Response farming and weather disaster management option

Lecture-6

Contents

- Response farming
- Weather disaster management options

Response farming

❖ **What is Response Farming?**

- Framing flexible adaptation strategies for the forth coming rainy season.
- It is methodology that identifies and quantifies seasonal rainfall related risk and guides to develop strategies for addressing them at farm level.
- This approach couples seasonal rainfall forecast with appropriate agronomic responses/tactics concerning crop planning.

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- It is a flexible system of farming in which key farm decisions affecting crop water utilization is taken in response to pre season and early season rainfall predictions.
- It focuses on water and its management at farm level for sustaning crop production by reducing climate related risks.
- Response farming focuses on water, and on farm management with respect to water.

Hypothesis for Response Farming

- Solutions to farming problems may be found for improved forecast of expected seasonal rainfall behavior in the cropping season.

Aim of Response Farming

- To exploit high rainfall seasons potential and minimize the risk of crop failures in poor rainfall season using rules based on date of onset and early season cumulative rainfall.
- Use interaction of rainfall and farming system to optimize crop production

❖ Need following:

- ✓ start date and amount of rainfall
- ✓ yield for corresponding amount of rain
- ✓ use to construct a “rainfall flag”

Which forecast is suitable for Response Farming

- Long range weather forecast and Seasonal climate forecast, since they have enough lead time to take farm decision on land use pattern, crop planning, technology selection and tailoring.

Where Response Farming is Useful

- Arid and Semi arid climate region
- Regions with frequent climate variability
- Where adaptations strategies developed already at village level

The General Approach and Notes on Usefulness

- Two approaches to overcoming the water constraint present themselves.
  - ✓ The more obvious one is to take control of the water supply and dispense it through irrigation schemes.
  - ✓ The remaining alternative is prediction of expected rainfall behavior, season by season, coupled with responsive management of the cropping system.
- The overall goal is to maximize crop yields and returns per unit of rainfall received.
- Considering the different farm activities required to achieve this, it is more useful to express the goal in two darts.
  - ✓ First is to maximize the fraction of total rainfall actually used by crops – termed evapotranspiration or, conversely, to minimize the fraction wasted.
  - ✓ Secondly, to maximize crop yields and returns per unit of water evapotranspired.

Weather disaster management options

- Disaster is defined as a crisis situation causing wide spread damage which *far exceeds our ability to recover*.
- Disasters are not totally discrete events. Their possibility of occurrence, time, place and severity of the strike can be reasonably and in some cases accurately predicted by technological and scientific advances.
- It has been established there is a definite pattern in their occurrences and hence we can to some extent *reduce the impact of damage* though we cannot reduce the extent of damage itself.

Types of Disaster

- Disasters can be classified in several ways. A possible subdivision is between:
  - ✓ Natural disasters are events which are caused by purely natural phenomena and bring damage to human societies (such as earthquakes, volcanic eruptions, hurricanes, floods, landslides, etc);
  - ✓ Human-made disasters are events which are caused by human activities (such as atmospheric pollution, industrial chemical accidents, major armed conflicts, nuclear accidents, oil spills), and
  - ✓ Human-induced disasters are natural disasters that are accelerated/aggravated by human influence.

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- The phases of all disasters, be it natural or man made, are the same.
- The disasters often differ in quantity of damage caused or in quality of the type of medical consequences.
  - ✓ For example earthquakes cause a lot of physical injury and fractures, floods cause drowning deaths and infections, chemical leaks cause toxic manifestations, etc.
- Natural disasters are extreme events within the earth's system which differs substantially from the mean, resulting in death or injury to humans, and damage or loss of valuable good, such as buildings, communication systems, agricultural land, forest, natural environment.

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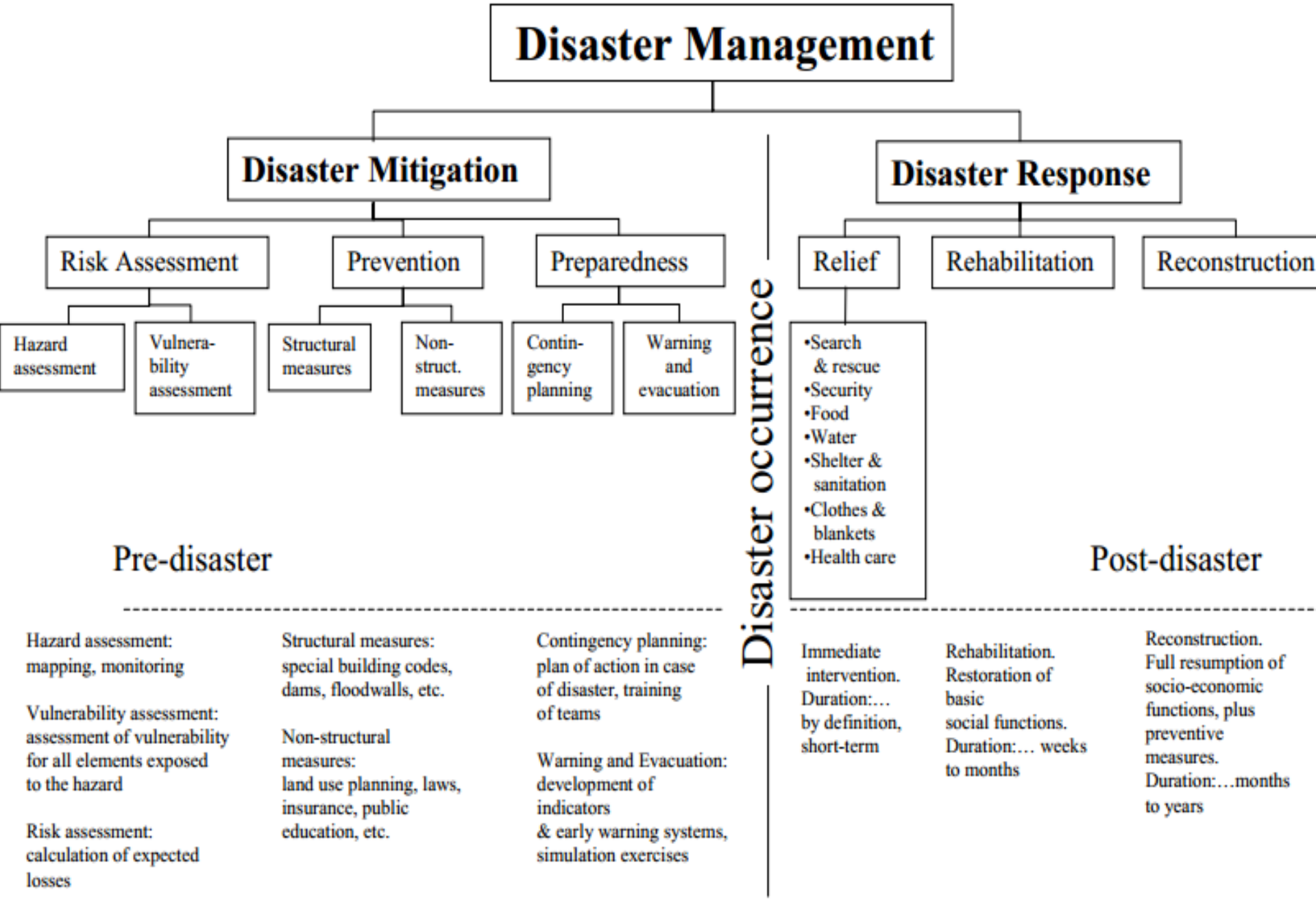
- They are a profound impact of the natural environment upon the socio-economic system.
- This impact may be rapid, as in the case of earthquakes, or slow as in the case of drought.
- Natural disasters occur in many parts of the world, although each type of disaster is restricted to certain regions.
- The impact of natural disasters to the global environment is becoming more and more severe over the last decades.
- The reported number of disaster has dramatically increased, as well as the cost to the global economy and the number of people affected.

DISASTER MANAGEMENT

- To effectively reduce the impacts of natural disasters a complete strategy for disaster management is required, which is also referred to as the disaster management cycle.
- Disaster management consists of **two phases** that take place before a disaster occurs, **disaster prevention and disaster preparedness**, and **three phases** that happen after the occurrence of a disaster, **disaster relief, rehabilitation and reconstruction**.
- Disaster management is represented here as a cycle, since the occurrence of a disaster event will eventually influence the way society is preparing for the next one.


Disaster Management
Disaster Mitigation
Disaster Response
Risk Assessment
Prevention
Preparedness
Relief
Rehabilitation
Reconstruction
Hazard assessment
Vulnera-bility assessment
Structural measures
Non-struct. measures
Contin-gency planning
Warning and evacuation
•Search & rescue
•Security
•Food
•Water
•Shelter & sanitation
•Clothes & blankets
•Health care
Disaster occurrence
Pre-disaster
Post-disaster
Hazard assessment: mapping, monitoring
Vulnerability assessment: assessment of vulnerability for all elements exposed to the hazard
Risk assessment: calculation of expected losses
Structural measures: special building codes, dams, floodwalls, etc.
Non-structural measures: land use planning, laws, insurance, public education, etc.
Contingency planning: plan of action in case of disaster, training of teams
Warning and Evacuation: development of indicators & early warning systems, simulation exercises
Immediate intervention. Duration:… by definition, short-term
Rehabilitation. Restoration of basic social functions. Duration:… weeks to months
Reconstruction. Full resumption of socio-economic functions, plus preventive measures. Duration:…months to years

Managing climate risk

- The ability to manage climate risk is fundamental to disaster prevention and preparedness.
- Climate information can improve prevention and preparedness, but it must be readily available and understandable to those who need it.
- The International Federation of Red Cross and Red Crescent Societies (IFRC) first employed a seasonal forecast to trigger an emergency appeal for preparedness for a rapid-onset disaster before the 2008 West African floods.
- This was not the first time a humanitarian organization had used climate information to mitigate, prepare for, or respond to a disaster, but it did highlight the specific opportunities of using this information more systematically.

Impacts of Natural Disasters in Agriculture

- Impacts from natural disasters on agriculture, rangeland, and forestry can be positive or negative.
- While the impacts are predominantly negative and do affect human society significantly, there are some positive impacts or benefits that can occur.
- The impact of natural disasters on agriculture, rangeland, and forestry can be direct or indirect in their effect.

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- Direct impacts arise from physical damage on crops, animals, and trees caused by the extreme hydro-meteorological event.
  - ✓ The impacts may be considered in terms of short-term, temporary damage at a particular crop stage to complete crop loss.
  - ✓ Within hours of their occurrence, natural disasters produce direct damage to agriculture in terms of total or partial destruction of farm buildings, installations, machinery, equipment, means of transport, storage as well as damage to crop land, irrigation works, dams, and destruction of crops ready for harvesting.

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- Disasters also cause indirect damage which refers to loss of potential production due to disturbed flow of goods and services, lost production capacities, and increased costs of production.
  - ✓ Such indirect impacts appear progressively as a result of low incomes, decreases in production, environmental degradation, and other factors related to the disaster.
- The impacts of natural disasters can also be classified as tangible or intangible.

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- Tangible impacts are those that can be easily measured in monetary terms.
- Intangible impacts are often difficult to measure in monetary terms.
- Many famines in pre-20th century Africa, Asia, and Europe were triggered by natural disasters, including drought, extreme cold, pests and diseases that devastated crops and livestock.
- In the case of agricultural income generating assets, the loss might be temporary or permanent.

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- Floods make land unsuitable for agricultural production until waters recede, while hurricanes might wash out arable land or permanently increase its salinity through storm surges and flash floods.
- Poor nations suffer the most from the natural disasters. Poor people are more exposed because they tend to live in marginal areas and depend on high-risk, low return livelihood systems such as rain-fed agriculture and face many sources of economic vulnerability including little physical infrastructure.

Mitigating the Impacts of Natural Disasters

- Socio-economic losses cannot be entirely eliminated, but timely and appropriate mitigation measures can certainly reduce the impacts.
- The Plan of Implementation of the World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002 highlighted the need to mitigate the effects of droughts and floods through such measures as
  - ✓ Improved use of climate and weather information and forecasts,
  - ✓ Early warning systems,
  - ✓ Land and natural resource management,
  - ✓ Agricultural practices, and
  - ✓ Ecosystem conservation in order to reverse the current trends and minimize degradation of land and water resources.

Improved use of Climate and Weather Information and Forecasts

- The interaction between weather and agricultural production is so complex that it is not just a case of developing a simple solution and expecting farmers to implement it.
- Each year or season will bring a different set of circumstances and hence the farmers have to make their decisions based on each situation.
- Hence a participatory approach involving the representatives of the National Meteorological and Hydrological Services (NMHSs), the agricultural extension agencies, and the farmers is necessary.
- One basic requirement is the awareness of the influence of weather and climate parameters on sustainable agricultural production.

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- In many cases, this awareness is acutely present and many farmers often look for intelligent, low-risk solutions. This should stimulate an interest among the farmers to evaluate the forecast products produced by the NMHSs.
- The principal scientific basis of seasonal forecasting is founded on the premise that lower-boundary forcing, which evolves on a slower timescale than that of weather systems, can give rise to significant predictability of atmospheric developments.
- These boundary conditions include sea surface temperature (SST), sea-ice cover and temperature, land surface temperature and albedo, soil moisture, and snow cover, although they are not all believed to be generally of equal importance.

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- Climate variations, also called anomalies, are differences in the state of the climate system from normal conditions (averaged over many years, usually a 30- year period) for that time of the year.
- The key weather variables for crop prediction are rainfall, temperature, and solar radiation, with humidity and wind speed playing also a role.
- Seasonal climate forecasts are able to provide insight into the future climate evolution on timescales of seasons and longer because slowly-evolving variability in the oceans significantly influences variations in weather statistics.
- Seasonal forecasts can be produced using mathematical models of the climate system.

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- A wide range of forecast methods, both **empirical-statistical techniques** and **dynamical methods**, are employed in climate forecasting at regional and national levels.
- Operational empirical-statistical methods, based on statistical links between current observations and weather conditions in the future, include
  - ✓ Analysis of general circulation patterns;
  - ✓ Analogue methods;
  - ✓ Time series, correlation, discriminant, and canonical correlation analyses;
  - ✓ Multiple linear regression;
  - ✓ Optimal climate normals; and
  - ✓ Analysis of climatic anomalies associated with El Nino-Southern Oscillation (ENSO) events.

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- Dynamical methods are model-based, using either atmospheric the General Circulation Models (GCMs) in a two-tiered prediction system, or the dynamically coupled atmosphere-ocean GCMs.
- These dynamical forecast models
  - ✓ An extension of the numerical methods used to predict the weather a few days ahead are based on systems of equations that predict the evolution of the global climate system in response to initial atmospheric conditions and boundary forcing from the underlying ocean and land surfaces.

Early Warning Systems

- A fundamental condition for disaster preparedness is the availability of risk assessments and well functioning early warning systems that deliver accurate and useful information in a timely and dependable manner to decision makers and the population at risk.
- While natural hazards may not be avoided, the integration of risk assessment and early warnings with prevention and mitigation measures can stop many hazards from becoming disasters.
- This means that action can be taken to considerably reduce the resulting loss of life and socio-economic damages.
- Without doubt, a fundamental pre-condition for disaster preparedness is a well-functioning early warning system, capable of delivering accurate information to the population at risk, dependably, and in a timely manner.

More Efficient Management of Land and Water Resources

- When prolonged natural disasters such as droughts occur, the high temperatures and low precipitation in the dry lands lead to poor organic matter production and rapid oxidation.
- Low organic matter leads to poor soil aggregation and low aggregate stability leads to a high potential for wind and water erosion.
  - ✓ For example, wind and water erosion is extensive in many parts of Africa. Excluding the current deserts, which occupy about 46 % of the landmass, about 25 % of the land is prone to water erosion and about 22 % to wind erosion.

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- On the contrary, during periods of heavy rainfall, eg., during cyclones, rainfall can erode soil by the force of raindrops, surface and subsurface runoff, and river flooding.
- The velocity of rain hitting the soil surface produces a large amount of kinetic energy which can dislodge soil particles.
- Erosion at this micro-scale can also be caused by easily dissoluble soil material made water soluble by weak acids in the rainwater.
- The breaking apart and splashing of soil particles due to raindrops is only the first stage of the process, being followed by the washing away of soil particles and further erosion caused by flowing water.
- The greater the intensity of rainfall and subsequent surface runoff, the larger the soil particles carried away.

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- Hence it should be apparent that natural disasters have a great impact on soils and the prevailing agricultural production systems, so farm technologies and management options have to be adapted to maintain soil functions for crop production to secure sustainable agricultural production.
- Agricultural practices adopted in regions that are continuously prone to natural disasters such as droughts and floods can strongly impact soil functions in the short term, and farming technologies and management can play an important role in these processes.

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- ✓ For example, improper irrigation schemes and use of irrigation water with high salt content can increase salinity of soils, making them unusable for agricultural production.
- ✓ Other examples are overgrazing in the Sahel zone and other semi-arid regions which for various reasons can lead to wind erosion and desertification.
- ✓ In temperate regions with high-input systems, heavy machinery use, often in combination with slowly developing crops and soil cover, contributes to soil compaction; which can decrease water infiltration, increase runoff, and result in water erosion.

Thank you!!!