Barnard James, Manyire Henry, Tambi Emmanuel and Bangali Solomon. FARA (2015). Barriers to scaling up/out climate smart agriculture and strategies to enhance adoption in Africa Forum for Agricultural Research in Africa, Accra, Ghana
* Pyburn, R. and J. Woodhill (eds.) 2014. Dynamics of Rural Innovation – A primer for emerging professionals.LM Publishers, Arnhem
* FAO (2010). Climate-Smart” Agriculture Policies, Practices and Financing for Food Security, Adaptation and Mitigation, Italy
* FAO (2013) Climate Smart Agriculture Source Book
* Westermann O, Thornton P, Förch W. 2015. Reaching more farmers – innovative approaches to scaling up climate smart agriculture. CCAFS Working Paper no. 135. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at: [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)
* Negra C. 2014. Integrated National Policy Approaches to Climate-Smart Agriculture.Insights from Brazil, Ethiopia, and New Zealand. CCAFS Report No. 11. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at: [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)
* Mohamed B., Mohamed B., and R. Gopichandran, Achieving Food Security in a Changing Climate: The Potential of Climate-Smart Agriculture in S.A. Shahid and M. Ahmed (eds.), 2014.Environmental Cost and Face of Agriculture in the Gulf Cooperation Council Countries: Fostering Agriculture in the Context of Climate Change, Gulf Research Centre Cambridge
* Chesterman, S. and Neely, C. (Eds) 2015. Evidence and policy implications of climate-­smart agriculture in Kenya. CCAFS Working Paper no. 90. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org.
* GiacomoBranca, TimmTennigkeit, Wendy Mann, Leslie Lipper(2012) Identifying opportunities for climate-smart agriculture investments in Africa, Food and Agriculture Organization of the United Nations, Rome
* Sally Brooks and Michael Loevinsohn, Shaping agricultural innovation systems responsive to food insecurity and climate change, Natural Resources Forum 35 (2011) 185–200
* Streck C, Burns D, and Guimaraes L. 2012. Incentives and benefits for climate change mitigation for smallholder farmers, CCAFS Report no. 7. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)
* Jidelbietan. 2011. Public Policy Making Process: Agricultural And Rural Development Policies In Nigeria (1960 To Date) VOL 8, NO 9 International Journal of Studies in the Humanities Of Studies
* Steve Wiggins, John Farrington, Natasha Grist, Giles Henley, Sharada Keats, Anna Locke, Christine Okali and Colin Poulton (2015) Agricultural development policy: a contemporary agenda .Overseas Development Institute
* Lídia Cabral and Ian Scoones (2006) Narratives of Agricultural Policy in Africa: What Role for Ministries of Agriculture?
* World Bank Group, FAO and IFAD (2015) Gender in Climate-Smart Agriculture

**Course Title: Climate Change and Pastoral System (E)**

**Course Code: CSAg-5251**

**Credit Hrs/ECTS: 2/3**

**Pre-requisite: No**

**Course Description:**

Global Pastoralism, pastoralism modernization and endism debates, characterization of pastoralism as a livelihood, pastoralist perception to climate change, managing key resources of pastoral communities, stability and perceptions of pastoral ecosystem, the dominant paradigm-pastoral degradation and pastoral system of livelihood, climate change and extreme weather conditions characteristics of equilibrium and non-equilibrium grazing systems, climate variation and plant production in pastoral ecosystems, determinants of pastoral systems, livestock population dynamics, human livestock interactions, Improving Carbon Cycling and Grassland Management, pastoral persistence, expansion of the spatial scale of pastoral resources exploitation, sustainable grazing management in pastoral ecosystems, the climate-plant-herbivory interactive model, land use change and resource use conflict, role of social institution in resource management and conflict resolution, indigenous early warning and social support systems to reduce social crisis, drought cycle management and coping strategies; climate change and implications of rainwater harvesting on pastoralist livelihoods and natural resource base, pastoralists coping strategy to climate change, pastoralist traditional calendar , institutional role and capacity in enhancing pastoral system’s resilience to climate variability and change impacts

**Course Objectives**:

* Undertake participatory identification of traditional and emerging climate change adaptation options and strategies at household and community levels and test them against future scenarios
* Acquire knowledge and recognize the multiple processes and stressors that govern the vulnerability of pastoralists to climate change
* Designing and arranging methods to protect pastoral land and enhance the mobility of pastoralists and their livestock
* To identify and analyze the institutional barriers to and opportunities for incorporating climate change adaptation measures into national development policies

**Course Content**

**1. Introduction**

**2. Pastoralist Way of Life**

2.1. Characteristics of Pastoralist Livelihood

2.2. Pastoralism and Modernization

**3. Pastoralist Perspectives to Climate Change**

3.1. Drought Cycle Management and Coping Strategies

3.2. Rainwater Harvesting On Pastoralist Livelihoods

3.3. Institutional Role and Capacity in Enhancing Pastoral System’s Resilience

**4. Resources of Pastoral Community**

4.1. Animal Resource in Pastoral community

4.2. Plant resource in Pastoral Community

4.3. Cultural Resources of Pastoral Community

**5. Pastoral Ecosystem**

5.1. The Dominant Paradigm-Pastoral Degradation

5.2. Pastoralist Livelihood and Ecosystem

**6. Effect of Climate Change**

6.1. Characteristics of Extreme Weather Conditions

6.2. Equilibrium and Non-Equilibrium Grazing System

**7. Effect of Climate Variation**

7.1. Plant Production in Pastoral System

7.2. Livestock Population Dynamics

7.3. Pastoral Livelihood System

7.4. Human Livestock Interaction

**8. Improving Carbon Cycling and Grassland Management**

**9. Grazing Management in Pastoral Ecosystems**

**10. Exploitation of Pastoral Resource and Conflict Resolution**

10.1. Land Use Change and Resource Use Conflict

10.2. Social Institution in Resource Management and Conflict Resolution

10.3. Indigenous Early Warning and Social Support

10.4. Pastoralist Traditional Calendar

**Mode of Delivery**

There will be Coursework lecturing, questions, discussions, practical visit and paper presentation

**Assessment Strategy:**

The formal ways of assessment includes:

* Practical courses report
* Term paper presentations
* Quizzes
* Final exams

**Reference:**

* + - FAO, 2016. Ethiopia Climate-Smart Agriculture Scoping Study.byJirata, M., Grey, S. and Kilawe, E. Addis Ababa, Ethiopia
    - Negra C. 2014. Integrated National Policy Approaches to Climate-Smart Agriculture.Insights from Brazil, Ethiopia, and New Zealand. CCAFS Report No. 11. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)
    - IfejikaSperanza, Chinwe, 2010. Resilient adaptation to climate change in African agriculture / ChinweIfejikaSperanza. – Bonn : DIE. (Studies / DeutschesInstitutfürEntwicklungspolitik ; 54) ISBN 978-3-88985-489-6
    - Bishaw, Badege, Henry Neufeldt, JeremiasMowo, Abdu Abdelkadir, Jonathan Muriuki, GemedoDalle, TewodrosAssefa, Kathleen Guillozet, HabtemariamKassa, Ian K. Dawson, EikeLuedeling, and CheikhMbow. 2013. Farmers’ Strategies for Adapting to and Mitigating Climate Variability and Change through Agroforestry in Ethiopia and Kenya,edited by Caryn M. Davis, Bryan Bernart, and Aleksandra Dmitriev. Forestry Communications Group, Oregon State University, Corvallis, Oregon.
    - Herrero, M., Ringler, C., van de Steeg, J., Thornton, P., Zhu, T., Bryan, E., Omolo, A., Koo, J. and Notenbaert, A. 2010. Climate variability and climate change and their impacts on Kenya’s agricultural sector. Nairobi, Kenya. ILRI.

**Course Title: Postharvest Management and Value Addition of Agricultural Produces (E)**

**Course Code: CSAg-5261**

**Cr. Hrs/ECTS:3/5**

**Pre-requisite: No**

**Course Description**

This course will include and is designed to equip students with the concepts and principles of post-harvest management and value addition of agricultural produces with respect to climate smart agriculture. These constitute: Overview of post-harvest management practices, creating a value-added agricultural produces, post-harvest managements to minimize contamination and maximize quality, post-harvest handling of agricultural products, and post-harvest grain loss assessment methods.

The major knowledge that students are required to obtain, from this course, include: Understanding the post-harvest management practices; the role of creating a value-added agricultural produces and to identify factors that determine post-harvest quality of agricultural produces; understand how post-harvest managements help to minimize contamination and maximize quality of agricultural produces; understand the basics of post-harvest handling of agricultural produces; and post-harvest grain loss assessment methods.

**Objectives**

At the end of this course, students will be able to:

* Explain the post-harvest management practices of agricultural produces
* Describe the benefits of creating a value added agricultural produce through control of post-harvest losses
* Discuss the underlying causes and control of post-harvest losses of agricultural produces
* Describe the profile of different types of agricultural produces, storage methods, and value addition
* Develop practical methods on post-harvest physiological processes and storage of agricultural produce to minimize contamination and maximize quality
* Understand and explain postharvest grain loss assessment methods of agricultural produces in a changing climate and how it affects food security

**Course Contents**

**1. An overview of Post-Harvest Management Practices**

1.1. An overview of postharvest losses

1.2. Post-harvest Handling and Treatments of fresh agricultural produces

1.3. Principal Causes of Post-harvest losses of agricultural produce

1.3.1. Pre-harvest factors

1.3.2. Biological factors: Physiological, insects and pests

1.3.3. Environmental Factors

1.4. Post-harvest management procedures for agricultural produces

1.4.1. Primary: on-farm processing technologies

1.4.2. Storage technologies for primary processed agricultural products

1.4.3. Technologies for management of perishable produces

**2. Creating a Value-Added Agricultural Products**

2.1. Control of postharvest losses and value addition of agricultural produces

2.2. Storage Systems and value addition of agricultural produces

2.2.1. Storage system and value addition of fruits and vegetables

2.2.2. Storage system and value addition of cereals and legumes

2.3. Processing of agricultural produces for value addition

2.3.1. Processing of fruits and vegetables for value addition

2.3.2. Processing of fruits and vegetables for reducing post-harvest losses

2.3.3. Processing of cereals and legumes for value addition

2.4. Factors that determine post-harvest quality of agricultural produces

**3. Post-Harvest Managements to Minimize Contamination and Maximize Quality**

3.1. Treatments to reduce microbial contamination of agricultural produce

3.2. Treatments to minimize water loss of agricultural produce

3.3. Treatments to reduce ethylene damage

3.4. Treatments for decay control of agricultural produce

3.5. Treatments for insect control of agricultural produce

**4. Postharvest Handling of Agricultural Produces**

4.1. Cleaning an sorting of agricultural produces

4.2. Packing and Processing of agricultural produces

4.3. Storage life of harvested agricultural produces

4.3.1. Storage and Shelf life problem of agricultural produces

4.3.2. Storage system for fresh produces: Fruits, vegetables, cereals and legumes

4.4. Transportation of agricultural produces

4.5. Distribution of agricultural produces and channel choice

4.6. Types of post-harvest losses in agricultural produces

4.6.1. Primary causes of post-harvest losses of agricultural produces

4.6.2. Secondary causes of post-harvest losses of agricultural produces

4.7. Technologies and practices to reduce post-harvest losses of agricultural produces

**5. Postharvest Grain Loss Assessment Methods**

5.1. Postharvest management of agriculture in a changing climate

5.2. Food security and post-harvest management of agricultural produce

5.3. Factors influencing the adaptive capacity of post-harvest systems

5.4. Climate-smart post-harvest agricultural adaptation opportunities

**Mode of Course delivery:**

The course will be delivered through lectures, discussion, questioning and answering, reading, assignments, individual and/or group problem identification and presentation. There will also be practical laboratory sessions. This process will also be supported by seminars, which form a significant element in the student workload as well as contributing to the course formative assessment. Moreover, the lectures will be supported by case studies that will include post-harvest management practices and value addition of agricultural produces from Climate Smart Agriculture perspectives.

**Assessment Methods:**

Seminar and assignments (40%) and final exam (60%)

**References**

* Christensen et al. 2007. Regional climate projections. Climate Change 2007: The Physical Science Basis. WGI 4AR IPCC.
* FAO, 2011. Global food losses and waste: Extent, Causes and Prevention
* Kader, A. A. and Rolle, R. S. 2004. The role of post-harvest management in assuring the quality and safety of horticultural produce.FAO Agric. Services Bulletin 152.
* Parry, M.L., Rosenzweig, C., Iglesias, A., Livermore, M. and Fischer, G. 2004. Effects of climate change on global food production under SRES emissions and socio-economic scenarios. Global Environmental Change, 14, 53-67.
* Parry, M., Evans, A., Rosegrant, M.W. and Wheeler, T. 2009. Climate change and hunger: responding to the challenge. WFP.
* World Bank, 2011. Missing Food: the case of postharvest grain losses in sub-Saharan Africa
* Oluwalana, I. B. 2007. Lecture notes on Perishable Crop storage and processing. Department of Food Science and Technology, the Federal University of Technology, Akure.
* Rembold, F., Hodgex, R., Bernard, M., Knipchild, H. and Leo, O. 2011. The African Postharvest Losses Information System (APHLIS). JRC Scientific and Technical Reports. Luxemburg.
* United Nations, Food and Agricultural Organization. 2011. Global Food Losses and Food Waste- Extent, Causes and Prevention. Rome
* Von Braun, J. 2007. The World Food Situation: New Driving Forces and Required Actions. Washington DC, IFPRI.
* World Food Logistics Organization (WFLO). 2010. Identification of Appropriate Postharvest Technologies for improving market access and incomes for small horticultural farmers in Sub-Saharan Africa and South Asia. Alexandria VA, March

**MODULE 3**

**Course Title:Statistical Methods and Data Analysis**

Course Code: BdEM5312

Credit Hours: **2+1**

**Course Description**

The course Statistical Methods and Data Analysis introduces students with basic and applied concepts, principles and procedures of various statistical methods and tools that are commonly used in biodiversity and ecosystem assessment, survey and management. The intent of this course is to provide students with basic understanding and practical skills of those statistical techniques that are commonly used in summarizing, analyzing and interpreting data related to biological diversity and variability, and ecosystem management. The course utilizes appropriate statistical software(s) and related data to apply the statistical methods and techniques in data summarization analysis.

The course covers about the meaning and use of statistics; basic concepts and definitions of terminologies commonly used in statistics; methods used for an effective organization and graphical presentation of qualitative and quantitative data; numerical methods or descriptive measures of central tendency, measures of variability (dispersion), measures of the shape of a distribution, and measures of relative position; probability and probability distributions; sampling and sampling distributions; point and interval estimation of parameters; determination of confidence interval; hypothesis testing; analysis of variance; regression and correlation; multiple regression analysis; chi-square tests and categorical data analysis; non-parametric statistical methods; and choosing an appropriate statistical method for data analysis.

The course is divided into five chapters, and at the end of each chapter there will be practical exercises using appropriate statistical software(s) and related data. In each chapter, explanation of topics, that means statistical concepts and theories of will be accompanied by examples relevant to biodiversity and ecosystem management.

**Course Objective**

At the end of the course students are able to:

* Know the basic statistical concepts, principles and procedures ;
* Understand the application of various statistical concepts, principles and procedures in biodiversity and ecosystem analysis and interpretation;
* Apply the statistical methods and techniques that are commonly used to summarize, analyse and interpret data related to biodiversity and ecosystem management;
* Use statistical software packages that are relevant to data set related to biodiversity and ecosystem management;
* Identify sources and types of data; and
* Choose appropriate statistical methods for data analysis

**Course Contents**

**1. Introduction**

* 1. Statistics
  2. Data, types and measurement scales
  3. Data collection tools

1. **Presenting and summarizing data (Descriptive Statistics)**
   1. Data Presentation
      1. Graphical presentation of qualitative data
      2. Graphical presentation of quantitative data
   2. Numerical methods for presenting data
      1. Measures of central tendency (location)
      2. Measures of variability (dispersion)
2. **Probability and Probability Distribution**
   1. Probability of an event
   2. Rules of Probability
   3. Conditional Probability and Independence
   4. Probability Distribution
      1. Probability distribution of discrete random variables
      2. Probability distribution of continuous random variables
3. **Sampling and sampling distributions**
   1. Sample versus population
   2. Statistical inference
      1. Estimation of population parameters by sample statistics
      2. Sampling error
   3. Sampling distribution of the mean
   4. Confidence interval for a mean
   5. Sampling distribution of the proportion
   6. Confidence interval for a proportion
   7. Sampling methodology
   8. Sample size determination
4. **Hypothesis testing**
   1. Basic concept of hypothesis testing
   2. Statistical significance
   3. Statistical versus biological significance
   4. The t-test: comparing one or two tests
   5. The F-test: comparing two variances or more than two means
   6. The chi-square test: comparing proportions
   7. Linear Correlation and regression
   8. Multiple Regression
   9. Non-parametric data analysis

**Mode of Delivery (***for courses require practical integration should be considered here, based on the course description***)**

* Lectures
* Group Discussion
* Assignments
* Software and data based hands on exercises

**Assessment Methods**

* Exams
* Individual and group assignments

**Course materials**

* Course module
* Data set
* Statistical software
* Computer lab

**Further reference materials/ Supplemental Readings**

* Sheldon M. Ross (2010). Introductory statistics 3rd ed. Elsevier Inc.
* R. Lyman Ott, and Michael Longnecker (2010). An Introduction to Statistical Methods and Data Analysis, Sixth Edition. Brooks/Cole, Cengage Learning.
* Shirley Dowdy, Stanley Weardon and Daniel Chilko (2004). Statistics for research. 3rd edition. John Wiley & Sons, Inc., Hoboken, New Jersey (Wiley series in probability and statistics; 1345).
* Myra L. Samuels, Jeffrey A. Witmer and Andrew A. Schaffner (2012). Statistics for the Life Sciences. Fourth Edition, Pearson Education, Inc.

**Course Title: Research Methods in Climate Smart Agriculture**

**Course code: CSAg-5322**

**Credit Hour/ECTS: 2/3**

**Pre-requisite: No**

**Course Description**

The course will allow students learn principles and procedures in undertaking scientifically sound and relevant research in agriculture in general and climate smart agriculture in particular. Topic covered include theories of science; definition of research; characteristics of research; objectives of research; types of research; interdisciplinary and participatory research; the research process/scientific method; research design; sampling design; methods of data collection; developing a research proposal/project; thesis/dissertation research proposal or synopsis; climate-smart agriculture research agenda; writing scientific articles/thesis/dissertation; ethical considerations in research.

**Course objectives**

At the end of the course students will be able to:

* Understand basic concepts, principles and procedures of science and research
* Identify, analyze and prioritize the research problems in their field of specialization (climate-smart agriculture)
* Identify the type of methods best suited for investigating different type of problems and questions
* Develop relevant and innovative research proposals in their field of specialization (climate-smart agriculture)
* Write scientific paper in general and the thesis in particular independently in their field of specialization (climate-smart agriculture)
* Develop enthusiasm to be researchers in their future career in climate-smart agriculture
* Work in an interdisciplinary and participatory research approach to address climate-smart agriculture research problems

**Course Contents**

**1. Introduction to Research**

1.1. Theory of Science

1.2 Definition of Research

1.3 Characteristics of Research

1.4 Objectives of Research

1.5 Criteria of Good Research

1.6 Types of Research

**2. Procedures in Applied Research**

2.1 Overview of the Research Process

2.2 Formulating Research Problem

2.3 Problem Analysis in Agricultural Research

2.4 Priority setting

2.5. Literature Review

2.6 Constructing Hypothesis

**3. Research Design**

3.1 Meaning of Research Design

3.2 Need for Research Design

3.3. Types of Experimental Design

3.4 Concepts Commonly Used in Experimental Design

**4. Sampling Design**

4.1 Census and Sample Survey

4.2 Steps in Sample Design

4.3 Types of Sampling Design

4.4 Sample Size and its Determination

**5. Methods of Data Collection**

5.1 Definition of Some Terms

5.2 Measurement Scales

5.3 Data types and Data Collection Techniques

**6. Developing a Research Project Proposal**

6.1 Quality of Research Proposal

6.2 Components of Research Project

6.3 Criteria for Evaluating Proposal

6.4 Why Proposals Fail?

**7. Thesis/Dissertation Research Proposal**

7.1 Title

7.2 Introduction

7.3 Review of Literature

7.4 Materials and Methods or Methodology

7.5 Plan of Activities

7.6 Budget

7.7 References

7.8 Appendix (if any)

**8. Climate-Smart Agriculture Research Agenda**

**9. Writing Scientific Articles**

9.1 Title

9.2 Abstract/Summary

9.3 Introduction

9.4 Materials and Methods

9.5 Results

9.6 Discussion

9.7 References

9.8 Acknowledgements

9.9 Appendix

**10. Scientific presentation**

10.1 oral presentation

10.2 Poster presentation

**11. Ethical Considerations in Research**

11.1 Ethics in Research

11.2 Fundamental Ethical Principles

11.3 Ethics and Professionalism in Science

**Mode of course delivery**

* The mode of delivery of the course combines lectures, discussion, questioning and answering, readings, assignments, individual and /or group problem identification and presentation.
* Proposal writing and presentation: Each student will be required to identify research problem, set hypothesis, write and present research proposal

**Assessment Methods**

* Evaluation will include proposal writing and presentation, and written examination.

**References**

* Andrew, C.O. and Hildebrand, P.E. 1982 . Planning and Conducting Applied Agricultural Research. pp. 14–33. Westview Press Inc., Colorado, USA.
* Day, Robert A. (1998). *How to Write & Publish a Scientific Paper*. 5th ed. CambridgeUniversity Press
* Desai, Vandana and Potter, Robert B. (2006). *Doing Development Research*. SAGE Publication Ltd., London
* Dixon, J ., Bouma, M. and Atkinson, K. 1987. A Handbook of Social Science Research. Oxford University Press, Oxford, UK.
* Greenfield, T. 2002. Research Methods for Postgraduates. Second edition. Arnold, London, UK. 384 pp.
* Greenfield, T. 2002. Writing the thesis. In: Research Methods: Guidance for Postgraduates, Greenfield, T. (Ed.), pp. 307–316. Second edition, Arnold Publishers, London, UK.
* Kerri *et al.* (2014). Climate-smart agriculture global research agenda: scientific basis for action. Agriculture & Food Security 3:11. DOI: 10.1186/2048-7010-3-11
* Kish, L. 1987. Statistical Design for Research. John Wiley & Sons, New York, USA.
* Lal, R. 1994 . Soil Erosion Research Methods. S t Lucie Press, Florida, USA. 352 pp.
* Lohr, S.I. 1999. Sampling Design and Analysis. Duxbury Press, Pacific Grove, California, USA.
* Lyons, K .2003 . How to Write a Literature Review. University o f California, USA. Available from: ht tp://library.ucsc.edu/ref/howto/literaturereview.html
* Macauley, P. 2001 . The Literature Review, Deakin University. Geelong , Victoria, Australia. Sayer, J .A. and Campbell, B. 2001. Research to integrate productivity enhancement , environmental protec- tion and human development . Conservation Ecology 5(2): 32.url: ht tp://www.consecol.org/vol5/1552/art32.
* Reid, P. (2000). Handbook for preparing and writing research proposals. International Union of Forestry Research Organization, Vienna, Austria.
* Taylor, S. 2002. Managing your PhD. In: Research Methods: Guidance for Postgraduates. Second edition. Greenfield, T. (Ed.), pp. 13–27. Arnold, London, UK.
* Tham, M. 2001. Writing Research Theses or Dissertations – Guidelines and Tips. University of Newcastle-upon-Tyne, UK. Available from: ht tp://lorien.ncl.ac.uk/mingDept/Tips
* Thompson, S.K. 2002 . Sampling. Second edition. John Wiley & Sons, New York, USA.

**Course title: GIS and Remote Sensing for Climate Change (E)**

**Course code: CSAg 5332**

**Credit Hour/ECTS: 3/5**

**Prerequisite: No**

**Course Description**

Through lectures and laboratory exercises, this course illustrates the fundamental concepts of GPS, GIS and remote sensing technologies in the context of Climate Smart Agriculture and Biodiversity conservation. Topics include the physical basis for remote sensing, remote sensing systems, digital image processing, data structures, database design, and spatial data analysis. The course is intended to provide students with extensive training in particular image processing or GIS package and, hands-on computer laboratory sessions re-enforce critical concepts. Working knowledge of personal computers and completion of a term project are required.

**Learning objectives**

* Master the principles and concepts of GIS and RS
* Acquire, manipulate, save the data sources in a GIS
* Understand how GIS database works and how to update
* Learn how to edit data in GIS
* Learn digital image processing techniques
* Become familiar with specific functionality to the GIS: "Spatial Analysis"
* Learn map design, symbolization and   publishing
* Mastering the output and dissemination of results of a GIS project.
* Develop and implement a GIS project
* Present the software and data sources available on the current GIS market
* Discover and use the internet for publishing maps

**Course Contents**

1. **Introduction to Principles of GPS, GIS and Remote Sensing**
   1. Principles of GIS and  Remote Sensing
   2. Components of GIS Systems
   3. GIS Capabilities and Functions
   4. Spatial Data Infrastructure
   5. Introduction to GPS and Global Navigation Satellite
2. **Data Acquisition: Using GPS/Mobile based GPS (ODK)**
   1. Principles and concepts  of GPS
   2. Introduction to Mobile Data gathering
   3. Survey Authoring
   4. GIS Mapping using open data kit (ODK) collected data
   5. Online web mapping with Google maps
   6. Exporting to GIS /RS environment for further analysis
   7. Hosting the data online
3. **Data Acquisition: Extraction of Feature From Other Sources**
   1. Extracting data from Satellite images,
   2. Extracting data from online GIS data sources
   3. Importing data to GIS
   4. Obtaining Data from topographic sheets
   5. Downloading Data from open street maps
4. **Database Design and development**
   1. Working with spreadsheets data in GIS
   2. Conceptual and logical database design
   3. Building and coding the attributes
   4. Digitizing and scanning of maps
   5. Relating spatial and attribute data
5. **Editing and management of GIS**
   1. Adding feature to GIS data
   2. Reducing GIS data
   3. cutting points of interest in image datasets
   4. Transforming GIS data
6. **Integrating Imagery and Remote Sensing into GIS**
   1. Radiometric and atmospheric correction
   2. Temporal normalization
   3. Geo-coding and geo-referencing
   4. Transformation
   5. Signature development
   6. Supervised Classification
   7. Unsupervised Classification
   8. Change detection
   9. Accuracy assessment
7. **Geo-Spatial Analysis**
   1. Geo-processing
   2. Creating views and themes
   3. Working with themes
   4. Working with attribute tables
   5. Spatial query and analysis
   6. Working with charts
   7. Creating a map layout
   8. Digital Cartography and Visualization
8. **Introduction to cartographic visualization and the mapping process**
   1. Components of a map
   2. Map design
   3. Symbol design
   4. Name design and placement
   5. Concept of scale
   6. Map projections
   7. Data pre-processing techniques
   8. Thematic mapping;
   9. Digital mapping
9. **Online Publishing of Maps and GIS Outputs**
   1. Working with Google Maps and Fusion Tables
   2. Publishing into other web based platforms
10. **Case Study and Short Project**
    1. Case study of a related programme use of GIS and RS technology

**Mode of Delivery**: Lecture, critical Review and Presentation, Practical Session

**Assessment**: Midterm Exam= 20%, critical paper review and presentation =15%, Practical Session =25% and Final Exam 40%

**Reference**

* Rolf A. de, 2001. Principles of Geographical information System: an introductory text book
* Lucas L., F. Janssen and Gerrit C., 2001. Principles of Remote Sensing: an introductory text book
* Remote Sensing and GIS Integration Theories, Methods,Applications. 2010 by the McGraw-Hill Companies, Inc.

**Course Title: Animal and Plant Genetics and Molecular Techniques (Elective)**

**Course Code**:CSAg-5342

**Credit Hours/ECTS**: 2/3

**Prerequisite: No**

**General Objectives**: To acquaint students to advanced concepts, techniques and applications of genetics and molecular biology, with special emphasis to applications to climate smart agriculture

**Specific objectives**: At the end of this course, students will be able to:

* Understand the past and the current contribution of genetics to agricultural development
* Envisage the potential roles of genetics and molecular techniques in climate change mitigation
* Gain advanced concepts of genetic variation and inheritance of traits
* Understand and practice advanced methods of genetic analysis (qualitative, quantitative, and molecular techniques)
* Learn and practice molecular laboratory techniques and procedures (from DNA extraction to genotyping)

**Course Description**: Introduction (genetics and agriculture-historical perspectives, the roles of genetics, breeding and molecular tools for climate change mitigation); Variation and inheritance of biological traits (qualitative vs. quantitative variation and the role of the environment, epigenetic and somaclonal variations); Genetic analysis: revision of Mendelian principles for qualitative traits; statistical genetics approaches for analysis of quantitative traits-phenotypic and genotypic variance, coefficient of variation, heritability and genetic advance; molecular genetic analysis- introduction to functional genomics, forward and reverse genetics approaches to genetic analysis and the respective procedures; mapping population development, phenotyping and genotyping, genetic mapping and QTL analysis; Molecular markers and their roles in genetic analysis- definition, types and uses of molecular markers; molecular biology techniques and procedures-DNA extraction, quantification and handling; PCR protocols and programs; gel electrophoresis; sequencing, and other genotyping platforms. genetic engineering, TILLING.

**Course Content**s

**1. Introduction**

1.1. Genetics and agriculture-historical perspectives

1.2. The roles of genetics, breeding and molecular tools for mitigating climate change

**PART – I: Genetics**

**2. Variation and Inheritance of Biological Traits**

2.1. Qualitative vs. Quantitative traits: variation, genetic control, heritability and the effect of the environment

2.2. Somaclonal and epigenetic variations

**3. Genetic Analysis**

3.1. Revision of Mendelian principles (qualitative traits)

3.2. Statistical genetics approaches for analysis of quantitative traits

3.2.1. Analysis of variance (ANOVA) and Expected Mean Squares (EMS)

3.2.2. Phenotypic and Genotypic Variances and Coefficients of Variations

3.2.3. Partitioning of Genotypic Variance

3.2.4. Estimation of heritability and genetic advance

3.3. Molecular Approaches to Genetic Analysis

3.3.1. Forward vs. Reverse Genetics

3.3.2. Procedures of forward genetics (from phenotype to QTL/gene)

3.3.2.1. Mapping populations for genetic analysis: Types, development procedures, and specific uses

3.3.2.2. DNA extraction, genotyping and genetic map construction

3.3.2.3. Phenotyping and statistical analysis of phenotype data

3.3.2.4. QTL mapping and other genetic analyses

3.3.2.5. Positional cloning/fine mapping

3.3.3. Reverse genetics approaches (from gene to phenotype)- genetic

engineering/genetic transformation

3.3.4. Targeting Induced Local Lesions in Genomes (TILLING)

**PART-II: Molecular Techniques**

**4. Molecular Marker Technology**

4.1. Definitions and types of molecular markers with examples (**2 hrs**.)

4.1.1. Morphological vs. molecular markers

4.1.2. Biochemical vs. Genetic Markers

4.1.2.1. PCR based and non-PCR based DNA markers

4.1.2.2. Properties of ideal genetic markers

4.1.2.3. Comparisons of molecular marker techniques

4.2. Applications of molecular marker technology to genetic analysis and Plant/Animal Breeding (**2 hrs.)**

**5. Molecular Techniques and Procedures**

5.1. DNA extraction methods, and DNA quantification, quality checking, preservation, and handling (**3.5 hrs**)

5.2. Genotyping and genotyping platforms

5.2.1. Polymerase Chain Reaction (PCR)

5.2.1.1. PCR protocols and programs

5.2.1.2. Gel electrophoresis, allele scoring and generating genotyping data

5.2.2. Other genotyping platforms (GBS, KASP, HRM, etc)

5.3. Construction of Genetic Maps (Genetic linkage maps and Association maps)

**Total lecture hours = 16**

**Practical hours = 16\***

**Mode of Delivery**

Lecture, audio-visual aids, assignments, practical works

**\*Practical Activities (16 hours)**

* Data analysis (statistical genetics)
* DNA extraction
* DNA quantification using Nanodrop and DNA quality checking
* PCR
* Gel electrophoresis, allele scoring and generating genotyping data
* Genetic mapping
* QTL analysis

**Assessment Mechanisms**

* Assignments: 10%
* Quizzes: 10%
* Mid exam: 30%
* Final exam: 50%

**References**

* Anthony J.F. Griffiths , Susan R. Wessler, Sean B. Carroll, and John Doebley,2012**Introduction to Genetic Analysis,** 10th Edition,
* T.A. Brown. 2010. **Gene Cloning and DNA Analysis: An Introduction**, 6thed: Wiley-Blackwell
* Daniel L. Hartl and Elizabeth W. Jones. 1988. Genetics: Principles and Analysis, 4th ed., Johns and Bartlett Publishers
* R. Hoelzel. 1998. Molecular Genetic Analysis of Populations: A Practical Approach (Practical Approach Series) 2nd ed.
* Zehua Chen. 2013. Statistical Methods for QTL Mapping
* Lörz, H. and G. Wenzel (eds.). 2005. **Molecular Marker Systems in Plant Breeding and Crop Improvement**, Springer-Verlag Berlin Heidelberg .
* Robert J. Henry. 2012.Molecular Markers in Plants

**Course title: Climate Smart Agricultural Mechanization and Energy**

**Course code: CSAg 5332**

**Credit Hour/ECTS: 3/5**

**Prerequisite: No**

**Course Description**

Introduction to inherent and transient physical properties of agricultural soil and their effects on soil structure, fluid movement in soil, root growth and development, moisture holding, conserving and release; the role of soil tillage in plant growth and crop production; type of soil tillage vs. climate smart agriculture, optimum plant population and crop yield and resources (water and nutrient) utilization; weed, insect, pest and disease proliferation and their control in the face of climate change using mechanical devices (agricultural machines); harvesting, threshing/shelling cereals and other crops and use of cleaning, sorting, grading, dressing, bagging and labelling machines in the production, handling, and marketing of quality seeds; problems of soil compaction in relation heavy machinery usage and their remedies; potential, prospect and problems of energy utilization and environmental protection in the face of climate change; and cost of owning and operating agricultural machinery in climate smart agriculture.

**Development of the Course**

1. The course expected to cover everything from land preparation all the way to processing and handling of products including energy management (see the paragraph above). Energy Management is a course by its own right at other MSc Programme here at Haramaya University. Hence, the credit hour must be at least 3 to do justice to the proposed course;
2. The course title is too long; hence it is suggested that the total should read “Mechanization and Energy in CSA”; and
3. Applicants academic background is very essential; applicants with no exposure to a course(s) such as principles/introduction to farm machinery, farm implement and tools, theory and practice of tillage etc., will find it very difficult to deal with specialized machinery used in CSA, Conservation Agriculture (CA) such as zero tillage, minimum tillage, residue management, and planting, fertilizing and chemical applicants used with these systems (CSA and CA).

**Objectives**

**General Objective**

* To introduce students to the fundamental principles mechanization in general and that CSA in particular including energy sources on farm, potential, prospect and problems associated with use of energies from different sources.

**Specific Course Objectives are: -**

* To establish relationships between soil tillage and induced soil physical properties in light of infiltration, soil erosion, penetration resistance , root growth and distribution in soil, disease, pest and insect control;
* To familiarize students with advantage and limitation of conservation tillage, conventional tillage and implements used in each case;
* To introduce students to different types of agricultural machinery, implements and equipment used in plant production, protection, handling and primary processing;
* To enable students to identify potential energy sources in agriculture and the problems associated with use of these energy sources; and
* To equip students with basic knowledge and fundamental principles of machinery cost analysis and selection of machinery, implements and equipment.

**Course Contents**

1. **Soil and Tillage:** 
   1. Definition of soil;
      1. Physical/ index properties (transient and inherent) and their effects on plant growth and crop production,
      2. Soil erosion,
      3. Moisture conservation;
      4. Soil temperature,
      5. Soil moisture release characteristics,
      6. Soil organic matter & soil carbon,
      7. Application of soil physical properties on soil tillage and land development.

1.2. Soil Tillage

* + 1. Advantages and limitations of different types of tillage
    2. Definition of tillage; types of tillage
    3. Objectives of conventional tillage;
    4. Tillage implements;
    5. Tillage implements in relation to agroecology,
    6. Mouldboard plough,
    7. Types/kinds of mouldboard ploughs and their uses;
    8. Disk ploughs- their types and uses and selection of disk plough;
    9. Subsoilers,
    10. Chisel ploughs.

1. **Planting, Seeding and Fertilizing Machines:** 
   1. Plant population and yield
   2. Factors affecting germination and emergency,
   3. Plant stand and yield;
   4. Planting surface profile;
   5. Methods of crop establishment;
   6. Functional requirement of planting machine and grain drills in the face of changing climate,
   7. Method and manner of fertilizer application;
   8. Calibration of planting and fertilizing machines and their adjustment;
   9. Care of planting and fertilizing machines.
2. **Cultivation and Cultivation Machines:** 
   1. Objectives of mechanical cultivation;
   2. Methods of weed control (manual, mechanical, chemical, flame) in CSA.

**4. Sprayers and Dusters:**

* 1. Type of equipment and application;
  2. Type of spray chemicals,
     1. Organic,
     2. Inorganic and petroleum
  3. The role of chemicals as a means of insect, pest and disease control;
  4. Chemicals and the environment under CSA.

1. **Grain and Seed Harvesting and Processing Machine:** 
   1. **P**rinciple and types of threshing/shelling mechanisms;
   2. Mechanics of seed, straw and chaff separation;
   3. Seed and grain cleaning, sorting, grading, dressing, bagging and labeling machines;
   4. Seed/grain drying, storing and dehulling and value addition.
2. **Traffic & Soil Compaction:** 
   1. Definition of soil compaction,
   2. Causes of soil compaction,
   3. Manifestation/symptoms of soil compaction;
   4. Optimum and limiting soil densities;
   5. Compaction and root growth and nutrients up take;
   6. Measurement of soil compaction (density and penetration resistance or cone index);
   7. Sugarcane stool damage and effect on yield of sugarcane;
   8. Control and alleviation of soil compaction.
3. **Energy in CSA** 
   1. Introduction
   2. Potential, prospect and problems of energy development in Ethiopia;
   3. Energy from wastes;
   4. Research and development, policies and strategies in energy development,
   5. Utilization and environmental protection;
   6. Measurement of greenhouse gases,
   7. Analysis and interpretation of greenhouse gases
   8. Monitoring and evaluation of impacts on the environment
   9. Research and development in the areas of energy and environment and CSA.

**Mode of Delivery:**

* Lecture; two hours per week for whole semester;
* Tutorials, field visit, and demonstration of land preparation, planting, pest and weed control, on site water harvesting technique, etc;
* Demonstration of postharvest machinery, crop drying and processing of grains and seeds.

**References**

* R. A. Kepner, R. Bainer, and E. L. Barger (1982) Principles of Farm Machinery
* D. Hunt (1983) Farm Machinery Management
* Krause, R, F. Lorenz, and W. B. Hoogmoed. 1984. Soil Tillage in Tropics and Subtropics. GTZ, Eschborn, Germany.
* Articles on CA, CSA, and Energy and Environment must be provided as the course instruction progresses.
* Brian G Sims and Josef Kienzle. 2006. Farm power and mechanization for small farms in sub-Saharan Africa. Food and Agriculture Organization of the United Nations, Rome.
* FAO. 2013. Mechanization for Rural Development: A review of patterns and progress from around the world; Edit. Josef Kienzle, John E. Ashburner and Brian G. Sims. Integrated Crop Management Vol.20/2013.

**Assessment:**

**Term Paper & Presentation**

1. Term paper, about 3000 words, on agricultural mechanization and CSA in Ethiopia or potential, prospect and problems of energy utilization (any one of the energy resources; renewable or nonrenewable energies) in relation to technology, economics and environment. **(30%)**
2. Oral presentation of the term paper **(20%);** and
3. Final Examination **(50%)**

**Course Title: Climate Dynamics and Modeling (E)**

**Course Code**:CSAg-5362

**Credit Hours/ECTS**: 3/5

**Prerequisite: No**

Course Description

This course begins with a study of the role of dynamics in the general physics of the atmosphere, the consideration of the differences between modeling and approximation, and the observed large-scale phenomenology of the atmosphere. Global energy balance, Problems include the Hadley circulation and its role in the general circulation, atmospheric waves including gravity and Rossby waves and their interaction with the mean flow, climate modeling, Agricultural planning under future climate change and its impacts on different sectors

**Objective of the course**

* Acquire knowledge of the basic components of climatic system
* Able to understand the relationships among components of climatic system andto understand the key physical, chemical and biological processes which govern climate
* Able to understand observed global, regional and local climate.
* Understand the role of different circulation components in transporting energy and momentum.
* Be able to articulate the ways in which the general circulation relates weather phenomena to the climate.
* Become familiar with the application of the mathematical theories to the observed atmospheric and Ocean circulation.
* Able to understand the main concepts of the large-scale climate such as: the energy balances, the large-scale atmospheric and ocean circulations, the forces acting in the climate system.
* Able to understand climatic models can be used to simulate climate on a variety of spatial and temporal scales.
* Develop an understanding of atmospheric dynamics in the context of observed phenomena.
* Develop the theory of the steady symmetric circulation (i.e., the Hadley Circulation) and its role in the general circulation.
* Develop the theory of internal gravity waves in general basic states, and develop the theory for how these waves interact with the mean flow. Applications to specific phenomena are emphasized.
* Isolate the impact of rotation in a spherical atmosphere, derive the quasi-geostrophic approximation, and apply this approximation to the study of Rossby waves. Again, applications (including the nature of stationary disturbances) are emphasized.

**Course Contents**

**1.Introduction**

1.2. Climate Mean State

1.3. Coordinate System

1.4. Components of Climatic system

1.4.1. Land Surface

1.4.2. Atmosphere

1.4.3. Ocean

1.4.4. Biosphere

1.4.5. Crysphere

1.5. Atmospheric composition

1.6. Hydrological and carbon cycles in climate system

**2. Atmospheric Energy Balance**

2.1. Basic equations

2.1.1. Energy conservation equation

2.1.2. Diagnostic equations

2.1.3.Prognostic equations

2.2.The Earth’s energy budget

2.2.1. Global solar radiation distribution

2.2.2. Factors affecting solar radiation distribution over the globe

2.2.3. Greenhouse effect on Earth’s energy balance

2.2.4. Net heat insolation at the top of the atmosphere

2.3. Zero, first, Second and third order Energy model

**3. The Atmospheric and Ocean Circulation**

3.1. Geofluid Dynamics

3.1.1. The Momentum Equation

3.1.2. Gravitational force

3.1.3. Pressure Gradient Force

3.1.4. Hydrostatic Balance

3.1.5. Continuity and Convection

3.1.6. Geostrophic Balance

3.1.7. Thermal Wind Balance

3.1.8. Friction in Atmospheric boundary layer

3.2. Atmospheric Circulation

3.2.1. The basic thermal structure of the Atmosphere

3.2.2. The Large Scale Atmospheric Circulation

3.2.3. Conservation of energy, momentum, mass and Ideal gas low equations

3.2.4. Roles of divergence and rotational flow in the Atmosphere

3.2.5. Stationary waves

3.2.6. The Rossby Wave Source.

3.2.7. Small scale Atmospheric circulation

3.3. The Oceans circulation

3.3.1. Ocean stratification

3.3.2. Surface (wind driven) Circulation

3.3.3. Upwelling and Convection

3.3.4. Thermohaline (geostrophic) Circulation

3.3.5. Deep Ocean Time Scales

3.4. Heat Transport in the Climate System

3.4.1. Heat storage and transport

3.4.2 .The Zonal Mean Heat Balance

3.4.3. Meridonal Heat Balance

3.4.4. The Advective and Turbulent Heat Transport

**4 .Climatic Fluctuations and Variability**

4.1.Climatological analysis

4.3. Characteristics of climate variability

4.1.3.Sources of climate variability

4.1.4. Inter-annual variability, Inter seasonal to seasonal variability

4.1.3. Ocean as a buffer of temperature change

4.2.El Niño and Southern Oscillation/ENSO

4.2.1.ENSOteleconnections

4.2.2.Predictability of ENSO

4.3.North Atlantic Oscillation index

4.4.Thermohaline Circulation (THC)

4.5.‘‘Normal’’ conditions—equatorial upwelling and the Walker circulation

4.6.Paleo Climate

4.6.1.Climate Proxy Data

4.6.2.Ice Ages (The Milankovitch Cycles)

4.6.3.Orbitalforcings (The Milankovitch Cycles)

**5.Perturbationand Climate System**

5.1.Climate forcing and response

5.1.2.Concept of radiative forcing

5.1.3.Majorradiative forcing

5.1.4. Climate Feedback Mechanisms

5.1.5. External RadiativeForcings

5.1.6. Internal Forcing Mechanisms of Earth System

5.1.7.Radiative Perturbations from Earth System

5.2. Climate Sensitivity, Stability and Feedbacks

5.2.1. Stability and Climate Potential

5.3. Equilibrium and transient response of the climate system feedback

5.3.1 Water vapour

5.3.2. Albedo

5.3.3. Clouds

5.3.4. Oceanic Processes and Feedbacks

5.3.5. Land-Surface Processes and Feedbacks

5.3.6. Ice-albedo feedback

5.3.7. ENSO feedback

5.3.8. Greenhouse gas feedback

5.3.9. Geochemical, biogeochemical and bio geophysical feedbacks

5.3. Representative Concentration Pathways (RCPs)

**6. Empirical Study of the Climate**

6.1.Source of climatic data

6.1.1.Climatic data from Instrumental Observation

6.1.2.Climatic data from proxies information

6.1.3.Principle sources of proxy data for palaeoclimatic analysis

6.2.Statistical Analysis of climatic elements from Instrumental Records

6.3.Palaeoclimate Reconstruction from Proxy Data

**7. Climate Modeling**

7.1. Major steps and processes in climate modeling

7.1.1. Radiative

7.1.2.Dynamics of Energy

7.1.3. Earth surface process

7.2.Simplifying the Climate System

7.3.Modeling the Climatic Response

7.4.Main categories of Climatic model

7.4.1.Energy balance models (EBMs)

7.4.2.One dimensional radiative-convective model (RCMs)

7.4.3.Two-dimensional statistical-dynamical models (SDMs)

7.4.4.Three-dimensional general circulation models (GCMs).

7.5.Weather forecasts Vs climate prediction model

7.5.1. Statistical climate prediction method

7.5.2. Dynamical climate prediction method

7.5.3. Statistical and dynamical combined climate prediction method

7.6. Statistical downscaling from global to regional or local

7.7. Dynamical downscaling from global to regional or local

7.8.How do models results vary from one another

7.9.Confidence in simulation and Validation of the climate Model

7.10. Verification of the climate model

7.11.Evaluating climate Model Uncertainty

**8. Evolution of Global Climate: Causes and Mechanisms**

8.1 Introduction

8.2. The climate science the Earth's formation

8.2.1 Precambrian climate

8.2.2 Phanerozoic climate

8.2.3 Cenozoic climate

8.3. The last million years: glacial interglacial cycles

8.3.1. Variations in orbital parameters and insolation

8.3.2. The orbital theory of paleoclimates

8.4.3. Glacial-interglacial variations in the atmospheric CO2concentration

8.5 The Holocene and the last 1000 years

8.5.1 The current interglacial

8.5.2. The last 1000 years

8.5.3. The last century

**9.Impacts of Future Climate Changes**

9.1. Emission scenarios

9.1.1 The purpose of the scenarios and scenario development

9.1.2 Special Report on Emission Scenarios (SRES)

9.1.3 Representative concentration pathways (RCPs)

9.2 Climate projections for the 21st century

9.2.1. Changes in global mean surface temperature

9.2.2 The spatial distribution of surface temperature and precipitation changes

9.2.3 Changes in the ocean and sea ice

9.2.4. Application of climate modeling for 21st century on Agricultural, water and health sectors

9.3. Impacts of climate change on Sea level rise, ice sheets melting and on low level country

9.3.2. Future climate change Risks and Impacts

9.3.3. Climate change adaptation mechanisms

**References**

* Andrews D.G., J.R. Holton and C.B. Leovy.Middle Atmosphere Dynamics.Academic Press, 1987.
* Gill, A.E. Introduction to Atmosphere-Ocean Dynamics.Academic Press, 1982.
* Grotjahn, R. Global Atmospheric Circulations. Oxford University Press, 1982.
* Haltiner, G.J. and R.T. Williams.Numerical Prediction and Dynamic Meteorology.John Wiley & Sons, 1989.
* Masaki, Satoh. Atmospheric Circulation Dynamics and General Circulation Models.Springer, 2004.
* James, I.N. Introduction to Circulating Atmospheres. Cambridge University Press, 1994.
* Lindzen, R.S. Dynamics in Atmospheric Physics. Cambridge University Press, 1990.
* Peixoto, J. and A.H. Oort.The Physics of Climate.American Institute of Physics, 1992.
* Salby, Murry L. Fundamentals of Atmospheric Physics.Academic Press, 1996.
* Wiin-Nielsen, A. and T.-C. Chen. Fundamentals of Atmospheric Energetics.Oxford University Press, 1993.

**Centre of Excellence for Climate Smart Agriculture and Biodiversity Conservation (ClimateSABC)**

**Master of Science**

**in**

**Biodiversity and Ecosystem Management**

**Table 3: Modules, courses with their order in the module,course type and credit hours**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Module code** | **Module Name** | **Course Name and order in the module** | **Course code** | **Type** | **Cr. Hr** | **ECTS** |
| M-1 | Biodiversity and Ecosystems | Theories, principles and practices of climate smart agriculture | CSAg-5111 | Core | 3 | 5 |
| Biodiversity Conservation and Management | BdEM5111 | Core | 2 | 3 |
| Ecosystem Services and Sustainable utilization | BdEM5121 | Core | 2 | 3 |
| Institutions, Policy, and Innovations for Biodiversity Conservation | BdEM5131 | Core | 2 | 3 |
| Range Ecology and Dryland Biodiversity | BdEM5141 | Elective | 2 | 3 |
| Agricultural Ecology | BdEM5151 | Elective | 2 | 3 |
| Agricultural and Environmental Microbiology | BdEM5161 | Elective | 2 | 3 |
| **Total** | | | | | **11/15** | **17/23** |
| M-2 | Genomics and bioinformatics in Genetic Resource Conservation | Genomicsand bioinformatics | BdEM5211 | Core | 3 | 5 |
| Livestock Characterization, Conservation and Management | BdEM5222 | Elective | 2 | 3 |
| Crop Characterization, Conservation and Management | BdEM5232 | Elective | 2 | 3 |
| **Total** | | | | | **5/7** | **8/11** |
| M-3 | Research Methods and Tools | Statistical Techniques and Data Analysis | BdEM5312 | Core | 3 | 5 |
| Research Methods in Climate Smart Agriculture | CSAg-5322 | Core | 2 | 3 |
| GIS and Remote Sensing for Climate Change | CSAg-5332 | Core | 3 | 5 |
| Bio-geographical and Ecosystem Modelling | BdEM5322 | Core | 2 | 3 |
| **Total** | | | | | **10** | **16** |
| M-4 | Seminar and MSc Thesis research | Seminar | BdEM5412 | Core | 1 | 2 |
| MSc Thesis research | BdEM6421 | Core | 6 | 10 |
| **Total** | | | | | **7** | **12** |

**Distribution of Modulesby Year and SemesterwithMode of Delivery**

**Year 1: Semester I**

**Table 4: First semester module and courses**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Module code | Module Name | **Course Name** | **Course code** | **Cr. Hr.** | **ECTS** | **No of weeks** | **Way of Delivery** |
| M-1 | Biodiversity and Ecosystems | Theories, principles and practices of climate smart agriculture | CSAg5111 | 3 | 5 | 4 | Block |
| Biodiversity Conservation and Management | BdEM5111 | 2 | 3 | 3 | Block |
| Ecosystem services and sustainable utilization | BdEM5131 | 2 | 3 | 3 | Block |
| Institutions, Policy, and Innovations for Biodiversity Conservation | BdEM5131 | 2 | 3 | 3 | Block |
| Range Ecology and Dryland Biodiversity (E) | BdEM5141 | 2 | 3 | - | Parallel |
| Agricultural Ecology(E) | BdEM5151 | 2 | 3 | - | Parallel |
| Agricultural and Environmental Microbiology (E) | BdEM5161 | 2 | 3 | - | Parallel |
| M-2 | Genomics and Bioinformatics inGenetic Resources Conservation | Genomics and Bioinformatics | BdEM5211 | 3 | 5 | - | Parallel |
| **Total** | | | | **14/18** | **22/28** |  |  |

E = Elective

**Year 1: Semester II**

**Table 5: Second semester module and courses**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Module code** | **Module Name** | **Course Name** | **Course code** | **Cr. Hr.** | **ECTS** | **No of weeks** | **Way of Delivery** |
| M-2 | Genomics and bioinformatics inGenetic Resources Conservation | Livestock Characterizatin, Conservation and Management (E) | BdEM5222 | 2 | 3 | **-** | Parallel |
| Crop Characterization, Conservation and Management (E) | BdEM5232 | 2 | 3 | **-** | Parallel |
| M-3 | Research Methods and Tools | Statistical Techniques and Data Analysis | BdEM5312 | 3 | 5 | 4 | Block |
| Research Methods in Climate Smart Agriculture | CSAg-5322 | 2 | 3 | 3 | Block |
| GIS and Remote Sensing for Climate Change | CSAg-5332 | 3 | 5 | - | Parallel |
| Bio-geographical and Ecosystem Modelling (E) | BdEM5322 | 2 | 3 | - | Parallel |
| M-4 | Seminar and MSc Thesis research | Seminar | BdEM5412 | 1 | 2 | - | Parallel |
| **Total** | | |  | **13/15** | **21/24** |  |  |

**Year 2 (Semester I and II)**

**Table 6. Second year module and courses**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Module code** | **Module Name** | **Course Name** | **Course code** | **Cr. Hr.** | **ECTS** | **Way of Delivery** |
| M-4 | Seminar and MSc Thesis research | MSc Thesis research | BdEM6421 | **6** | **10** | Semester I and II |

**9. COURSE SYLLABUS**

**Module One: Biodiversity and Ecosystems**

**1.Theories, Principles and Practices of Climate Smart Agriculture**

**Course Code: CSAg-5111**

**3 Credit Hours/5 ECTS**

**Pre-requisite: No**

**Course Description**

Agriculture in developing countries must undergo significant transformation if it is to meet the growing and interconnected challenges of food insecurity and climate change. A proposed means of achieving such improvements is increased use of a ‘climate-smart agriculture’ approaches through the courses like **Theories, Principles and Practices of Climate Smart Agriculture.** This course contains seven major sections: Introduction; Agriculture, Climate Change and Food Security; Background to CSA; Climate Change Adaptation, mitigation and disaster risk reduction; Perspectives of Climate Change and Energy; Capacity building and policy innovation; and future research on CSA. Thecourse will provide students with an insight into the theories, principles and practices of Climate Smart Agriculture. It will also deal with climate change during the past, present and in the future; major causes and effects of climate change; issues related to Greenhouse Gases and their emissions, Agriculture, Climate Change, Food Security. Climate change mitigation, adaptation and resilience, Farming Systems, Concepts and principles of Climate Smart Agriculture, Climate Smart Agricultural Technologies, Indigenous Knowledge for CSA, Policy perspectives to CSA, Climate Change Adaptation, Mitigation and Disaster Risk management, the concept of carbon sequestration; Carbon Trading and REDD+, Organizations working on Climate Change and Agriculture, energy perspectives of CSA, Capacity Building and Policy Innovation, issues of Clean Development Mechanism (CDM) and development of modalities and procedure of Future research on CSA.

The course is supported with practical activities on climate change impacts on crops and on soils; Sources and sinks of GHGs; Estimating GHG emissions; Carbon monitoring and sequestration; Analysis and interpretation of climate data; modeling climate impact on crops; Farming system field analysis; soil, plant and water analysis; Animal waste management practice; Field trip and case studies.

**General Objectives of the course:**

To impart theoretical and practical knowledge about then challenges of agriculture due to climate change and explore ways to enhance food security while contributing to adaptation and mitigation to climate change.

**Specific Objectives of the course:**

After successful completion of the course, the students will be able to:

* discuss about the theories, principles and practices of climate smart agriculture:
* identify the major causes of climate change and its effects on agriculture;
* assess issues related to climate change mitigation, adaptation and resilience;
* explain the concept of food security, sustainable agriculture, conservation agriculture, Farming systems;
* explain the concepts and components of CSA;
* discuss the synergies and Tradeoff s between CSA objectives;
* assess Indigenous Knowledge and technologies related to Climate Smart Agriculture;
* assess the policy perspectives of Climate Smart Agriculture;
* discuss on the energy perspectives of climate change and CSA;
* discuss about Carbon sequestration, Carbon Trading, REDD+, Clean Development Mechanism (CDM);
* Identify the major definitions and concepts of climate change, mitigation and adaptation;
* Identify the major barriers to adopt Climate Smart Agricultural Practices;
* Analyze national and global policies related to CSA and disaster risk management;
* Identify the major renewable energy sources in line with CSA;
* To assess the capacity building and policy innovations, national and international initiatives for Climate Smart Agriculture;
* Identify and analyze the different adaptations and mitigation options for monitoring CSA
* assess Greenhouse Gas emissions and prioritizing coping mechanisms for climate change;
* climate change adaptation: adaptation and technological needs; adaptation and coping mechanisms; national and local
* Discuss the models and procedures of climate change impacts on Crops.

**Course contents**

1. **Introduction**
   1. Climate: Past, present and future
   2. Causes and Evidences of Climate Change
   3. Major Green House Gases and their Emissions
   4. Climate Change Scenarios in Africa and Global context
2. **Agriculture, Climate Change and Food Security**
   1. Food Security
   2. Sustainable Agriculture and Food Security
   3. Climate Change; Impacts, Vulnerability and Resilience in Agriculture
   4. Climate Change, Development and Farming systems in Africa
   5. Impacts of Climate variability and change on Soil Health, Environment, and Plant -Water interactions
   6. Agricultural Impacts on Climate change
3. **Background to Climate-Smart Agriculture**

3.1 Concept and Principles of Climate-Smart Agriculture (CSA)

* 1. Components of CSA and their Assessment
  2. Synergies and Tradeoffs between CSA Objectives
  3. Climate-Smart Agriculture for future food production, Food Security and Resilience
  4. Approaches and practices of CSA
  5. Climate-Smart Agriculture Technologies
  6. Integrated farming system and Conservation Agriculture for Climate Resilience
  7. Indigenous knowledge for CSA
  8. Gender, Climate-Smart Agriculture and Climate change
  9. Development of Climate- Resilient Green Economy strategies in Ethiopia and other African countries
  10. Integrated National Policy Approaches, Strategies and Institutions related CSA

3.12 Barriers to Adoption of Climate Smart Agriculture practices

1. **Climate Change Adaptation, Mitigation, and Disaster Risk Reduction**

4.1 Mitigating greenhouse gas emissions from Agriculture

4.2 Building Adaptation and Resilience to Climate Change in Agriculture

4.3 Climate-smart agriculture: integrating adaptation and mitigation

4.4 Impacts and Response of Agriculture to Climate Change

4.5 Managing Climate Risks with development of CSA

4.6 Community-Based approaches for CSA

4.7 Over view of Climate-smart management of livestock, forestry, agro-forestry,

Fisheries and aquaculture

4.8 Clean Development Mechanism, Carbon Trading, Carbon Sequestration and REDD+

4.9 Organizations working on Climate Change and Agriculture

**5.Perspectives of Climate Change and Energy**

5.1 Management of Energy for CSA

5.2 Opportunities for synergies between CSA, REDD+ and Energy

5.3 Energy Efficiency and Renewable Energy

* 1. Moving forward-possible Energy Solutions for CSA

1. **Capacity Building and Policy Innovation in Ethiopia and other African Countries**

6.1 Capacity Development for CSA

6.2 Assessment, monitoring and Evaluation for CSA

6.3 National and International Initiatives on CSA

6.4 Mainstreaming CSA into National Policies and Programmes

**7. Future Research on Climate-Smart Agriculture**

7.1 Improving Access to Knowledge and Monitoring of CSA

7.2 Prioritizing the Climate Change Adaptation and Mitigation Options

7.3 Quantifying Greenhouse Gas Emission from Crops and cropping systems

7.4 Modeling Climate Change Impacts on Crops

**Mode of Delivery:** Lecture, assignments, practical field trips, term papers, presentation, climate change video and case study.

**Methods of Assessment**

The assessment will be made mainly through Assignments and Examination.Students are also expected to review articles and present.

* Assignments (15%)
* Review articles on cases of Theories and Principles of Climate Smart Agriculture and presenation (15%)
* Reports on field visit and practical activities (20%)
* Final examination (50%)

**References:**

* IPCC (2014) Climate Change 2014. Fifth Assessment Synthesis Report of Inter-Governmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, USA.
* Pathak H and Chakrabarti B (2015) Climate Change and Agriculture. Technologies for Enhancing Resilience. Indian Agricultural Research Institute, New Delhi, pp. xvi + 237. ISBN No. 978-93-83168-22-4.
* FAO, 2013. Climate-Smart Agriculture Source Book. The Food and Agriculture Organizationof the United Nations. http://www.fao.org/docrep/018/i3325e/i3325e.pdf.
* WMO, (2013). A summary of current Climate Change findings and figures. ClimateChangeInfoSheet2013-03final.pdf. Accessed 15th June, 2015
* Adams, R.M, Hurd, B.H, Lenhart, S and Leary, N. 1998. Effects of global Climate change on Agriculture: An Interpretative Review. Climate Research. Clim Res. Vol. 11: 19–30.
* FAO. 2008. Climate Change and Food Security- A Framework Document. http://www.fao.org/forestry/15538-079b31d45081fe9c3dbc6ff34de4807e4.pdf.
* Scherr , S. J , Shames, S and Friedman, R. 2012. From climate-smart agriculture to climate- smart landscapes. Agriculture & Food Security 2012, 1:12, Agriculture and Food

Security. http://www.agricultureandfoodsecurity.com/content/1/1/12.

* Fellmann, T. 2012. The assessment of Climate Change-related vulnerability in the

agricultural sector: reviewing conceptual frameworks. FAO/OECD Workshop. Building

Resilience for Adaptation to Climate change in the Agriculture sector.

* FAO, 2010a. Climate change implications for food security and natural resources management in Africa. Background paper prepared for the Twenty-sixth Regional Conference for Africa. Luanda, Angola.
* FAO. 2012. Identifying opportunities for climate-smart agriculture investments in Africa.

http://www.fao.org/docrep/015/an112e/an112e00.pdf

* FAO 2014a. Climate-Smart Agriculture: What is it? Why is it needed? http://www.fao.org/3/a-i4226e.pdf
* FAO. 2014b. FAO Success stories on climate smart agriculture. Food and Agriculture

Organization of the United Nations. http://www.fao.org/3/a-i3817e.pdf.

* Intergovernmental Panel on Climate Change. 2014. Climate Change 2014: Impacts,

Adaptation and Vulnerability. IPCCWGIIAR5 Technical Summary.

* Henderson-Sellers, A. & K. McGuffie (2012). The future of the world’s climate.

Other relevant IPCC reports available at [www.ipcc.ch](http://www.ipcc.ch)

* Admassu H, Getinet M, Thomas TS, Waithaka M, Kyotalimye M. 2012. East African

Agriculture and Climate Change: A Comprehensive Analysis – Ethiopia. Washington,

DC: International Food Policy Research Institute.

* FAO. 2010. Climate-smart agriculture: policies, practices and financing for food security,

adaptation, and mitigation. Rome.

* FAO. 2013. Community for Climate Change Mitigation in Agriculture. Mitigation of climate change in agriculture (MICCA) programme.
* McCarthy, N., Lipper, L. & Branca, G. 2011. Climate-smart agriculture: smallholder

adoption and implications for climate change adaptation and mitigation. FAO, MICCA

Series No. 4. Rome, FAO.

* FAO, 2010 .Climate-Smart” Agriculture Policies, Practices and Financing for Food Security, Adaptation and Mitigation
* World Bank 2010. The Hague Conference on Agriculture, Food Security and Climate

Change: Opportunities and Challenges for a Converging Agenda: Country Examples.

Washington, DC: World Bank.

**2. Biodiversity Conservation and Management**

**Course code: BdEM5011**

**2 Cr. Hrs/ ECTS 3**

**Prerequisite course(s): No**

**Course Description:**

Basic concepts of biodiversity, characterization of biodiversity at genetic, species and ecosystem level, importance/values/benefits of biodiversity, threats and loss of biodiversity and its impact; the climate system and greenhouse effect vs. biodiversity; climate changes and its impacts on ecosystems and species distributions; biodiversity conservation tools and techniques (such as in-situ and ex-situ); qualitative and quantitative biodiversity resource assessment techniques, management plan for biodiversity conservation, the role of local people in biodiversity conservation (local/indigenous knowledge and its importance in biodiversity conservation), conservation incentives and incentive provision approaches; hotspots and mega-diverse countries, bioprospecting, biopirecy, and benefit sharing. Ethiopia centre of origin for some major crops. National and global conventions, policies and institutional aspect in biodiversity conservation and ecosystem management.The course is supported with field practical activities on qualitative and quantitative measurement of biodiversity.In addition, software programs in biodiversity informatics, national, regional and global biodiversity information databases and sources of thematic biodiversity information should be covered.

**Course Objectives:**

After completing this course, students will be able to:

* Explain the key concepts and definition of biodiversity.
* Characterize the biodiversity at any level in a systematic approach.
* Describe the major threats and challenges faced on the biodiversity.
* Understand the impacts of climate change on the biodiversity and develop knowledge on mitigation and adaptation strategies.
* Develop skill on the quantitative and qualitative measurement of biodiversity and carbon stock analysis of the various carbon pools.
* Develop knowledge on various techniques of management plan and conservation tools.
* Describe the global and national conventions, policies, and institutions of biodiversity conservation.

**Expected Competencies:**

* Characterization of the biodiversity of a given ecosystem
* Analyze the effect of climate change onecosystems and species distributions
* Measurement of biodiversity, set priority conservation actions and advise biodiversity conservation strategies and mechanisms
* Manage and conserve biodiversity of a given ecosystem
* Teamwork in biodiversity conservation and management.
* Skills to collect, organize, analyze, and communicate biodiversity data.
* Use basic technologies, databases, and software of thematic biodiversity informatics

**Course Contents**

**1. Basics of Biodiversity**

1.1. Concepts and definitions of biodiversity

1.2. Characterization of biodiversity at genetic, species, ecosystem and cultural levels

1.3. Spatial and Temporal Patterns of Biodiversity

1.4. Structural and functional biodiversity

1.5. Importance/values/benefits of biodiversity

**2. Climate change and challenges on biodiversity**

2.1. The greenhouse gases effect vs. biodiversity

2.2. Climate changes and its impacts on ecosystems and species distributions

2.3.Threats and loss of biodiversity and its impact

**3. Biodiversity measurement and conservation methods**

3.1. Qualitative and quantitative biodiversity assessment/measurement methods

3.2. Conservation priorities

* hotspots and mega-diverse countries

3.3. Biodiversity conservation tools and techniques

* in-situ and ex-situ conservations

3.4. Management plan for biodiversity conservation

**4. Biodiversity and society**

4.1. The role of local community in biodiversity conservation

4.2. Indigenous communities and biodiversity

4.3. Indigenous knowledge in the use and conservation of biodiversity

4.4. Gender and biodiversity

4.5. Bioprospecting, bio-piracy, and benefit sharing

4.6. Conservation incentives and incentive provision approaches

**5. Overview of African biodiversity**

5.1.An overview of African biodiversity (Flora, fauna, microorganisms, and endemism)

5.2. Biodiversity hotspots and Mega-diverse countries in Africa

5.3. Overview of Ethiopian biodiversity

5.4. Ethiopia centre of origin for some major crops and wild relatives

5.5. Major biodiversity conservation challenges and opportunities

**6. Conventions, policies and institutions for biodiversity conservation**

6.1. Conventions/protocols and policy instruments

6.2. Institutional arrangements

6.3. Regional and international cooperation to manage genetic resources

**Method of Delivery**: Lecture, assignments, term papers/independent studies, presentation, field works on quantitative measurement of biodiversity andwork on Sourcesof Biodiversity information (Local to global databases,Global, regional and thematic information centres and databases and On-line sources of information).

**Assessment Methods:**

Group and individual assignments and presentations, field work reports, mid and final examinations.

**References:**

1. Richard B. Primack, 2006. Essential of Conservation Biology. 4th edition. Sinauer Associates, Inc., USA. (Haramaya University Library: QH bstr. 57).

2. Van Dyke, F. 2008.Conservation Biology Foundations: Concepts and Applications 2nd Edition, Springer.

3. Melina F. Laverty; Eleanor J. Sterling; Amelia Chiles; Georgina Cullman. 2008. [Biodiversity 101](https://www.questia.com/library/120085966/biodiversity-101). Greenwood Press,

4. Hube, Bernhard, Sinclair, Bradley J., Lampe, Karl-Heinz. 2005. African Biodiversity:Molecules, Organisms, Ecosystems. Springer.

**5. Monson**, Russell K. (Ed.). 2014. Ecology and the Environment. Springer.

**3. Ecosystem services and sustainable utilization**

**Course Code: BdEM5112**

**Credit Hour/ECTS: 2 cr. hrs (3 ECTS)**

**Prerequisite course: No**

**Course Description**

The course will focus on integrated management of land, water and living resources and place human needs at the centre of ecosystemservices and the sustainable use of ecosystems.The course links theories, principles and practices in the science of ecosystems. It begins within the fundamentals of ecology that leads to the concept of ecosystems, and sub-divisions of ecosystems including agro-ecosystems.Highlight on thestructural aspects of ecosystem like,biotic and abiotic components, and detail on the functional processes of ecosystems like, energy and organic matter flow, hydrologic and biogeochemical cycles; trophic levels, ecological pyramids; and ecosystem stability and resilience are all covered. The factors that influence ecosystem structure and function,mechanisms by which climate affects ecosystems, projections of future climate change and potential impacts on ecosystem services. The course also deals with ecosystem restoration, and principles and methods to repair ecosystems that have been degraded, damaged, or destroyed as well as technologies and models for ecosystem restoration.It deals with the major categories of ecosystem services (like, provisioning services; regulating services; supporting services and cultural services). Methods used to value ecosystem services(including economic valuation); the natural and human drivers of change in the provision of ecosystem services; and challenges exist in defining, measuring, valuing, and protecting ecosystem services. Lesson, best practices and case studies in sustainable ecosystem management practices.

**Course Objective**

After completing this course, students will be able to:

* To understand the physical, chemical, and biological factors controlling the dynamics of aquatic and terrestrial ecosystems.
* Explain how ecosystem structures, functions, and processes are controlled by factors such as climate, parent material, topography and potential biota, and how human management and activities, including climate change, affect them.
* Learn the practical elements of restoration planning, implementation, monitoring and adaptive management.
* Gain an understanding of the linkages between natural and human systems and how these affect the production of ecosystem services and its sustainable uses.
* Obtain a skill on the processes of identifying, measuring, valuing, and protecting ecosystem services to enhance sustainable uses.
* Describe the global and national policy instruments that could be organized to facilitate valuation of ecosystem services including payment for ecosystem services as a tool in the mitigation and adaptation for climate change at all levels.

**Course Competencies**

Upon completion of this course, students will be able to develop the following competencies:

* Describe key concepts related to ecosystems structure and functions at all levels of complexities.
* Analyze the impacts of conservation and management of the ecosystems structure and functions.
* Develop systematic and critical thinking skills and management approaches towards an integrated ecosystem conservation and sustainable uses.
* Communicate clearly and effectively about ecosystems, values ecosystem services and its sustainable uses through writing and oral presentations.
* Develop skills in identifying research questions related to ecosystems and ecosystem services.
* Collaborate effectively in multidisciplinary and multicultural groups within a group project and be able to work alone or in a team on problems of ecosystems.
* Critically read, understand and apply scientific literature on quantitative and qualitative impacts of natural and human-induced environmental changes on ecosystems.

**Course Content**

**1. Introduction to Ecosystems**

1.1. Fundamentals of ecology

1.2. The Ecosystem Concept

1.3. Types of Ecosystems

**2. Ecosystem processes**

2.1. Components of Ecological Systems

2.2. Ecological Productivity and Energetics

2.3. Trophic chains and webs, ecological pyramids, and Energy Flow

2.4. Biogeochemistry and climate change

2.4.1. Nutrient Cycling in Ecosystem vs. climate change

2.4.2. Carbon inputs and budgets in Ecosystems

2.4.3. Carbon sequestration vs. climate change

**3. Ecosystem dynamics and restoration**

3.1. Ecosystem dynamics and drivers

3.2. Concepts of ecosystem restoration

3.3. Restoration planning

3.3.1 Prioritizing sites for restoration

3.3.2 Project design and management

3.3.3 Regulations and policy

3.3.4 Aesthetics and design

3.3.5 Use of volunteers in restoration

3.3.6 Project monitoring and evaluation

3.4. Procedures in restoration practice:

3.4.1. Assessment of the ecosystem/habitat problem

3.4.2. Statement of restoration goals/targets

3.4.3. Restoration plan

3.4.4.Monitoring plan

**4. Ecosystem Services**

4.1. The history and rise of the ecosystem services concept

4.2. Ecosystem services

4.2.1.Provisioning services

4.2.2. Regulating services

4.2.3. Supporting services

4.2.4. Aesthetic and cultural services

4.3. Integrated Ecosystem management

**5. Valuation of Ecosystem Services**

5.1. Accounting and valuation of ecosystem services

5.2. Prices, Value and Importance

5.3. Methods for Valuation of Ecosystem Services: Non-monetary techniques

**6. Ecosystem service indicators and resilience**

5.1. Ecosystem service indicators development framework

5.2. Ecosystem resilience

5.3. Ecosystem Stability and Sustainability

**7. Programs for ecosystem services and their evaluation**

7.2. The Millennium Ecosystem Assessment framework

7.2. Software Programs for ecosystem services and their evaluation

**Mode of Delivery/Learning strategies**

* Lecture
* Theoretical and practical exercises
* Independent study and team work.
* Practical fieldworkpeer presentation

For example, Practical exercise on a systematic analysis/investigation on the nearby terrestrial and aquatic ecosystem in a synergistic approach from the four perspectives of ecosystem services. The analysis/investigation report must include integration of natural science (e.g., ecology, hydrology, nutrient cycle, or climatology) and social science approaches (e.g., economics, sociology, anthropology, policy or political perspectives). Existing natural and anthropogenic challenges encountered and mitigation opportunities and options for ecosystem stability and sustainability.

**Assessment Methods**

Assignments, individual and teamwork and reporting, field work reports, quiz, and final exam.

**Course materials**

1. Textbook “[Ecosystem Services: From Concept to Practice](http://www.cambridge.org/us/academic/subjects/life-sciences/natural-resource-management-agriculture-horticulture-and/ecosystem-services-concept-practice)”published by Cambridge University Press (2015). ISBN: 9781107062887.

2. Chapin, F.S. III, P.A. Matson, P.M.Vitousek. 2011. Principles of Terrestrial Ecosystem Ecology. Springer-Verlag, NY.

3. National Research Council (NRC). 2005. Valuing Ecosystem Services: Toward Better Environmental Decision-Making. National Academies Press (Washington, DC).

4. [Jacobs](http://store.elsevier.com/authorDetails.jsp?authorId=ELS_1152221)   &   [Dendoncker](http://store.elsevier.com/authorDetails.jsp?authorId=ELS_1152222)   &   [Keune](http://store.elsevier.com/authorDetails.jsp?authorId=ELS_1152223)   2013. Ecosystem Services, 1st Edition. *Ecosystem Services: Global Issues, Local Practices****.***Elsevier. Print Book ISBN :9780124199644

5. K.N. Ninan 2014. Valuing Ecosystem Services: Methodological Issues and Case Studies. ISBN: 978 178195 515 4.

6. Constanza, Robert et al. (1997). The value of the world’s ecosystem services and natural capital. Nature, Vol. 386, May 15th, pp. 253-260.

**Further reference materials**

1. MEA, The Millennium Ecosystem Assessment, Ecosystems and human well‐being: Synthesis.2005, World Resources Institute: Washington D.C. p. 86.

2. Kareiva, P., et al., eds. Natural Capital: Theory & Practice of Mapping Ecosystem Services. 2011, Oxford University Press.

3. Kareiva, P., *et al*., eds. Natural Capital: Theory & Practice of Mapping Ecosystem Services. 2011, Oxford University Press.

4.Howell, E.A., J.A. Harrington, and S.B. Glass,Introduction to restoration ecology.2012,Washington, DC: Island Press. xv, 418 p.

5. J. Ranganathan. 2008. Ecosystem Services: A Guide for Decision Makers. WRI.

6. Hunter, Malcom L., Jr. (Ed.) 1999. Maintaining Biodiversity in Forest Ecosystems. Cambridge University Press. Cambridge, UK. 698 p.\

**4. Institutions, Policy, and Innovations for Biodiversity and Ecosystem Management**

**Course Code: BdEM5113**

**Credit hour/ECTS: 2/3**

**Course Description:**

The course starts with introducing the basic concepts of institutions, policy and innovations and general issues related to policy, institutions and innovation in biodiversity and ecosystem management. It includes biodiversity and ecosystem management policies, benefit sharing and property rights, financing mechanisms, resource ownership and resource-based conflicts, policy-making processes, policy analysis frameworks, institutions and development, institutional change and innovations. The need for institutional and policy support to mainstream biodiversity and ecosystem management into national policies and program will also be discussed. Technological innovations and barriers to adoption of biodiversity and ecosystem management innovations will be part of the course. Moreover, gender in biodiversity and ecosystem management is included.

**Learning Objectives**

At the end of the course, the students will be able to

* Define concepts of policies, institutions and innovations.
* Explain policies and institutions in biodiversity and ecosystem management
* Discuss the technological innovations of biodiversity and ecosystem management
* Explain the factors influencing to adopt/not to adopt biodiversity and ecosystem management technological innovations
* Explain the major institutions/institutional structures and institutional supports in biodiversity and ecosystem management
* Discuss ways of financing and investments for biodiversity and ecosystem management
* Explain the importance of mainstreaming biodiversity and ecosystem management into national policies and programs
* Discuss climate change biodiversity and ecosystem management policies, in relation to gender, benefit sharing, resource ownership, property right

**Course Content**

**1. Introduction**

1.1 Institutions in Biodiversity and ecosystem management

1.2.1. The concept of institutions

1.2.2. Institutions and development

1.2.3. Institutional change

1.2. Policies in Biodiversity and ecosystem management

1.1.1. Biodiversity and ecosystem management policies

1.1.2 The process of policy-making

1.1.3. Policy analysis framework

1.3. Innovations

1.3.1. Evolution of innovation thinking

1.3.2. Guiding principles for innovation processes

**2. Institutions**

2.1. Institutions: information production and dissemination

2.2. Climate, biodiversity and ecosystems data and information gaps

2.3. Dissemination mechanisms

2.4. Institutions to improve access, coordination and collective action

2.5. Institutions to support financing for ecosystem services

2.6. Resource ownership and management

2.6.1. State/public ownership and management

2.6.2. Community based ownership and management

2.6.3. Private ownership and management

2.7. Frameworks for institutional analysis

2.7.1 Institutional analysis and development framework

2.7.1 Institutions of sustainability framework

**3. Laws and Policies of Biodiversity and Ecosystem Services**

3.1. Enabling policy environment

3.1.1. Global and National laws and policies

3.1.2 Biodiversity and Ecosystem managementpolicy-making

3.1.3 Coordinated international policies

3.2. Stakeholder involvement in ecosystem service decision-making

3.3. Benefit sharing and Property rights

3.3.1 Concept of Benefit sharing and property rights

3.3.2 Property rights regimes

3.5.3 Forces of change in Benefit sharing and property rights

3.5.4 Property rights and legal pluralism

**4. Technological Innovations for Biodiversity and Ecosystem management**

4.1. Concepts of Technological innovations

4.2. Adoption and diffusion of technological innovations

4.3. Barriers to adoption of Biodiversity and Ecosystem managementpractices

4.3.1 Human behavioral and cultural context

4.3.2. Physical or hardware barriers to adoption of Technological Innovations

4.3.3. Non-physical or software barriers to adoption of Technological Innovations

4.4. Strategies and actions to enhance adoption of Technological Innovations

5. **Mainstreaming Biodiversity and Ecosystem management into Policies and Program**

5.1. Biodiversity and Ecosystemswithin larger economic and policy frameworks

5.1.1. Identification of supporting policies and programs

5.1.2. Providing an enabling legal and policy environment

5.2. Improving access to knowledge and monitoring: the role of implementing actors

5.3.1. Role of local institutions and participatory approaches

5.3.2. Policies to mobilize non-state actors

5.3.3. Monitoring and assessment framework

5.3. Gender in Biodiversity and Ecosystem management

**Teaching Methods/ Mode of Delivery**

• Lecture, discussion, article review, seminar presentation

**Methods of Assessment**

The assessment will be made mainly through assignments (individual and group) and exam. Students are also expected to review articles and present.

30%- group assignment and presentation

20%- individual assignment and presentation

20%- paper/article review

30%- final exam

**References**

Agrawal, A. (2007). Forests, Governance, and Sustainability: Common Property Theory and its Contributions. *International Journal of the Commons* 1 (1), 111-136.

Robin C. and Stephen D. (2004) Institutional Change for Sustainable Development Centre for Resource and Environmental Studies, The Australian National University, Canberra, Australia Edward Elgar Publishing

Pyburn, R. and J. Woodhill (eds.) 2014. Dynamics of Rural Innovation – A primer for emerging professionals.LM Publishers, Arnhem

Bolton, G. E., and Ockenfels, A. (2000). A theory of equity, reciprocity, and competition.

Demsetz, H. (1967). Towards a theory of property rights. *The American Economic Review*57 (2), 347 – 359.

Joireman, S.F. (2001). Property rights and the role of the state: evidence from the Horn of Africa. *Journal of Development Studies* 38 (1), 1 – 28.

Longlake Experience of Property Rights Transformation. *Politics and Society* 29 (3), 415- 445.

McCann, L., Colby, B., Easter, K.W., Kasterine, A. and Kuperan, K.V. (2005). Transaction cost measurement for evaluating environmental policies. *Ecological Economics* 52, 527 – 542.

Meinzen-Dick, S. R. and Pradhan, R. (2002). Legal Pluralism and Dynamics of Property rights. CAPRi Working Paper no. 22.

North,D. C. (1991). Institutions. *The Journal of Economic Perspectives*, 5 (1),

Ostrom, E. (1999). Institutional Rational Choice: An Assessment of the Institutional Analysis and Development Framework. In: Sabatier, P.A. (ed.). *Theories of the Policy Process*. Boulder and Hill: Westview Press, 35 – 71.

Paavola, J. (2007). Institutions and environmental governance: A reconceptualization. *Ecological Economics* 63, 93 – 103.

Poteete, A. R. and E. Ostrom, E. (2004). Heterogeneity, Group Size and Collective Action: The Role of Institutions in Forest Management. *Development and Change* 35(3), 435–461. pp. 97-112.

Baland, J.M. P Bardhan and S. Bowles (eds.) (2002). Inequality, Cooperation and Environmental Sustainability. Princeton University Press

Bossetti, V., Carraro, C. Massetti, E. and Tavoni, M. (2014). Climate Change Mitigation,Technological Innovation and Adaptation: A New Perspective on Climate Policy. Edward Elgar Publishing. Cheltenham, UK.

Dasgupta, P. and Serageldin, I. (Eds.). (1999). Social Capital: A Multifaceted Perspective. World Bank

Juul, K. and Lund, C. (eds.) (2002). Negotiating Property in Africa. Portsmouth, NH: Heinemann

Laffont, J. and D. Martimort (2002). The theory of incentives: principal-agent model.New Jersey. Princeton University Press.

Loehman, E. T. and D. M. Kilgour (eds.) (1998). Designing Institutions for Environmental and Resource Management. Edward Elgar Publishing.

Rydin, Yvonne and Falleth, Eva (2006). Networks and Institutions in Natural Resource Management. Edward Elgar Publishing.

1. **Range Ecology and Dryland Biodiversity (Elective)**

**Course code: BdEM5014**

**Credit hours/ECTS: 2 Cr. Hrs (1+1)/3 ECTS**

**Prerequisite course(s)**

There is no prerequisite course

**Course Description:**

The course provides students basic knowledge about rangeland concepts and principles; range community composition; community pattern in space and in time-succession; gradient analysis; primary and secondary productivity. Specifically it deals with rangeland management theories (equilibrium versus disequilibrium), models and paradigms such as the concept of rangeland success theory; range condition and trend analyses; plant – animal – and soil interaction, nutrient cycling in rangelands;range improvement practices including weed and bush encroachment control, range re-seeding, fertilization, and grazing systems. It also deals with basic concepts on dryland ecosystems and the uniqueness of dryland biodiversity, special adaptation of dryland biota, importance of rangelands and dryland biodiversity to global conservation initiatives and livelihood support, the current status of African rangelands and dryland biodiversity in relation to climate change, drivers of rangelands and dryland biodiversity dynamics and ecosystem loss, managing and conserving dryland biodiversity (the role of protected areas and community conserved Areas). Strategies for dryland biodiversity conservation.

**Practical: Plant, Soil and Water Analysis (1 Cr. Hr.)**

Students will be actively involved, through hands-on participation, in all aspects of field and laboratory activities. Field and laboratory activities consisting of: (i) sample collection, storage, and preparation for laboratory analysis. (ii) Determination of plant chemical composition (DM, CP, ether extract, fiber fraction, macro and micro nutrients) and in-vitro digestibility. (iii) Analyzing the physical (texture, particle size and bulk densities, porosity, field capacity, permanent wilting point, and available water holding capacity); chemical (soil pH, electrical conductivity, organic matter content, total nitrogen, cation exchange capacity, and micronutrients) and biological properties soil samples. The practical also includes analyses of water for various macro – and micronutrients.

**Specific Objectives**

After completing the course, students will be able to:

* Explain basic concepts, theories and principles of rangeland ecology.
* Analyze range condition and trend
* Diagnose drivers and mechanisms of rangeland and dryland biodiversity dynamics.
* Understand the uniqueness of dryland biodiversity and explain its importance to global conservation.
* Understand the ecological/biological relationships which exist between wildlife, grazing animals, and rangeland plant species.
* Acquire a working knowledge of rangeland and dryland dynamics and will be able to describe the changes taking place in rangeland using indicator species.
* Evaluate forage resources for estimating carrying capacity.
* Acquaint themselves with rangeland management theories.
* Apply different rangeland improvement practices to prevent rangeland degradation and dryland biodiversity loss.
* Prepare, collect and store samples (plant, soil and water )
* Determine plant chemical composition, soil properties and nutrients in water and interpret the results.

**Expected Competence:**

* Explain the status of rangeland condition and dryland biodiversity.
* Identify the causes/drivers and mechanisms of rangeland degradation, vegetation dynamics and dryland biodiversity loss.
* Advise the proper and suitable intervention mechanisms to restore rangeland degradation.
* Manage and conserve rangeland resources sustainably.
* Analyze plant, soil and water samples in a laboratory.
* Conduct   research on a major question surrounding rangeland ecology and dryland biodiversity
* Teamwork in rangeland management and dryland biodiversity conservation

**Course Content:**

**Chapter 1:Introduction**

1.1. Concepts,importance,and servicesof rangelands.

1.2. Historical, ecological, economic, social, and political context of rangeland management.

1.3. Rangelands challenges in a changing climate.

**Chapter 2:Range plant physiology and ecology**

2.1. Identification of range grasses, forbs and shrubs

2.2. Physiological process of range plants

* Photosynthesis
* Response to grazing/defoliation

**Chapter 3:Rangeland management theories/principles**

3.1. The ecological debate equilibrium versus disequilibrium paradigms

3.2. Rangeland evaluation procedures

* The range condition model
* State and transition models

**Chapter 4:Range inventory, monitoring and evaluation**

4.1. General principles of Rangeland inventory and monitoring:

* Sampling techniques,
* Measuring vegetation attributes (biomass, cover and density)

4.2. Rangeland evaluation

* Range site
* Range condition
* Range trend

**Chapter 5:Rangeland improvement**

5.1. Grazing management

5.2. Weed and brush control

* Types of fire,
* Use of prescribed burning in Range Improvement,
* Impact of fire on soils, vegetation and animals

5.3. Range Seeding/Re-vegetation

* Principles of Range seeding,
* Plants for Range seeding,
* Methods of Range seeding

5.4. Fertilization

**Chapter 6:Dryland biodiversity**

6.1. Importance of dryland biodiversity to global conservation

6.2. The uniqueness of dryland biodiversity

6.3. The status of dryland biodiversity

**Chapter 7: Drivers of dryland biodiversity and ecosystem loss**

**Chapter 8: Managing and conserving dryland biodiversity**

8.1. The role of protected areas and community conserved areas

8.2. Strategies for dryland biodiversity conservation.

**Practical Session Programs:**

**Week 1-2:** Sample collection, storage, and preparation for laboratory analysis

**Week 3-6:** Determination of plant chemical composition

**Week 7-9:** Analyzing the physical, chemical and biological

**Week 10-13:** Water analysis for various macro – and micro nutrients.

**Method of Delivery**: A variety of learning methods such as: lecture, assignments, term papers, presentation and case studies will be used.

**Assessment Methods:**

**Theory:**

* Examinations --------------------------------- 45%
* Assignments --------------------------------- 15%
* Paper presentation --------------------------- 15%

**Practical: ------------------------------------------------------** 25%

**Text books/References:**

1. Davies, J., Poulsen, L., Schulte-Herbrüggen, B., Mackinnon, K., Crawhall, N., Henwood,

2. W.D., Dudley, N., Smith, J. and Gudka, M. 2012. Conserving Dryland Biodiversity. xii +84p

3. Holechek, J. L. P., Herbel, R. D., Holechek, C. H. J. L., Pieper, R. D., & Herbel, C. H. 2001. *Range management: principles and practices* (No. 636.0845 H6R3 2001).

1. **Agricultural Ecology(Elective)**

**Course Code:BdEM5015**

**Credit Hrs. 2 Cr hrs/3ECTS**

**Prerequisite course:**

**Course Objectives:**

At the completion of this course students will be able to:

1. Examine how general ecological principles apply to agricultural systems.

2. Understand how crops interact with biotic and abiotic factors in the environment.

3. Explore the interactions between agriculture and natural ecosystems.

4. Discuss practices of conventional agriculture that impact natural resources and present

barriers to sustainability.

5. Learn about practices, technology, and research that represent possibilities for long-term sustainability in agriculture.

**Course Description:**

An introduction to the theory of agricultural ecology (agroecology) and the current practices of sustainable agriculture. Application of ecological principles to modern farming systems to achieve goals of long-term food production without depleting Earth’s resources. Explore on-farm and off-farm ecological implications of agricultural and livestock practices for crop biodiversity, agroforestry, soil fertility, and pasture. Agricultural ecology deals with the application of ecological principles in agroecosystems such as enhance recycling of biomass and optimizing nutrient availability and balancing nutrient flow, securing favorable soil conditions for plant growth, particularly by managing organic matter and enhancing soil biotic activity, minimizing losses due to flows of solar radiation, air and water by way of microclimate management, water harvesting and soil management through increased soil cover, species and genetic diversification of the agroecosystem in time and space, and enhance beneficial biological interactions and synergisms among agrobiodiversity components thus resulting in the promotion of key ecological processes and services, addresses many of the shortcomings of conventional agriculture.

**Course Content**

**1. Introduction**

1.1. Agroecology as the application of ecological concepts and principles to farming systems

1.2. The Agroecosystem Concept and Sustainability

1.3. Properties and Components of Agroecosystem

1.4. Scope of the Discipline

**2. Resource capture and utilization in Agroecosystems'**

2.1. The Plant Resources

2.2. The Impacts of CO2, Radiation and Temperature in Defining Potential Crop Production.

2.3. Crop Production Limiting Factors: Water and Nutrients.

2.4. Agroecosystem Determinants contributing to Reduced Crop Production

**4. Species interactions in crop communities**

4.1. Categories of Species Interactions

4.2. Interaspecific Interactions

4.3. Interaction in Mixtures of Species

**5. Ecosystem functioning of farming systems**

5.1. Energy and Material flows, Trophic Relations

5.2. Input and Output, Subsidies

5.3. Domestication, Selection and Protection of Crop Plants and Farm Animals

**6. Nutrient Cycling in Agroecosystems**

6.1. Decomposition, Organic Matter Turn Over and Nutrient Dynamics in Agroecosystem

6.2. Organic Farming and Fertilizer use

6.3. Carbon sequestration in Agroecosystem

**7. Farming Systems and Biodiversity**

7.1. Biodiversity of Farming Systems

7.2. Concept of Conservation Agriculture

7.3. Climate Change/Variability, Mitigation and Adaptation

**8. Ecological Problems of Crop cultivation**

8.1. Pollution, Leakage and Erosion

8.2. Diseases, Weeds and Pests

8.3. Environmental Impacts on Agroecosystems

**Mode of Delivery**

This course will depends on diversity of learning methods. Instructor facilitated learning experiences and lectures will be combined to students-led discussions andseminar presentations. Some specific methods include lectures, field works laboratory activities, reading assignments and group discussions.

**Assessment Methods**

Assessment will be determined by a variety of evaluations pertaining to lecture, field works and lab activities. Students are required to do assignments, submit field and laboratory reports, present course based seminars and sit for examinations. The sum of these activities will be evaluated out of 100%.

**References**

1. Altieri, M (2002) Agroecology: the science of natural resource management for poor

famers in marginal environments. Agriculture, Ecosystems, and Environment 1971: 1‐24.

2. Miguel Altieri (1995). Agroecology: The Science of Sustainable Agriculture. Westview Press

3. Lowrance, R., Stinner, B.R. and House, G.J. 1984. Agricultural Ecosystems: unifying

concepts. John wiley sons. Inc. New York.

4. Kumar, B.M. and P.K.R. Nair (2004). The enigma of tropical homegardens.

Agroforestry Systems,61: 135‐152.

5. Ong, C.K. and Huxley, P. 1996. Tree-crop Interactions: A physilogical Approach.

CAB International, UK.

Perfecto et al. (1996). Shade Coffee: A disappearing refuge for biodiversity. Bioscience  46: 598‐608.

Perfecto. I., J. Vandermeer and A. Wright (2010). Nature’s Matrix: Linking Biodiversity, Conservation and Food Sovereignty. Earthscan: Washington D.C.

Sanchez, P., G. Denning and G. Nziguheba (2009). The African Green Revolution Moves Forward. Food Security 1:37‐44.

Smith, R. (1996) The Ecosystem in Ecology and Field Biology, Harpur Collins.

Stephen Gliessman (2007). Agroecology: The Ecology of Sustainable Food System,  Second, Edition. CRC Pres

Tivy, J. 1997. Agricultural Ecology. Longman, UK.

Vanderneer, J. 1989. The Ecology of Intercropping. Cambridge University Press, Vandermeer, J. (2010).

The Ecology of Agroecosystems, Jones and Bartlett Publiers:  Boston.Cambridge, UK.

Wezel et al. (2009) Agroecology as a science, a movement and a practice, Journal of Agronomy for Sustainable Development 29: 503‐519.

**7. Environmental and Agricultural Microbiology (Elective)**

**Course Code: BdEM5016**

**Credit Hour:2 (1 + 1)**

**Prerequisite: No**

**Course Description**:

This course provides a comprehensive overview of the role of microorganisms in environmentally relevant processes including biogeochemical cycles, bioremediation of pollutants, and waste treatment. Student will gain knowledge in microbial processes with an emphasis on their application to environmental quality issues. The course will also focus on the applications of microorganisms to solve agricultural problems and improve agricultural productivity in sustainable ways.

**Course objective**

After completion of this course, a student with will able to:

* Describe interaction of microorganisms in the environment
* Explain microbial Life in different environments
* Understand carbon, nitrogen, sulfur and phosphorus cycles
* Understand the role of microorganisms in pollution control and management
* Understand the role of microorganisms in agricultural productivity
* Explain the application of microbial biotechnology in agriculture and the environment

**Course content**

**Chapter 1: Introduction to Environmental and Agricultural Microbiology**

1.1. Scope of environmental and Agricultural microbiology

1.2. The Microbial World and classification of microorganisms

1.3. Microbial Metabolism and Growth

**Chapter 2: Microbial Ecology**

2.1. Microbial and metabolic diversity

2.2. Inter-relationships among microorganisms, plants and animals and their impacts

2.3. Adaptation of microbes to different environments

2.4. Microbial loop

2.5. Microorganisms in soil

2.6. Microorganisms in air

2.7. Microorganisms in water

**Chapter 3: Microbial Biogeochemistry (The role of microorganisms in nutrient cycling)**

3.1. Introduction

3.2. Carbon and Nitrogen Cycle

3.3. Sulfur and Phosphorus cycle

**Chapter 4: Role of Microorganisms in Environmental Pollution Control and Management**

4.1. Biodegradation

4.1.1 Concept of biodegradation

4.1.2 Factors affecting biodegradation

4.1.3 Aerobic degradation of organic compounds

4.1.4 Anaerobic degradation of organic compounds

4.1.5 Biodegradation of polychlorinated biphenyls

4.1.6 Biodegradation of detergents

4.2. Bioremedetion

4.2.1 Concept of bioremediation

4.2.2 Approaches in bioremediation

4.2.3 Bioremediation of soil and aquifers

4.2.4 Bioremediation of liquid and solid wastes

4.2.5 Microbes in abatement of heavy metals

**Chapter 5** - **The role of microorganisms in sustainable agricultural production**

5.1 Role of microflora in organic fertilizer and feed production

5.2 Role of microflora in the production of Biopesticides

5.3 Role of microflora in Biofertilizers

**Chapter 6**– **Application of Microbial Biotechnology in Agriculture and in the Environment**

6.1. Biosensors

6.1.1 Microorganisms as pollution indicators

6.1.2 Types of biosensors

6.1.3 Application of biosensors

**Evaluation methods**

* Laboratory practical and report (30%)
* Assignments/exercises/quizzes (20%)
* Final examination (50%

**Reference:**

1. Atlas and Bartha, Microbial Ecology fundamentals and applications, 4th edition ,1998
2. Sirinivas T., Environmental Biotechnology, 2008
3. Ross Mckinney, Environmental pollution control microbiology, 2004
4. Gabriel Bitton, waste water microbiology, 3rd ed., 2005
5. Metcalf and Eddy, Wastewater engineering: treatment and reuse, 4th edition
6. Lawrence K. Wang, Handbook of Environmental Engineering Environmental Biotechnology, 2010

**Practical**

* Introduction to Microbiological tools and laboratory safety issues
* Sample collection and analysis
  + - Soil sample
    - Water and waste sample
    - Sediment sample
    - Air sample
* Sample processing and analysis
  + - Methods for Isolation from the environment
* Determination of microbial number
* Determination of microbial biomass
* Biochemical methods for environmental samples
* Organic matter decomposition
* Mini project

**Module 02. Genomics and Bioinformaticsin Genetic Resource Conservation**

**1: Genomics and Bioinformatics**

Course Code: BdEM5211

Credit Hours: **3 Cr Hrs**(2 + 1)**/5ECTS**(3+2)

**Course Description**

The course provides a comprehensive view on current methods that can be used to investigate genomes and gene function through integrated presentation of genome organization, genome sequencing and characterization, comparative genomics, transcriptomics, proteomics, metagenomics, metabolomics, and systems biology. The course will expose student to bioinformatics and computational biology in key aspects of data managing and using from internet (database mining, BLAST and FASTA searches and alignments). The central themes of the genomics and bioinformatics are towards genetic resources conservation and utilization.

**Course Objective**

The recent proliferation of genomic data has transformed biology, making previously laborious and expensive experiments easier and cheaper, enabling new avenues of inquiry, and fundamentally altering the understanding of biology**.** Bioinformatics is becoming a cornerstone for modern biology, especially in fields such as genomics. It is thus crucial for biologist and computer scientists interested in biology to understand the basic ideas and to learn fundamental bioinformatics techniques. Bioinformatics generate information for genetic resources conservation in which currently the world faced unpredictable climate change threatened genetic resources. Therefore, the students in the field of biology and agriculture need to have knowledge and skill in genomics and bioinformatics. Therefore, the primary goals in **g**enomics and bioinformaticsare:

* to provide a knowledge base in genomics and help students to understand how genomic data are being used to provide new insights throughout biology
* to expose student to the basic and core concepts of bioinformatics and genomicsand make the students familiar with the tools and databases available for bioinformatics analysis,
* to develop the ability of students in formulating and investigating genomic research questions, and to effectively communicate the questions, methods, and results.
* to provide a statistical and bioinformatics basic and applied knowledge to understand values of genetic resources, current conservation issues, importance of genetic information in conservation of living organisms
* to develop understanding of students to the available molecular tools for characterization, evaluation and conservation of genetic resources and equipped students in choosing an appropriate genetic tool for a given genetic resource issue

**Course Competencies/Learning outcomes**

The overall aim of the course is to provide practical and theoretical skills concerning **genomics and bioinformatics**and how approaches, technologies, techniques, methods and tools are best put into use.After completion of the course, the student should be able to:

* describe the overall structure and organization of the genome in microorganisms, plants and animals, and the stages in a genome sequencing and DNA-sequencing technologies,
* describe and differentiate between large-scale analyses at different levels, including genomics, transcriptomics, proteomics, metabolomics, metagenomics and systems biology
* describe and understand when to use a broad spectrum of functional genomics methods, and be updated on current technical developments within the fields of genomics
* suggest and outline solutions to theoretical and experimental problems within the fields of genomics using classical as well as new techniques
* handle and analyze large-scale experimental datasets, and present results and interpretations in a scientifically stringent manner based on the understanding of ethical aspects of genetics/genomics
* critically examine research reports and publications dealing with genomics, and be able to suggest alternative interpretations and salient follow-up experiments
* able to identify and utilize appropriate methods, techniques and biotechnology tools understand the status ofgenetic resources, the linkages with agricultural systems, and utilization for the sustainable development of agriculture

**Prerequisites**

The students are expected to take the courses of genetics and statistics as prerequisites tounderstand basic statistics tools and methods in biology,DNA structure and regulation, RNA transcription and post-transcriptional processing, Protein translation and post-translational modification, basic amino acid and protein structure, Controlling factors in gene expression, Mendelian genetics theory and evolution via natural selection. Therefore, it is the student's responsibility to take the courses to acquire the basic concepts, tools and methods that help them to easily understand genomics and bioinformatics topics as lecture and practical exercises.

**Course Contents**

**Chapter one: Introduction to Genomics and Bioinformatics**

* 1. Principles, background and application of genomics and bioinformatics
  2. Introduction to organization of genomes
  3. Fundamental bioinformatics sequence analysis techniques

**Chapter two:Gene Expression, Regulation and Functional Genomics**

2.1. Common features of genomes

2.1.1. Structure and organization of genomes

2.1.2. Genome evolution

2.1.2.1. Genomic features shared in eukaryotic and prokaryotic genomes

2.1.2.2. Variation in eukaryotic and prokaryotic genomes

2.1.3. Extranuclear genomes

2.1.3.1. Mitochondrial genome

2.1.3.2. Chloroplast genome

2.1.3.3. Evolution association to mitochondrion and chloroplast

2.2. Tools and methods to identify the genes of interest

**Chapter three: Genome Sequencing and Annotation**

3.1. Databases

3.2. Genome Sequencing and Annotation

3.3. Comparative Genomics and Sequence Alignment

3.4. SNPs and Variation

3.5. Gene Expression and the Transcriptome

3.6. Integrative Genomics

**Chapter four: Proteomes**

4.1. Protein structure and functions

4.2. Protein isolation and characterization

4.3. Biochemical approaches to studying protein-protein interactions

4.4. Techniques for studies of protein-protein and protein-DNA interactions

4.5. Metagenomics and systems biology

4.6. Global gene regulation, transgenic organisms, and gene ethics

**Chapter five: Statistics for Genomics, Sequence Databases and Information Retrieval**

5.1. Parametric and non-parametric statistics (Canonical linear statistics t-test, AMOVA, PCA)

5.2. Models and machine learning algorithms to problems in bioinformatics

5.3. Database types, practical use of databases, and information retrieval from biological databases.

**Chapter six: Sequence Comparison, Similarity Searching andData Manipulation**

6.1. Sequence Homology versus Sequence Similarity

6.2. Sequence Similarity versus Sequence IdentityMethods

6.3. Scoring matrices (PAM, BLOSUM),

6.4. Pair wise alignment and dot sequence alignment

6.5. Basic Local alignment search tool (BLAST)

6.6. Use BLAST, FASTA, ClustalW, BOXSHADE and Heuristic database searching

6.7. Data manipulation & presentation

**Chapter seven:Molecular Phylogenetic Analyses**

7.1. Genetics of speciation and molecular evolution

7.2. Phylogenetic and biological concept of species

7.3. Patterns and mechanisms of reproductive isolation and models of speciation (Allopatric, sympatric, parapatric)

7.4. Molecular phylogenetics

7.4.1. Gene phylogeny versus species phylogeny

7.4.2. Estimate distances

7.4.3. Construction of phylogenetic trees and description tree (UPGMA, Fitch, Neighbor-joining, Construct trees using Phylip and use bootstrapping to evaluate tree quality)

**Laboratorypractical Exercises**

1. Isolation and purification of DNA
2. Polymerase chain reaction (PCR) and DNA amplification
3. Structural classification of databases, structure determination and quality assessment
4. Tools for sequence alignment and comparison: Blast
5. Hmology based gene prediction in prokaryotic and eukaryotic genomes
6. Identifying restriction sites and designing of primers
7. Analyzing Protein Sequences, protein classification and function prediction tools
8. Analyzing amino acid sequences and finding the Open Reading Frames (ORF)
9. Perform an alignment using ClustalW of a given FASTA sequence, estimate distances between sequences, and construct phylogenetic trees from ClustalW results
10. Data manipulation & Presentation: Import pictures and tables into documents, convert data from one format into another, format data for presentation/publication using desktop software applications

**Mode of Delivery/Learning strategies**

* **S**eminar style course as lectures in which all parts of the course will not take more than 4 weeks
* Practical and/or laboratory exercises
* Assignment and paper presentation: for each specific parts of the module contents (Genomics, Bioinformatics, and Genetic Resources) at least one assignment on current topic and the review paper will be presented

**Assessment Methods**

The theory part is examined through a written examination and seminars. The module practical and laboratory exercise requires implementation of the given assignment during the period allocated for the sessions, prepare written practical and laboratory exercises reports followed up with oral presentations.

Written examination (40%) and seminar presentation on current topics (20%): 60%

Field practical and/or laboratory exercise: 30%

Class, exercises, and seminars attendance and participation: 10%

**Course materials**

Genomics, Proteomics and Bioinformatics 7th edition, A. Malcolm Campbell and Laurie J. Heyer, (second Ed.) 2006, Benjamin-Cummings-: CSH Press, NY.

Campbell, A. Malcolm and Laurie J. Heyer, Discovering Genomics, Proteomics & Bioinformatics, 2nd edition, 2007, Pearson Benjamin Cummings

Baxevanis, Andreas D. and B.F. Francis Ouellette (editors), Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition, 2005, Wiley

Falconer DS and Mackay TFC (1996) Introduction to Quantitative Genetics 4th edition, Longman

Applied ecology and environmental management. Ed. by I. Newman. Blackwell Science.

Victor J. Nesatyy and bMarc J.-F. Sut. (2007). Proteomics for the Analysis of environmental Stress Responses in Organisms. Environmental Science and Technology Vol. 41, No. 20, 6891-6900.

Gracey AY, Cossins AR (2003) Application of microarray technology in environmental and comparative physiology. Annu Rev Physiol 65:231–259

Ben-Hur A, Ong CS, Sonnenburg S, Schölkopf B, Rätsch G (2008) Support Vector Machines and Kernels for Computational Biology. PLoS ComputBiol 2008, 4(10)

Jain P, Hirst JD. Automatic structure classification of small proteins using random forest. BMC Bioinformatics. 2010 Jul 1;11:364.

Statistical Methodsin Bioinformatics Warren J.E wens and Gregory R. Grant publisher:Springer edition:second year:2009

AnIntroduction to Bioinformatics Algorithms authors: Neil C. Jones and Pavel A. Pevzner publisher: MITPress edition: first year:2004.

**2**. **Livestock Characterization, Conservation and Management (Elective)**

**Course Code:** BdEM5222

**Credit Hours: 2 Cr. Hr (3 ECTS)**

**Prerequisite: No**

**Course Description**

The course will focus on the livestock resources, development, improvement, management and conservation in function of climate smart and resilience. Livestock resources under diversified agro ecology, management system and production are covered. The course links theories, principles and applied scientific knowledge for the adaptation of livestock under tropical climate condition. The course also deals with the concepts of phynotypic, genotypic and heritability characterization of livestock resources including cattle, sheep, goat, camels equine, poultry and swine. The course includes characterization of production performance, yield and product quality under a range of climatic condition.

Next parte of the course covers phynotipic and genotypic identification and conservation of livestock of good performance, resistance to health problems, adapted to and compatible with wide agro ecology and climatic condition, and tropical ecosystems, under sustainable production and reproduction performance, yield quality and quantity. Here, all possible techniques, methods, knowledge and technologies used for livestock conservation and production performancemaintenance are applied

Livestock management system including cattle (beef, dairy), shoat, camels equine, poultry and swine farming (intensive, semi-intensive and extensive), feeding and bio security systems and technology are covered. Interlinked livestock-land-fed-fodder management system, identification of macro- and micro-nutrients of functional elements in a farmland, feed and available resources are covered.

Livestock biotechnology such as artificial insemination (AI), embryo transfer (ET), in-vitro fertilization (IVF), somatic cell nuclear transfer, and the emerging technology on somatic cell nuclear transfer used in improving the breeding stock of animals are covered. Genomics and Marker-Assisted Selection (MAS) Applications which applies discovery and identification of DNA sequences or molecular markers associated with important animal traits has various applications that include trait improvement, heritability determination, and product traceability.

Impacts (direct and indirect) of climate change on livestock health, pathogenes (parasites, bacteria, fungi and virus), feed and water are included. Climate based emerging and re-emerging of livestock pathogenes and zoonotic agent in all farming systems, agroecology and ecosystems are also covered. The course highlight livestock diseasesurveillance, climatic change based diseasesforecasting for redyness and application of biosecurity, diseases control and prevention techniques.

**Course Objective**

The general objective of this course is to provide students with fundamentals of livestock characterization, techniques and principles of conservation and managements of livestockes under various farming systems of various agroecology and climatic condtion. It enables students to identify the methods and procedues in characterization of different livestock in relation their breed, heritability and adaptation to various ecosystems of tropical and the world, too. The course also provide students with management techniques of indigenous and exotic breeds of livestockes Students are awarded of direct and indirect impacts of climate change on livestock health, pathogenes feed and water. It is also aimed to provide students with knowledge of climate based emerging and re-emarging of livestock pathogenes and zoonotic with highlighting of diseas survelance, climatie change based diseases forcusting for redyness and application of biosecurity, diseases control and prevention techniques.

After completing this course, students will be able to:

* Understand concepts of phynotypic, genotypic and heritability characterization livestocks resources including cattle, sheep, goat, camels equine, poultry and swine.
* Explain and transfer the knowledge on livestock resources development, improvement, management and conservation in function of climate smart and resilience under diversified agroecology, management system and production.
* Links theories, principles and applied scientific knowledge for the adaptaion of livestocks under tropical climaticcondition.
* Characterize the production performance, yield and product quality of livestockes under a range of climatic condition.
* Identify the phynotype and genotype of livestockes of good performance, health problemes resistate, excellent adaptation and compatible to wide agroecology and climatic contion
* Determine the sustainable production and reproduction performance, yield quality and quantity.
* Identify and used all possible techniques, methods, knowledge and technologies used for livestock conservation and production performancemaintenanceconservation
* Describe livestock management systems including farming, feeding and biosecurity systems and technology. They will also able to interlinked livestock-land-fed-fodder management system, identification of macro- and micro-nutrientes of functional elements in a farm land, feed and available resources.
* Livestock biotechnology for reproduction improvement and genomics and marker-assisted selection (MAS) applications for important of animal traits are covered.
* Identify all possible direct and indirect inpactes of climat change on livestock health, pathogenes, and availability and conservation of feed and water resources.
* Explain and forcuest climate based emerging and re-emarging livestock diseases. They will also abale to suggest climatie change based diseasessurveillance, forcusting for redyness of biosecurity, diseases control and prevention techniques.

**Course Competencies**

Upon completion of this course, students will be able to develop the following competencies:

* Develop systematic and critical thinking skills towards time based livestock conservation and utilisazation approach for food security and sustainable development in respective agroecology.
* Describe key concepts related to livestock characterization using phynotype and genotype in relation to adaptation and production performance in a given agro-eco-farming systems.
* Analyze the benefits of and techniques in livestock conservation in various agroecological system.
* Identify and characterize a range of indigenous and exotic livestockin the world with respective management approaches.
* Forcuest and ommunicate nationally and internationally in clear and effective way on climate change related livestock impact, pathogenes, feed, watering and farming land resores management.
* Apply livesrtock biotechnology at any circumstance.
* Comple and anylyze litratuers through writing and oral presentations in a professional setting of livestock for food security.
* Develop researchable hypotheses, identifying research questions, work on in a field and laboratory, and communicate the finding for better utilization of livestocks resources in the world. Hence,
* Effectively analyse biological and natural livestock management systems as to risk avert climate change-related problems from the context of national and international.

**Course Contents**

1. Livestock and its Characterization
   1. Livestock biodiversity and climate change
   2. Characterization of cattle, shoat, camels equine, poultry and swine populations of Ethiopia using microsatellite markers
   3. Use and implications of microsatellite markers for conservation and management of indigenous livestock populations
   4. Characterizing commercial, pastoral and mixed (crop-livestock) farms in tropical climate
2. Conservation of livestock resources
   1. Climate change and the characterization, breeding and conservation of animal genetic resources
   2. Conservation and sustainable use of genetic resources for food and agriculture
   3. Livestock Adaptation differences relevant for climate change

* Physiological stress and thermoregulatory
* Nutritional stress
* Disease stress

1. Conservation of indigenous
   1. Local breeds in selected regions of tropics and sub-tropics
   2. Conservation and exchange
2. Biotechnology for the Livestock Industry
   1. Reproductive Animal Biotechnology
      1. Artificial Insemination.
      2. In-vitro Fertilization.
      3. Embryo Transfer.
      4. Somatic Cell Nuclear Transfer
   2. Genomics and Marker-Assisted Selection (MAS) Applications
      1. Molecular marker-assisted introgression (MAI).
      2. Parentage, product traceability and genotype verification.
      3. Screening for undesirable genes
3. Climate smart livestock management
   1. Farming systems evolution
   2. Climate change adaptation of livestock production systems
   3. Adaptation of husbandry practices
   4. Species and breed shifts (direct Climate change effect)
   5. Breeding for climate change adaptation and mitigation

* Heat tolerance
* Productivity and feed efficiency
* Effects of productivity increase in dairy production
* Disease resistance
* Challenges
  1. Conservation and sustainable use of genetic resources for food and agriculture
  2. Enhancing livestock productivity - through better reproduction and breeding management

1. Livestock and climate change impacts
   1. Impact of climate change on livestock productivity, reproduction and production
   2. Impact of climate change on livestock health and pathogenes (parasites, bacteria, fungi and virus)
   3. Impact of climate change on livestock feed and water resources and availability in range of agroecology
   4. Climate change based emerging and re-emerging of livestock pathogenes and zoonotic agent
2. Mitigation of livestock production and management challenges
   1. Reducing the environmental impact on livestock sector
   2. Diseasesurveillance
   3. Climate change based diseases forcusting for redyness and application of biosecurity
   4. Risk, management and sustainability
   5. Diseases control and prevention techniques
3. Livestock marketing and trading
   1. Livestock conservation and international trading
   2. Animal and animal product quarantine and regulation

**Mode of Delivery/Learning strategies** (*for courses require practical integration should be considered here, based on the course description*)

* Lecture
* Theoretical and practical exercises
* Independent study and team work. practical fieldwork

Practical exercise visiting filed on different livestock farmes (intensive, extansive, semi-intensive) or traditional pastural farming systems at different agroecology and laboratories work on livestock sectores involved in phynotypic and genotypic characterization, visting farming systemes, livestock research sectors, involve in laboratory analysis of livestock product (meat, milk, egg) for yeiles and quality assessment as well as assuriance. Genetical assesing trait of interest for adivers climate resistanc, good production performance, feed convestion efficiency, disease resistance and others. Idivadual, national and internation institution as a teamwork.

Assessment Methods

Assignments, individual and teamwork and reporting, field work reports, quiz, final exam

**Course materials**

* Handout
* PowerPoint
* Journals and published materials
* Proceedings

**Further reference materials/ Supplemental Readings**

Animal genetic resources characterization and conservation research in Africa: An overview

Bayou, E, A Haile, S Gizaw and Y Mekasha 2014. Characterizing husbandry practices and breeding objectives of Sheko cattle owners for designing conservation and improvement strategies in Ethiopia. Livestock Research for Rural Development 26 (12)

ESAP Proceedings 2003. Farm Animal Biodiversity in Ethiopia: Status and Prospects. Proceedings of the 11th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, August 28-30, 2003.

Hanotte O. and H. Jianlin 2005: Genetic characterization of livestock populations and its use in conservation decision-making. The role of biotechnology Villa Gualino, Turin, Italy – 5-7 March, 2005

Luis Iniguez, J. Stuart F. Barker Genetic resources for livestock production. In: Management of agricultural, forestry, and fisheries enterprises – Vol. I

Matt Wilson - Environmental Specialist/OMAFRA Building Permit Requirements for Livestock Operations

Solomon Gizaw. 2011. Characterization and conservation of indigenous sheep genetic resources. International Livestock Research Institute. Wageningen UR. Animal Sciences Group.

UN, 2008: Challenges and opportuni ties for mitigation in the agricultural sector. Technical paper

**3.Crop Characterization, Conservation, and Management ((Elective))**

**Course code:** BdEM5232

**Prerequisite course(s):** Basic biology

**Course Description**

Basic concepts of crop characterization; importance of characterization in crop production; characteristics which distinguish crops among species and among genera, types of characterization (morphological/morphomtric or agronomic, cytological; cytogenetic and molecular),tools for characterization (morphological and molecular descriptors) . Basic concepts of crop conservation, importance of crop conservation, methods of crop conservation (in-situ and ex-situ), challenges in conservation. Crop production and population growth; crop production as an art and as science; domestications, adaptations and classifications of crop plants; climatic and soil factors affecting crop production; tillage; seeding; irrigation management; cropping systems, sustainable crop production, dryland farming; organic agriculture; precision agriculture.

The course is supported with practical activities on morphological characterization of major crops.

**Course objectives**

The general objective of this course is to provide students with principles and practices of crop characterization, conservation and management to enhance crop productivity and environmental sustainability. After completing this course, students will be able to understand:

* Explain basic concepts of crop characterization and conservation
* Develop skill of distinguishing crops under field condition morphologically
* Develop knowledge on various methods of crop characterization and conservation
* Be able to use different tools of characterization
* Understand the challenges in conservation
  + the status and the challenges facing crop production
  + the crop environment and the interaction of various biotic and abiotic factors
* Understand the efficient use of agricultural inputs for sustainable crop production
* Understand the efficient strategies of recent agronomic practices (selection of crop varieties, cropping systems, integrated nutrient and water management system).

**Expected Competencies:**

* Characterization of crops of a given area
* Able to distinguish crops under field condition
* Skills to conserve crop biodiversity (in-situ and ex-situ)
* Develop skills to address the challenges in conservation
* Develop skills of crop management practice that will maximize productivity and conserve the crop genetic resources

**Course materials**

Seeds of different crops, laboratory equipments for seed testing, green house and items such as pots.

**Course Contents**

1. Basic concepts of crop characterization
2. Importance of characterization in crop production
3. Characteristics which distinguish crops among species and among genera
4. Types of characterization

* Morphological/morphomtric or agronomic
* Cytological
* Cytogenetic
* Molecular)

1. Tools for characterization

* Morphological descriptors
* Molecular descriptors

1. Basic concepts of crop conservation
2. Importance of crop conservation
3. Methods of crop conservation

* In-situ
* Ex-situ)

1. Challenges in conservation
2. Crop production and population growth
3. Crop production as an art and as science
4. Domestications and adaptations of crops
5. Classifications of crop plants; climatic
6. Soil factors affecting crop production
7. Agronomic practices
8. Irrigation management
9. Cropping systems

* Sustainable crop production, dryland farming

1. Organic agriculture;
2. Precision agriculture

**Mode of Delivery/Learning strategies**

Lecture, group discussion, field practical (morphological and agronomic characterization of crops on farmers’ and research fields),

**Assessment Methods**

Assignments, term paper, presentation of assignments and/or term papers, laboratory and green house activities (seed germination, crop emergence, observation and measurements of early growth parameter of selected crops for part of the semester), mid and final exam.

References:

1. Abebe Demissie, Giorgis H/mariam and Regassa Feyissa, 1989. Ethiopian Wheat Germplasm Collection, Conservation, Characterization/Evaluation and Utilization: In The Sixth Regional Wheat Workshop, For Eastern, Central and Southern Africa, A.A., Ethiopia. Editors Douglas G. Tanner, Maarten van Ginkel and Wilfred Muangi.
2. Connor, D.J., Loomis, R.S., and Kenneth G. Cassman. 2011. Crop Ecology: Productivity and Management in Agricultural systems. Cambridge University press. London.
3. Conservation of Crop Germplasm – An International Perspective CSSA Special Publication Number 8: Proceedings of a symposium sponsored by Divisions C-1, C-4, and A-6 of the Crop Science Society of America in Washington, DC, 14-19 Aug. 1983.
4. Evans, L. T. 1998. Feeding the Ten Billion: Plants and population growth. Cambridge: Cambridge University Press.
5. Molecular Techniques in Crop Improvement2010, 2nd Edition; edited by S.Mohan Jain, D.S. Brar .
6. Regeneration of Seed Crops and their Wild Relatives, 1995: Proceedings of a Consultation Meeting, 4–7 December 1995, ICRISAT, Hyderabad, India.
7. Seed systems and crop genetic diversity on-farm: Proceedings of a workshop of workshop, 16-20 September 2013, Pucallpa, Peru. International Plant Genetic resources Center, Italy.
8. Systems Author(s): Miguel A. Altieri and Laura C. Merrick Source: Economic Botany, Vol. 41, No. 1 (Jan. - Mar., 1987), pp. 86-96 Published by: Springer on behalf of New York Botanical Garden Press Stable URL: <http://www.jstor.org/stable/4254942>
9. Vanderneer, J. 1989. The Ecology of Intercropping. Cambridge University Press, Cambridge, UK
10. Willey, R.W. 1979. Inter cropping its importance and research needs: Agronomy and research approaches. Field crop Abstracts 32 (2), 78 - 85.
11. Willey, R.W. 1979. Intercropping - Its importance and research needs: Competition and yield advantages. Field Crop Abstracts 32(1), 2-10
12. Willey, R.W. and Hearth, S.B. 1969. The quantitative relationship between plant populations and crop yield. Advances in Agronomy 21, 281 - 321.

**Module Three: Research Methods and Tools**

**1. Statistical Methods and Data Analysis**

Course Code: BdEM5312

Credit Hours: 3(**2+1)**

**Course Description**

The course Statistical Methodsand Data Analysis introduces students with basic and applied concepts, principles and procedures of various statistical methods and tools that are commonly used in biodiversity and ecosystem assessment, survey and management. The intent of this course is to provide students with basic understanding and practical skills of those statistical techniques that are commonly used in summarizing, analyzing and interpreting data related to biological diversity and variability, and ecosystem management. The course utilizes appropriate statistical software(s) and related data to apply the statistical methods and techniques in data summarization analysis.

The course covers about the meaning and use of statistics; basic concepts and definitions of terminologies commonly used in statistics; methods used for an effective organization and graphical presentation of qualitative and quantitative data; numerical methods or descriptive measures of central tendency, measures of variability (dispersion), measures of the shape of a distribution, and measures of relative position; probability and probability distributions; sampling and sampling distributions; point and interval estimation of parameters; determination of confidence interval; hypothesis testing; analysis of variance; regression and correlation; multiple regression analysis; chi-square tests and categorical data analysis; non-parametric statistical methods; and choosing an appropriate statistical method for data analysis.

The course is divided into five chapters, and at the end of each chapter there will be practical exercises using appropriate statistical software(s) and related data. In each chapter, explanation of topics, that means statistical concepts and theories of will be accompanied by examples relevant to biodiversity and ecosystem management.

**Course Objective**

At the end of the course students are able to:

* Know the basic statistical concepts, principles and procedures ;
* Understand the application of various statistical concepts, principles and procedures in biodiversity and ecosystem analysis and interpretation;
* Apply the statistical methods and techniques that are commonly used to summarize, analyse and interpret data related to biodiversity and ecosystem management;
* Use statistical software packages that are relevant to data set related to biodiversity and ecosystem management;
* Identify sources and types of data; and
* Choose appropriate statistical methods for data analysis

**Course Competencies**

**Course Contents**

1**.** Introduction

* 1. Statistics
  2. Data, types and measurement scales
  3. Data collection tools

1. Presenting and summarizing data (Descriptive Statistics)
   1. Data Presentation
      1. Graphical presentation of qualitative data
      2. Graphical presentation of quantitative data
   2. Numerical methods for presenting data
      1. Measures of central tendency (location)
      2. Measures of variability (dispersion)
2. Probability and Probability Distribution
   1. Probability of an event
   2. Rules of Probability
   3. Conditional Probability and Independence
   4. Probability Distribution
      1. Probability distribution of discrete random variables
      2. Probability distribution of continuous random variables
3. Sampling and sampling distributions
   1. Sample versus population
   2. Statistical inference
      1. Estimation of population parameters by sample statistics
      2. Sampling error
   3. Sampling distribution of the mean
   4. Confidence interval for a mean
   5. Sampling distribution of the proportion
   6. Confidence interval for a proportion
   7. Sampling methodology
   8. Sample size determination
4. Hypothesis testing
   1. Basic concept of hypothesis testing
   2. Statistical significance
   3. Statistical versus biological significance
   4. The t-test: comparing one or two tests
   5. The F-test: comparing two variances or more than two means
   6. The chi-square test: comparing proportions
   7. Linear Correlation and regression
   8. Multiple Regression
   9. Non-parametric data analysis

**Mode of Delivery/Learning strategies**

* Lectures
* Group Discussion
* Assignments
* Software and data based hands on exercises

**Assessment Methods**

* Exams
* Individual and group assignments

**Course materials**

* Course module
* Data set
* Statistical software
* Computer lab

**Further reference materials/ Supplemental Readings**

1. Sheldon M. Ross (2010). Introductory statistics 3rd ed. Elsevier Inc.
2. R. Lyman Ott, and Michael Longnecker (2010). An Introduction to Statistical Methods and Data Analysis, Sixth Edition. Brooks/Cole, Cengage Learning.
3. Shirley Dowdy, Stanley Weardon and Daniel Chilko (2004). Statistics for research. 3rd edition. John Wiley & Sons, Inc., Hoboken, New Jersey (Wiley series in probability and statistics; 1345).
4. Myra L. Samuels, Jeffrey A. Witmer and Andrew A. Schaffner (2012). Statistics for the Life Sciences. Fourth Edition, Pearson Education, Inc.

**2. Research Methods in Climate Smart Agriculture**

**Course Code:** CSAg-5322

**Credit Hour: 2 Cr. Hrs/ 3 ECTS**

**Pre-requisite: No**

**Course Description**

The course will allow students learn principles and procedures in undertaking scientifically sound and relevant research in agriculture in general and climate smart agriculture in particular. Topic covered include theories of science; definition of research; characteristics of research; objectives of research; types of research; interdisciplinary and participatory research; the research process/scientific method; research design; sampling design; methods of data collection; developing a research proposal/project; thesis/dissertation research proposal or synopsis; climate-smart agriculture research agenda; writing scientific articles/thesis/dissertation; ethical considerations in research.

**Course objectives**

At the end of the course students will be able to:

* Understand basic concepts, principles and procedures of science and research
* Identify, analyze and prioritize the research problems in their field of specialization (climate-smart agriculture)
* Identify the type of methods best suited for investigating different type of problems and questions
* Develop relevant and innovative research proposals in their field of specialization (climate-smart agriculture)
* Write scientific paper in general and the thesis in particular independently in their field of specialization (climate-smart agriculture)
* Develop enthusiasm to be researchers in their future career in climate-smart agriculture
* Work in an interdisciplinary and participatory research approach to address climate-smart agriculture research problems

**Course contents**

**1. Introduction to Research**

1.1. Theory of Science

1.2 Definition of Research

1.3 Characteristics of Research

1.4 Objectives of Research

1.5 Criteria of Good Research

1.6 Types of Research

**2. Procedures in Applied Research**

2.1 Overview of the Research Process

2.2 Formulating Research Problem

2.3 Problem Analysis in Agricultural Research

2.4 Priority setting

2.5. Literature Review

2.6 Constructing Hypothesis

**3. Research Design**

3.1 Meaning of Research Design

3.2 Need for Research Design

3.3. Types of Experimental Design

3.4 Concepts Commonly Used in Experimental Design

**4. Sampling Design**

4.1 Census and Sample Survey

4.2 Steps in Sample Design

4.3 Types of Sampling Design

4.4 Sample Size and its Determination

**5. Methods of Data Collection**

5.1 Definition of Some Terms

5.2 Measurement Scales

5.3 Data types and Data Collection Techniques

**6. Developing a Research Project Proposal**

6.1 Quality of Research Proposal

6.2 Components of Research Project

6.3 Criteria for Evaluating Proposal

6.4 Why Proposals Fail?

**7. Thesis/Dissertation Research Proposal**

7.1 Title

7.2 Introduction

7.3 Review of Literature

7.4 Materials and Methods or Methodology

7.5 Plan of Activities

7.6 Budget

7.7 References

7.8 Appendix (if any)

**8. Climate-Smart Agriculture Research Agenda**

**9. Writing Scientific Articles**

9.1 Title

9.2 Abstract/Summary

9.3 Introduction

9.4 Materials and Methods

9.5 Results

9.6 Discussion

9.7 References

9.8 Acknowledgements

9.9 Appendix

**10. Scientific presentation**

**10.1.Oral presentation**

**10.2. Poster presentation**

**11. Ethical Considerations in Research**

11.1 Ethics in Research

11.2 Fundamental Ethical Principles

11.3 Ethics and Professionalism in Science

**Mode of course delivery**

* The mode of delivery of the course combines lectures, discussion, questioning and answering, readings, assignments, individual and /or group problem identification and presentation.
* Proposal writing and presentation: Each student will be required to identify research problem, set hypothesis, write and present research proposal

**Assessment Methods**

* Evaluation will include proposal writing and presentation, and written examination.

**References**

* Andrew, C.O. and Hildebrand, P.E. 1982 . Planning and Conducting Applied Agricultural Research. pp. 14–33. Westview Press Inc., Colorado, USA.
* Day, Robert A. (1998). *How to Write & Publish a Scientific Paper*. 5th ed. CambridgeUniversity Press
* Desai, Vandana and Potter, Robert B. (2006). *Doing Development Research*. SAGE Publication Ltd., London
* Dixon, J ., Bouma, M. and Atkinson, K. 1987. A Handbook of Social Science Research. Oxford University Press, Oxford, UK.
* Greenfield, T. 2002. Research Methods for Postgraduates. Second edition. Arnold, London, UK. 384 pp.
* Greenfield, T. 2002. Writing the thesis. In: Research Methods: Guidance for Postgraduates, Greenfield, T. (Ed.), pp. 307–316. Second edition, Arnold Publishers, London, UK.
* Kerri *et al.* (2014). Climate-smart agriculture global research agenda: scientific basis for action. Agriculture & Food Security 3:11. DOI: 10.1186/2048-7010-3-11
* Kish, L. 1987. Statistical Design for Research. John Wiley & Sons, New York, USA.
* Lal, R. 1994 . Soil Erosion Research Methods. S t Lucie Press, Florida, USA. 352 pp.
* Lohr, S.I. 1999. Sampling Design and Analysis. Duxbury Press, Pacific Grove, California, USA.
* Lyons, K .2003 . How to Write a Literature Review. University o f California, USA. Available from: ht tp://library.ucsc.edu/ref/howto/literaturereview.html
* Macauley, P. 2001 . The Literature Review, Deakin University. Geelong , Victoria, Australia. Sayer, J .A. and Campbell, B. 2001. Research to integrate productivity enhancement , environmental protec- tion and human development . Conservation Ecology 5(2): 32.url: ht tp://www.consecol.org/vol5/1552/art32.
* Reid, P. (2000). Handbook for preparing and writing research proposals. International Union of Forestry Research Organization, Vienna, Austria.
* Taylor, S. 2002. Managing your PhD. In: Research Methods: Guidance for Postgraduates. Second edition. Greenfield, T. (Ed.), pp. 13–27. Arnold, London, UK.
* Tham, M. 2001. Writing Research Theses or Dissertations – Guidelines and Tips. University of Newcastle-upon-Tyne, UK. Available from: ht tp://lorien.ncl.ac.uk/mingDept/Tips
* Thompson, S.K. 2002 . Sampling. Second edition. John Wiley & Sons, New York, USA.

**3.GIS and Remote Sensing for Climate Change**

**Course code: CSAg 5332**

**Credit Hour/ECTS: 3/5**

**Prerequisite: No**

**Course Description**

Through lectures and laboratory exercises, this course illustrates the fundamental concepts of GPS, GIS and remote sensing technologies in the context of Climate Smart Agriculture and Biodiversity conservation. Topics include the physical basis for remote sensing, remote sensing systems, digital image processing, data structures, database design, and spatial data analysis. The course is intended to provide students with extensive training in particular image processing or GIS package and, hands-on computer laboratory sessions re-enforce critical concepts. Working knowledge of personal computers and completion of a term project are required.

**Learning objectives**

* Master the principles and concepts of GIS and RS
* Acquire, manipulate, save the data sources in a GIS
* Understand how GIS database works and how to update
* Learn how to edit data in GIS
* Learn digital image processing techniques
* Become familiar with specific functionality to the GIS: "Spatial Analysis"
* Learn map design, symbolization and   publishing
* Mastering the output and dissemination of results of a GIS project.
* Develop and implement a GIS project
* Present the software and data sources available on the current GIS market
* Discover and use the internet for publishing maps

**Course contents**

1. **Introduction to Principles of GPS, GIS and Remote Sensing**
   1. Principles of GIS and  Remote Sensing
   2. Components of GIS Systems
   3. GIS Capabilities and Functions
   4. Spatial Data Infrastructure
   5. Introduction to GPS and Global Navigation Satellite
2. **Data Acquisition: Using GPS/Mobile based GPS (ODK)**
   1. Principles and concepts  of GPS
   2. Introduction to Mobile Data gathering
   3. Survey Authoring
   4. GIS Mapping using open data kit (ODK) collected data
   5. Online web mapping with Google maps
   6. Exporting to GIS /RS environment for further analysis
   7. Hosting the data online
3. **Data Acquisition: Extraction of Feature From Other Sources**
   1. Extracting data from Satellite images,
   2. Extracting data from online GIS data sources
   3. Importing data to GIS
   4. Obtaining Data from topographic sheets
   5. Downloading Data from open street maps
4. **Database Design and development**
   1. Working with spreadsheets data in GIS
   2. Conceptual and logical database design
   3. Building and coding the attributes
   4. Digitizing and scanning of maps
   5. Relating spatial and attribute data
5. **Editing and management of GIS**
   1. Adding feature to GIS data
   2. Reducing GIS data
   3. cutting points of interest in image datasets
   4. Transforming GIS data
6. **Integrating Imagery and Remote Sensing into GIS**
   1. Radiometric and atmospheric correction
   2. Temporal normalization
   3. Geo-coding and geo-referencing
   4. Transformation
   5. Signature development
   6. Supervised Classification
   7. Unsupervised Classification
   8. Change detection
   9. Accuracy assessment
7. **Geo-Spatial Analysis**
   1. Geo-processing
   2. Creating views and themes
   3. Working with themes
   4. Working with attribute tables
   5. Spatial query and analysis
   6. Working with charts
   7. Creating a map layout
   8. Digital Cartography and Visualization
8. **Introduction to cartographic visualization and the mapping process**
   1. Components of a map
   2. Map design
   3. Symbol design
   4. Name design and placement
   5. Concept of scale
   6. Map projections
   7. Data pre-processing techniques
   8. Thematic mapping;
   9. Digital mapping
9. **Online Publishing of Maps and GIS Outputs**
   1. Working with Google Maps and Fusion Tables
   2. Publishing into other web based platforms
10. **Case Study and Short Project**
    1. Case study of a related programme use of GIS and RS technology

**Mode of Delivery**: Lecture, critical Review and Presentation, Practical Session

**Assessment**: Midterm Exam= 20%, critical paper review and presentation =15%, Practical Session =25% and Final Exam 40%

**Reference**

* Rolf A. de, 2001. Principles of Geographical information System: an introductory text book
* Lucas L., F. Janssen and Gerrit C., 2001. Principles of Remote Sensing: an introductory text book
* Remote Sensing and GIS Integration Theories, Methods,Applications. 2010 by the McGraw-Hill Companies, Inc.

**1. Biogeography and Ecosystem modelling**

**Course Code:** BdEM5322

**2 Cr. Hrs/3 ECTS**

**Prerequisite: No**

**Course description**

The course will have the following major sections including Definition and Concepts of Biogeography and Ecosystem; Biogeography and creation, Historical Biogeography, Major Classifications of Biogeography, Development of Ecological Biogeography, Biogeographical Regions of the World, Major Classifications of Ecosystem, Communities and Ecosystem, Patterns of Biodiversity Distribution, Patterns of Life Today, Biogeography and Ecosystem Modeling, Modeling approaches for Integrated Environmental Assessment and Management, and Species Distribution Models for Managing Biodiversity under Future Climates; as well as interpreting the past and foretelling the future.

**Course Objectives**

At the successful completion of the course, the students should be able to:

* define and develop proper concepts of Biogeography and Ecosystem;
* associate the issues of Biogeography and creation,
* describe Historical Biogeography,
* identify the Major Classifications of Biogeography,
* describe the major Development of Ecological Biogeography,
* locate and map the Biogeographical Regions of the World,
* assess the Major Classifications of Ecosystem, discuss the Communities and Ecosystem,
* assess the major Patterns of Biodiversity Distribution of the present and the past,
* prepare and interpret the major models of Biogeography and Ecosystem,
* discuss the Modelling approaches for Integrated Environmental Assessment and Management, and
* use the Species Distribution Models for Managing Biodiversity under Future Climates; as well as interpret the past and foretelling the future.

**Course Outline:**

1. Definition and Concepts of Biogeography and Ecosystem
   1. Definitions  
      1.1.1.Biogeography

1.1.2. Ecosystem

* 1. Major Concepts:
     1. Biogeography
     2. Ecosystem

1.3. Historical Development of Biogeography

1. Biogeography and creation
2. Major Classifications of Biogeography
   1. Historical Biogeography
   2. Mammal Biogeography
   3. Island Biogeography
   4. Marine Biogeography
   5. Ecological Biogeography
   6. Molecular and Isotopic Biogeography
   7. Conservation Biogeography
   8. Biogeography Today
3. Development of Ecological Biogeography
4. Biogeographical Regions of the World
   1. Major Regions
   2. Patterns of Distributions
   3. Dynamics
   4. Factors
   5. Crisis Management to Biogeographical Loss
5. Biogeography and Ecosystem Modelling
   1. Biogeography Modelling
   2. Modelling Biomes and Climate
   3. Ecosystem Modeling
   4. Biogeography and Ecosystem Modeling: tradeoffs and synergies
6. Modeling approaches for Integrated Environmental Assessment and Management
   1. The dynamics of ecosystems
   2. Approaches to modeling complex systems
   3. Modeling cycle
   4. Considerations for model choice
      1. Model Purpose
      2. Types of data available
      3. Output requirements
      4. Optimization versus scenario-based approaches
   5. Application of models for the evaluation of ecosystem services
   6. Model transfer in space and time
7. Species Distribution Models for Managing Biodiversity under Future Climates
   1. Habitat fragments and fragmentation
   2. Species versus Community distribution
   3. Factors Impacting the Design and Utility of Species–Climate Models
      1. Biological Factors
         1. Interspecific interactions
         2. The appearance of unprecedented environmental domains
         3. Time lags and historic accidents
         4. Species mobility
         5. Evolution and adaptation
         6. Capacity to emigrate
         7. Land-use change
      2. Methodological Problems
         1. Incomplete sampling of niche space
         2. Cause and correlation
         3. Scale mismatch
   4. Decision making using SDMs Under Future Climates
8. Interpreting the past and foretelling the future
   1. Interpreting the Past I Molecular and Isotopic Biogeography.
   2. Interpreting the Past II Principles and Practice.
   3. Foretelling the Future.

**Mode of delivery/Learning strategies**

Lecture, computer lab, Practical work – conductance and completion of bio-geographical modeling and GIS analysis of model data for ecosystem management (group/individuals), three field excursions to visit different bio-geographical regions in Ethiopia)

**Assessment Methods:**Class attendance and participation, individual and group reports and presentations, field reports and final examination

**Reference**

1. Lomolino, Riddle, Whittaker, Brown. (2010). Biogeography 4th ed. Sinauer Assoc. Inc. USA.
2. MacDonald GM (2003) Biogeography: Space, Time and Life. John Wiley and Sons, Inc. ISBN 9780471241935
3. [C. Barry Cox](http://eu.wiley.com/WileyCDA/Section/id-302479.html?query=C.+Barry+Cox), [Peter D. Moore](http://eu.wiley.com/WileyCDA/Section/id-302479.html?query=Peter+D.+Moore) (2011) Biogeography: An Ecological and Evolutionary Approach, 9th Edition
4. [C. Barry Cox](http://eu.wiley.com/WileyCDA/Section/id-302479.html?query=C.+Barry+Cox), [Peter D. Moore](http://eu.wiley.com/WileyCDA/Section/id-302479.html?query=Peter+D.+Moore) (2010) Biogeography: An Ecological and Evolutionary Approach, 8th Edition
5. [Richard Ladle](http://eu.wiley.com/WileyCDA/Section/id-302479.html?query=Richard+Ladle) (Editor), [Robert J. Whittaker](http://eu.wiley.com/WileyCDA/Section/id-302479.html?query=Robert+J.+Whittaker) (Editor) (2011) Conservation Biogeography ISBN: 978-1-4443-3503-3, 320 pages, February 2011, Wiley-Blackwell
6. [C. Barry Cox](http://eu.wiley.com/WileyCDA/Section/id-302479.html?query=C.+Barry+Cox), [Peter D. Moore](http://eu.wiley.com/WileyCDA/Section/id-302479.html?query=Peter+D.+Moore) (2005) Biogeography: An Ecological and Evolutionary Approach, 7th Edition. ISBN: 978-1-4443-1117-4; 440 pages, April 2009, ©2005, Wiley-Blackwell.

**Module Four: Seminar and M.Sc. Theses research**

**Course 1**. Seminar

**Course core:** BdEM5412

**1 Cr hr/2 ECTS**

**Course description**

The course is primarilystudents’ independent work which should be supported by supervisors. The assigned Supervisor is expected to brief student about the nature of the course and intended learning outcome. And they are also expected to provide good supervision and follow the progress of the student. Students are expected to write seminar paper of topics related to current topics and related to biodiversity conservation and ecosystem management. Finally they are expected to make a presentation of their work.

**Course Objectives**

At the end of this course, students will be able to:

* Review and critically analyze scientific articles and papers related to current topics and advances in biodiversity conservation, ecosystem services and management.
* Present scientific papers and with appropriate delivery methods using visual aids of computer generated techniques.

**Assessment Methods**

* Preparation and presentation of seminar paper on current issues biodiversity conservation, ecosystem services and management accounts 100% of the evaluation.
* structural organization
* relevance and up to datedness of the topic
* Originality (critical review of the student, student's own work)
* Presentation skill and manner
* Subject matter knowledge

**2**. MSc Thesis research

**Course core:** BdEM6421

**6 Cr. Hrs/ 10 ECTS**

1. The textbook by Greene is accompanied by a CD-Rom, which contains working examples, data sets and codes for running various econometric procedures. The codes can be adapted for use by students during their project papers. STATA is also widely used and a significant amount of codes are published as annex to the recommended complementary book by Deaton. In addition, both software packages have examples and programmed codes in their help window. Online assistance is also readily available. IFPRI has training materials for STATA.Not found in the text. [↑](#footnote-ref-1)
2. [↑](#footnote-ref-2)