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To the Loving Memory of My Mother

Preface

After numerous scientific papers and books on most aspects of climate change and the design of pro-environmental policies (including some that suit some industrial lobby or another), is there relevance for another book and what is the purported role of this one? Is this yet another academic exercise or "much ado about nothing"? Do we have to bother designing green economic policies and incur transaction costs of this effort? Are there shortcomings of existing policies if we care to live "happily" on this planet? Is it not enough to care for the current generations so that the future generations can take care of themselves (or even be given the incentives for innovations – for lack of fully provided resources)? What can "we" do about the green economic policies (and what are these anyway)? What trade-offs, if any, are relevant in foregoing some benefits and in incurring some costs (not all of which can be expressed in monetary units)? What are the overarching objectives and priorities in the current context? What economic and other approaches are relevant for attaining the objectives? These are some of the questions the author reflected in writing this book.

After a few book publications that I launched about a decade ago, and after sustaining most of these foundations that have been found rather resilient, I believe this book strengthens the cause of green economic policy formulations and implementations in the interests of the humanity, not to exclude the rest of living creatures.

Undoubtedly a number of significant thoughtful contributions have been made by a variety of scientific disciplines and expertise, and it is hoped that this book offers a few additional insights for policy formulations and their implementation in a cost-effective manner. Much of what is suggested in the design and implementation of green economic policies here holds relevant even when there is an element of uncertainty about the degree of climate change, since the primary motivation is not merely to address change issues but a meaningful balancing of economic, environmental and social sustainability requirements with improved mechanisms of governance.

Readers' familiarity with economics is useful, especially in dealing with Chap. 4. Rather than detailing all relevant concepts in the text chapters, an extensive glossary is provided at the end of the book.

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P.K. Rao

Contents

Chapter 1
Introduction

Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs
(World Commission on Environment and Development, 1987).

Abstract This chapter lays the foundations: highlights emerging environmental problems as assessed in recent scientific studies, explains approaches of green economics, integrates these with the imperatives of economic and environmental resilience, and advocates the role of green economic policies that go beyond but not ignoring relevant realistic economic principles.

1.1 Why Green Economic Policies and What Are These?

Green economic policies (GEP) seek to ensure that environmental factors and socio-economic factors are taken into account in all economic policies, as if people and the earth's resources matter. These are usually based on the premise that environmental resources are not to be treated as free goods merely because there may not currently operate a price system (market-based or other) that sets a price on, say free high quality air or water. This is because the element of quality and free access has its own cost and price which, if not taken into account, can and will lead to a paradigm shift forcing resource users to pay high price or even be deprived of it over time. Besides, the effects of ignoring the relative thresholds limits of utilization various natural resources lead to adverse direct and indirect consequences, some of which are irreversible.

1.1.1 Objectives of GEP

- Attainment of sustainable development on an inclusive basis, where life matters;
- Application of realistic economic principles and methods for the design of economic and environmental policies affecting the efficiency of governance

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in a cost-effective manner, where costs include all resource costs as well as transaction costs;
- Efficient policies and institutions based on complementary roles of markets, regulations, and stakeholder participation;
- Policies and institutions addressing short-term priorities consistent with long-term objectives; and,
- Efficiency norms include economic, environmental, and social criteria with the role of adaptive efficiency.

These objectives will be relevant throughout the presentations in this book; some are explicitly stated and some are implicitly covered in various sections. Also, the design of GEP need not do away with neoclassical economic approaches although these may have partly contributed to the emergence of the current problems in the first place with their undue reliance on market parameters. We seek policy solutions with greater appreciation of institutional issues, new institutional economic and transaction cost perspectives.

An overarching formulation of framework draws primarily on the approaches of New Institutional Economics (NIE) combined with other aspects of economic investigation, including Transaction Cost Economics (TCE) (for more details on these aspects see Rao, 2003), and this enables using methods and tools of neoclassical economics wherever relevant within that framework. One of the reasons for this relative sequencing of approaches is the recognition of the critical role of institutions and of transaction costs. It may suffice to state here that a pragmatic approach that has potential for adoption is better than a non-pragmatic alternatives that never get considered under normal circumstances. This is not a suggestion toward unreasonable compromises in attaining desired objectives and goals of socioeconomic and environmental systems for their efficient governance in the short run as well as in the long run, but the idea is simply to make approaches and policies as practically feasible as possible. Also, policy formulations in this book neither obey "one size fits all" patterns. Accordingly, a great degree of flexibility for selection of rational choices needs to be left to the countries and regions, and to a reasonable extent to organizations and institutions – as long as the flexibility is not availed as freedom to usurp resources or indulge in economically, environmentally or socially damaging activities.

Those who believe a great global technical-economic model will yield "optimal" policies leading to GEP and thus offer effective solutions to climate change and its consequences in a cost-minimizing manner (where costs are not merely monetized costs) may need to reflect on the veracity of such claims in relation to the real world. The premise and deployment of principles, methods and policy prescriptions under the regime of GEPs stated in this book is largely a beginning being made in right earnest. Formal economic models do have a place in this approach but only within an overarching framework that provides for the roles of institutions, takes all real costs into account, and avails objectives that are inclusive (of all sections of society) and recognize the roles of equity. There is a long way to proceed from here. For one thing, some of the relevant tools are not covered here in the book; these are partly

developed elsewhere in literature and require sufficient modifications to bring them to greater realism. For example, if the tools relevant for environmental valuation are used they need to reflect meaningful value framework, beyond the neoclassical economics founded largely on "whosoever benefits accrue" value maximization (with little regard to attendant externalities, including narrow approaches to mitigating externalities). What good are market approaches, which theoretically promise economic efficiency – if the markets are awfully imperfect and can only lead to resource capture and rent-seeking, or if these markets are incapable of reflecting the relative scarcities of resources until and unless these resource factors show up in market factors directly?

GEP, if devised sensibly, need not hamper economic prosperity or quality of life; in fact, their main objective is to enhance the latter and sustain for the future. The critical issue in the design of these GEP is to be able to assess and exploit synergistic mechanisms of integrating economic, environmental and social factors to their mutual advantage both in the short run and in the long run. Should there be a conflict among them in the pursuit of one of these three individual features, a meaningful reconciliation should be carried out "efficiently". Later parts of this book will deal with the details of efficient governance, based on objective criteria.

1.2 Global Climate Change and Environmental Features

Since a number of environmental changes arise out of the phenomena of global warming (GW) and climate change (CC), it is useful to briefly recall the early assessment of global warming problems in relation to carbon dioxide (CO_2) emissions. Let us briefly clarify the concept of CC, following the United Nations Framework Convention on Climate Change (UNFCCC): "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods". CC is a broader notion than greenhouse effect (GE) or GW – since these two refer merely to the underlying processes contributing to CC. Since CC leads to a complex set of changes and destabilizes several systems, a comprehensive understanding of the issues and potential options to address the current and likely future problems is important. Fortunately, considerable work has already been undertaken form almost all fields of human knowledge, and policy as well implementation is slowly catching up with the tasks. Given the tardiness of the policy-based actions at various levels and sectors, a lot more attention to these aspects will be more productive.

1.2.1 Global Warming-Historical Background

Arrhenius (1896) was one of the earliest to seek explanations for temperature variations over thousands of years and noting the role of the earth's planetary

radiational balances. Scientific discoveries of the existence of the phenomenon of global warming may be attributed to Roger Revelle who discovered that the special features of the chemistry of the sea prevent substantial absorption of "excess" carbon dioxide emissions generated by human activities; he observed potential for global warming as a mere relationship and not to sound alarm at that time (see Revelle, 1971; Weart, 2003). Subsequently, several prominent scientists from a number of scientific disciplines asserted the bases and evidence.

Concerned with the scale of problems, the Swedish government launched an initiative for global summit. This was supported by the US Government and led to the first worldwide environmental conference on environmental issues; the UN Conference on the Human Environment was convened in 1972 in Stockholm. One of its by-products was the formation of the UN Environment Programme (UNEP), but more importantly, it led to a series of global and local debates focusing attention on environmental and climatic changes.

1.2.2 Effects of Climate Change

These adverse changes include, but not limited to loss of biological variety and endangering a number of species to the point of extinction, meltdown of glaciers and accelerating sea level rise and coastal flooding, magnifying weather extremities and threatening basic livelihoods in several regions of the world (especially in those with populations that possess least resource base or safety net), accelerating civil strife and security, exacerbating incidence and spread of diseases, and magnifying socio-economic and environmental instabilities. Broad consequences of climate change include, in addition, adverse impacts on the agriculture and rural development sectors, enhanced water insecurity and consequent ripple effects of loss of income-health-productivity, and several others. The human contributions to these adversities arise largely from unsustainable patterns of production and consumption, explained in detail in later chapters.

With reference to the impacts of global climate change, a recent 2009 report from the US Global Change Research Program, an interagency consortium at the federal government level, listed the following findings, inter alia:

(a) CC will stress water resources;
(b) Crop and livestock production will be increasingly challenged;
(c) Coastal areas face greater risks from sea-level rise and storm surge;
(d) Risks to human health will increase;
(e) Thresholds of environmental and ecological systems will be crossed and loss of resilience could be an outcome affecting species and the larger society.

Earlier, in 2007, the US Geological Survey (USGS) announced its prediction that changes in sea ice conditions could result in a loss of two-thirds of the world's polar bear population by 2050. Changes in agro-economic or other life supporting systems aggravate instabilities of societies.

1.3 The IPCC Reports

The UN-governed Intergovernmental Panel of Climate Change (IPCC) issued several major reports of study based on effective cooperation between hundreds of scientists around the world. The Nobel Prize-winning IPCC concluded that CC is "unequivocal", that humankind's emissions of greenhouse gases are than more than 90% likely to be the main causes of changes. The IPCC Report released its Fourth Assessment Report in November 2007 (IPCC, 2007). It predicts temperature rises of 1.8–4.0°C by 2100. The Panel concluded that "human influences have very likely contributed to sea level rise during the latter half of the twentieth century" and that changing wind patterns and increased temperature extremes have "likely" been a result of human activities. The Report warns that climate change could lead to "abrupt or irreversible" (or both) effects. Such major events can cause substantial misery to populations and result in catastrophic losses.

Regarding some of the region-specific effects of CC, the Report suggests that, by 2020, up to 250 million people may experience water shortages and in some African nations, food production could fall sharply, and also lead to food shortages for 130 million people across Asia by 2050. The report suggests that a 3.6°C increase in mean air temperature could decrease rain-fed rice yields by 5–12% in China. The increased patterns unsustainable agriculture, including the role of production in the livestock sector production, and attendant land use changes, may exacerbate the effects of climate change.

Among the highlights of the IPCC findings in its Fourth Assessment Report 2007 (see details at www.ipcc.ch):

Probable temperature rise in the range 1.8–4 C
Sea level most likely to rise by 18–59 cm
Very likely increase in heat waves
Accelerated melting of ice glaciers and species extinction.

The IPCC Working Group I Report (prepared for the Fourth Assessment Report, 2007) observed, inter alia:

(a) GW and sea level rise would continue to occur for centuries, due to time-lags in climate reactions on account of current and future concentrations of greenhouse gases, even if these are stabilized very soon;
(b) Warming is expected to be the greatest over land and at most high northern altitude.

1.4 More Recent Assessments

Recent independent studies indicate that some of the IPCC projections may constitute conservative estimates and that it is more likely to have worse outcomes. These

relative modest estimates in the IPCC Reports are due to the models and analysis underlying the reports did not fully incorporate the ice melting effects of Greenland and the Arctic region, regarding which more recent findings indicate severe melting problems, to contribute to sea level rise more than originally anticipated, in addition to biodiversity loss and other adverse effects. The severity of some of these problems is to be classified not simply under adverse effects of climate change but as serious environmental tipping events. The March 2009 International Scientific Congress on Climate Change in Copenhagen deliberated some of the major studies that indicated that the level of sea level rise by 2100 could be in the range of one meter, substantially higher than the IPCC projections.

CC-related sea level rise and *agricultural* disruption could cause 100 million environmental refugees in the year 2030 which could exacerbate insecurity in host countries and regionally. The flooding of some of the coastal regions and changes in their economic infrastructure may cause instability. In fragile circumstances, environmental stress could act as a destabilizing factor exacerbating conflict as it combines with other socio-political factors. Peace and security are prerequisites for realizing the benefits of sustainable development (SD) or even sustaining some sense of stability.

The Catlin Arctic Survey led a scientific team headed by Peter Wadhams at Cambridge University to conclude that the Arctic is warming is so rapidly that the region will be ice-free in summers within a decade. It has been observed that recent observations of global-average emissions show higher levels than the worst-case A1F1 scenario suggested by the IPCC in its Fourth Assessment Report (IPCC, 2007). The feedback (amplifier/multiplier) effects of accelerated change remain serious concerns, viz. the interaction of several of climate effects among themselves for a given magnitude of climate change. The evidence from the Arctic melting is disturbing and may be a foreteller of feedback effects. While the Earth has warmed by about 0.7° (F) over the past 150 years, the Arctic has warmed by two to three times that magnitude. This amplification arises from the continuous feedback mechanisms: ice melting leading to greater albedo effect when sea waters absorb more sun light, which in turn diminishes reformation of ice in winter. The irreversible loss of flora and fauna in the Arctic, in addition to other changes, suggests a serious loss of ecosystems on the planet, as per a very recent study. The Arctic is currently transforming at such rapid rate that it may soon be a geophysical thing of the past (Post et al., 2009).

Identifying and quantifying planetary boundaries for operational purposes such as greenhouse gas emissions, biodiversity loss, and ozone depletion could enable sustaining life on the planet Earth as we know it. The specifications themselves admit some element of interdependencies, with the requirement that each component of the biogeophysical system maintains resilience features (some details given by Rockström et al., 2009, but we have a long way to find out much of the required specifics). For policy action, higher trends in temperature with larger uncertainty and geographic variability warrant greater urgency and integrated approach for adaptation as well as mitigation strategies affecting climate change (see also Ganguly et al., 2009).

Is there any recent observed slow down in GW? Internal climate variability (ICV), viz. the capacity in the oceans for slow natural variations in the oceans to temporarily modify climate, is largely responsible for a lull in the continuous rise of mean temperatures of the planet during 2008. Since all other signals point in the same direction of climate change, it would be naïve to interpret a very short-term thermal stability in terms of possible less than best possible action to prevent and mitigate related problems. It would be just as meaningless if we construe that the fall in greenhouse gas emissions (GHGs) during 2008 and 2009 is a trend in itself -this period is a rather unusual recessionary phase of the economy when the production systems as well as consumption systems contract. Knight et al. (2009) explained that the decade of 1999–2008 is an episode that falls in one out of every eight decades of the pronounced role of ICV, and thus masking sustained rise in the planet's temperatures.

A recent report of the UNEP (2009), based on reviews of about 400 significant scientific contributions over the last 3 years, suggests that the impacts of CC are coming sooner and faster than anticipated in the IPCC (2007) and other major reports. Global GHGs emissions have been rising at an annual rate of 1.1% during 1990–1999 but rose to 3.5% during 2007. The melting of ice glaciers in the Arctic has accelerated very rapidly and the rate of melting in the Greenland Ice Sheet region during 2007 is estimated at 60% higher rate than in 1998. Estimates of sea level rise could be far higher than the IPCC (2007) projections, and may be in the range 0.8–2 m by 2100. The Hadley Centre of the British Meteorological Office also released reports in September 2009 that confirm similar results as in the UNEP report. It predicts that global temperatures could rise by 4°C by 2050 if current greenhouse gas emissions continue. Climate feedback effects or multiplier effects seem to be posing greater adverse changes all around. Thinning of ice around Greenland and Antarctic is the result of interactions (called dynamic thinning) (see Pritchard, Arthern, Vaughan, & Edwards, 2009) and may accelerate sea level rise. Some of these recent studies also suggest that the likely CC is worse than the IPCC projections (see for example, Sokolov et al., 2009).

1.5 Recent Trends in Emissions and Contributing Factors

Vast amount of high quality research from a wide variety of scientific disciplines all over the world has concluding during the past 5 years, more than ever, that there are significant anthropogenic factors causing significant GW and CC. The relative roles of various greenhouse gases GHGs in GW and CC are well documented and it is not proposed to go into details here (see the IPCC Reports for relevant details).

The IPCC (Fourth Assessment) Report (IPCC, 2007) concluded: global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since industrial revolution; the increases in carbon dioxide concentration are primarily due to fossil fuel use and changes in land use patterns, while those of methane and nitrous oxide are primarily due to the agriculture sector (including industrial livestock farms).

It is generally viewed by scientists that keeping carbon dioxide concentrations below about 450 parts per million (ppm) of carbon is necessary if the average global temperature is to be contained at 2°C increase level and other major impacts minimized. It has been estimated that stabilization of carbon dioxide concentrations between 445 and 535 ppm would cost less than 3% of Gross Domestic Product (GDP), global average. Let us very briefly note the following, since these main elements reverberate in other parts of the book.

Three major gases cause GW and lead to CC: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Global warming potential (GWP) of these gases per tonne of emissions varies. For the purpose of converting to an equivalent scale of CO_2 emissions, CO_2 has been assigned a value of one GWP, and the warming potentials of other gases are expressed relative to its power on a CO_2-equivalent basis:

Carbon dioxide (CO_2) 1
Methane (CH_4) 23
Nitrous oxide (N_2O) 296

Global annual emissions of greenhouse gases increased from 24 billion tons (BT) of CO_2 equivalents in 1970 to 33 BT in 1990 and 41 BT in 2005. The increase of 15% during 2000–2005 is substantially higher than the previous two 5-year periods: 1995–2000 at 6% annual rate and during 1990–1995 at 3% annual rate (Source: European Commission's Joint Research Centre and the Netherlands Environmental Assessment Agency; www.pbl.nl/en, report of May 26, 2009).

In terms of sectoral contributions globally, power sector shares 24% of emissions, land use 18%, buildings 8%, other energy sources 5%, waste sector 3%, and transport, agriculture, industry share 14% each (Sources: World Resources Institute, and UNEP). Beside the energy sector, land use and its changes contribute the most toward CC. Also, this sector has substantial potential in mitigating adverse effects of CC, as we shall examine later in this book. At the outset it is relevant to note the salient features and significance of this sector, based on an assessment of the relationships between land use change and CC (Dale, 1997):

(a) land use change has made more impact on ecological resources than has CC;
(b) major segment of these changes are not the result of CC;
(c) further changes in land use can contribute adversely to ecological systems.

Regarding contributing factors in land use changes, forest area as a percentage of total land area dropped by 1.253 million km^2 globally during 1990–2005, and that of the developing countries has been more than this magnitude (1.382 corresponding units), positive contributions arose from some of the industrial countries, and most negative contributions have been from Latin American countries. Developing countries depicted twice the global average rate of loss during this time interval. Regarding the trend of carbon dioxide emissions during 1990–2004, developing

countries showed an annual growth rate of 5.7%, and the global average estimate is about 2% (UNDP, 2007).

Among the major environmental damages of concern are the loss of biotic species and endangerment to the ecological sustainability of some of the species or their ecosystems. This concern arises out of potential irreversibility of some of the losses and/or their adverse consequences. There is growing threat of possible extinction to about a quarter of the world's mammal species. After its 1996 assessment, the IUCN – the World Conservation Union (comprising a partnership of several countries, non-governmental and scientific organizations, with the participation of about 10,000 scientists) prepared its 2000 Red List of Threatened Species. According to this, the endangered primate species increased from 13 to 19 and of freshwater turtles from 10 to 24 during this short span (partly due to revised information and partly due to continued neglect of species preservation at various levels). The recent update of the IUCN Red List of Threatened Species of 2009 shows that 17,291 species out of the 47,677 assessed species are threatened with extinction. The results reveal 21% of all known mammals, 30% of all known amphibians, 12% of all known birds, and 28% of reptiles, 37% of freshwater fishes, 70% of plants, 35% of invertebrates assessed so far are under threat. The IUCN Red List shows that 1,895 of the planet's 6,285 amphibians are in danger of extinction, making them the most threatened group of species known to date. Of these, 39 are already Extinct or Extinct in the Wild, 484 are Critically Endangered, 754 are Endangered and 657 are Vulnerable. Approximately 85–90% of New Zealand's wetlands have been lost or degraded through drainage schemes, irrigation and land development.

When an increasing number of species are at risk, the corresponding potential impact of their losses on human health and prosperity remains an area of concern. A destabilized ecosystem leads to new biological equilibrium. This contributes to increased incidence of unknown diseases while, at the same and for the same common reason, reduces the ability of humans develop necessary medical and pharmaceutical remedies. Spread of more unknown diseases then must be handled with less biodiversity and diminished potential for pharmaceutical developments, leading to a more restricted set of potential options to address emerging diseases (which are themselves expected to increase or transform because of CC).

1.5.1 Progress in Remedial Actions

Rather limited progress has been achieved since the largest ever meeting of heads of government in Rio de Janeiro that led to the 1992 declaration Agenda 21 of the World Conference on Environment and Development. The 1997 Kyoto Protocol remains feeble, costly, and fails the test of making an impact. Many international agreements remain rather ineffective. There have been some successful agreements such as the 1987 Montreal Protocol for Ozone Depletion, however. Later chapters will deal with related international environmental laws and institutions. Some argue that a technology-led effort has a better chance of tackling CC, since countries that fear signing on to costly emissions reduction targets are likely to favor "cheaper,

smarter path of innovation" (Lomborg, 2009). Although innovations are important and urgent, a mix of policy interventions and stakeholder actions will form a cost-effective and rather expeditious approach to address CC and deploy GEP for sustainable development.

If we want to adopt a do nothing approach and await severe adverse consequences of CC, here is a fallacious clue: since environmental damages on the aggregate are currently estimated to "cost" about 2 percent of gross domestic product (GDP) as a global aggregate, and since the technical progress factor contributes toward that much rise in economic growth, we may not be far behind in staying afloat even with no significant action (although we may be floating with sea level rises, thanks to the adverse effects of climate change). The lesson is: technical innovation is a necessary but not sufficient condition for addressing the emerging crises.

International agreements often contribute toward low impacts of their policies, relative to what stakeholders (consumers, producers, non-governmental organizations and so on) can potentially contribute. If this potential is not properly availed, we may be left with the problems largely intact – with the implication that adverse consequences of CC will continue to haunt us for several decades and beyond.

Most of the economic studies fail to recognize the ecological interdependencies whenever they seek to estimate the economic value of biotic species. Thus, these studies offer little policy advice. The global community must exercise relevant wisdom and prudent action to ensure appropriate preservation of biotic species and other environmental or ecological assets. The role of economics is more meaningful in devising cost-effective (where costs include all realistically applicable ones, including transaction cost, defined later) measures to attain stated objectives and goals, than in lopsided valuations of nature or ecosystem services. The main role of economics is not to set socioeconomic and environmental objectives but the role is important to examine the implications under plausible variations of the specifications of objectives, constraints and policy alternatives, considering the underlying linkages among constraints and dynamics of economic and environmental systems.

A more important distinction in the application of economic methodology arises from the nature of the problems and scale of operations for which economics has not yet fully geared itself. It is in respect of the management of global resources, and broadly the global commons. Depending on the specific characteristics of the usage of global resources, societies and the world will undergo smaller or catastrophic changes in terms of loss of resources, or climate change, or other adverse phenomena. It would be naïve for an economist to deploy marginal cost pricing (i.e. at an equilibrium, incremental benefits of intervention justify incremental costs) in the absence of relevant functioning markets and in the presence of multiple equilibria (most of these belong in the unknown or not identifiable "markets").

Governance of global commons is based on a wide variety of institutions, policies and legal or other standards of resource use. Global commons includes natural systems and resources of the planet earth, such as land, atmosphere and oceans that belong to all living beings rather than specific nations or other institutions. These issues are examined in later chapters.

The formal definition of sustainable development (SD) arises from the concept (quoted at the beginning of this chapter) stated by the World Commission on Environment and Development (WCED, 1987), partly quoted at the beginning of this chapter. An elucidation of the concept and approaches focus on a variety of related interpretations and imperatives (including the role of poverty), explained in the next chapter (see also Rao, 2000).

Issues relating to equity of resource distribution and economic well-being are also seen as important in this context (Anand & Sen, 2000, p. 2030): "The moral value of sustaining what we now have depends on the quality of what we have, and the entire approach of sustainable development directs us as much toward as toward the future." Accordingly, a pursuit of the concept of sustainability may need to extend to dimensions not simply focus on the futurity or aggregate intergenerational well-being. The role of GEP is seen as balancing the current and future interests, with reinforcement of desirable objectives and policies over time. Some of relevant approaches for GEP draw upon Green Economics, briefly discussed below and explained further in Chap. 2.

1.6 Greening of Economics – Why and How

This sounds an exercise in academics because it is largely one that arises in the academic context but lays foundation for academic expertise often devoid of reasonable understanding of the need to integrate environmental factors into economic and social analyses. It is amazing that a majority of economic readings do not even mention the word environment even they discuss resources and factors of production. Similarly, a very large percentage of textbooks on development economics and other areas of economics fail to address the critical role of environmental factors in deriving economic growth policies (and thus obviously less aware of sustainability of economic growth issues while seemingly talking about economic growth per se). Even the so-called Handbooks on development economics and some popular economic growth textbooks fail to even mention one word about environment and ecology, in this era of environmental resource limitations and major adverse consequences of resource utilization. There seems to prevail academic inertia that allows a great degree of disjointedness between development economics and environmental economics. Besides, there is lack of integration between development economics and environmental analysis, and between environmental economics and poverty analysis (Dasgupta, 2001). At the level of basic economic texts, a survey (Reardon, 2007) of 17 textbooks being used in the US on economic principles, only two qualified for reasonable coverage integrating economic and environmental dependencies.

Environmentalists do not have to seek a favor when they simply seek that better reasoning be availed in comprehending the factors of economic production – a fundamental aspect of study of economic science. In relation to GW and global economic policies, Nobel Laureate Joseph Stiglitz stated: ". . .it will do us little good to solve our common global economic problems if we do not do something about the

most pressing common environmental problem: global warming" (Stiglitz, 2006). Since GW is an element of broader problems associated with the requirements of sustainable development approaches and the economics of governance, we deal with these aspects briefly here; details will follow in later chapters.

Finding the most effective ways and means of helping the planet Earth, and helping humans and all other species that co-inhabit this planet continues to remain a great challenge of our times more than ever in the past. There is an urgent need for a great amount of soul-searching and seeking a comprehensive holistic approach to the whole set of issues of environmental governance balanced with imperatives of economic and human well being. This book is an attempt in that direction of policy inquiry.

1.6.1 Green Economics and the Economics of Greening Economics

The role of green economics is: (a) to reassess mainstream (viz. neoclassical) economics and propose reform where needed, offering new perspectives capable of reflecting environmental considerations as an integral part of analysis; and (b) to promote "fairness, equity, participation and democracy with social and environmental justice at its core" (Kennet & Heinemann, 2006).

Ideally, green economics should focus on maximizing economic welfare within ecological constraints applicable at different temporal and spatial segments, that is, in the aggregate as well as disaggregate level so that none of the specific components are lost sight of (see also Wall, 2006). Green economics may seem like "turning mainstream thinking on its head" (Prugh, 2008). It requires, among other things, the need to contain the scale of usage of resources, focus more on balanced economic development rather than on economic growth for its own sake, seek to reflect ecological supporting services in market prices of goods and services that draw upon broader ecological systems (directly or indirectly), judicious governance of the global commons, and socio-economic justice.

The task of greening economics (other than in the areas of much of environmental economics) is to integrate socio-economic and environmental factors, and to pay attention to the need to ensure inclusive SD. The trouble lies in figuring out the cost elements when they do not directly affect market assessments of costs and benefits, and when regulatory requirements of compliance with environmental governance are absent, weak or incomplete. In all cases, it pays to sensitize economic methodology to environmental implications and seek efficient choices that enhance the economic productivity and environmental upkeep. Only such integration can contribute toward real progress of individuals and societies on a sustainable trajectory. It could otherwise imply actions with one step forward and several steps backward in terms of results. Subsequent chapters address these aspects of economic analysis and its methodology largely in relation to well-known mainstream economic approaches such as neoclassical economic approaches. One can say why bother fitting into such frameworks that proved themselves futile at least in offering

economic and environmental resilience, as depicted by the recent financial crises and accelerating environmental problems, respectively. The aim is to provide greater support to the modification of the tools of analyses that already exist, enabling easier adoption of revised and more useful approaches. Conceded that even more useful approaches drastically deviating from the contemporary economic paradigms may be advocated but they may belong more in the "wish list" than "to do list" (as far as the less convinced economists are concerned).

1.6.2 Demand for and Supply of Green Economic Policies

The demand for GEP is largely normative in the sense that individuals, institutions and other entities tend to seek GEP for one or more of the reasons, inter alia, the following:

(a) compliance requirements with local, national and international environmental laws;
(b) concern about the future of resource access and sustainability of consumption patterns;
(c) recognition of the need to ensure welfare and well-being of future generations;
(d) potential role of enhancement of efficiencies of economic and environmental policies with proper integration of environmental features with economic features in economic policy making; and
(e) revisions in the scientific knowledge base to bring policy actions to modernity and forward looking status.

Where then is the role of self-interest in affecting demand for GEP? This usually arises from an informed public and stakeholders who are willing to reconsider and reflect on their paths of livelihood and successes, in relation to the rest of the larger system – economic, environmental, and social. Communities, governmental and other organizations have a responsibility to stay informed and inform other stakeholders about the severe adverse consequences of "business as usual" (BAU) modes of production and consumption. This will form a foundation for reformation of economic policies and pragmatic action; in turn this will also contribute toward minimizing costs of disruption – be it because of changes in economic policies or because of inaction (BAU scenario). There is, however, little comparison in the costs of unwelcome and unplanned disruptions arising from inaction relative to the adjustment costs warranted of GEP – if the latter are "efficiently" designed and implemented at all levels of society.

The provision of GEP or the supply of GEP is not yet market-based because the relevant market is incomplete as well as imperfect. These, to a very large, belong in the public goods arena so far. Motivated by informed scientific knowledge, sponsored by governmental or other bodies and select donors, environmental and pro-environmental members of public engage themselves and contribute toward formation of GEP. It is not an area for the "experts" in economics only (perhaps many

economists did contribute much less than they could have toward ensuring sustainable development and GEP, either by inaction or by using wrong tools). Effective contributors for GEP and their implementation arise from a variety of disciplines and knowledge bases (including, of course, visionaries); it is unlikely that a unitary formal discipline of training will offer meaningful solution for problems of multi-disciplinary complexity.

Greater and more effective policy formulation that can deliver better results is what is urgently needed. The task lies not only on governments and other institutions but also very much on individuals and communities in terms of their need to reduce their demands on relative extractive resources and to balance their quality of life interests with the needs to preserve resource for the future. Stakeholders' active participation, community-based organizations availing resources of the non-governmental organizations, is an important and cost-effective mechanism that promises to promote greater harmony and consistency among economic, environmental and social objectives of life on this planet. This is achievable in a pragmatic rather than utopian framework if all stakeholders are aware of the imperatives and willing to do something about the tasks ahead, rather than free ride on some others' efforts. An ethical movement will also be called for the collective good. Some of these issues will be addressed in the last parts of the book.

Making economic institutions sensitive and responsive to natural resource constraints are among the prerequisites toward an ambitious survival goal, viz. effective earth management (Daily, Ehrlich, & Alberti, 1996). As the UN Secretary General Ban Ki-moon stated (2007): "...Our job... is to open the age of green economics and green development."

1.6.3 About the Rest of the Book

This book adheres to the stand that it is better to be approximately right than be precisely wrong, as long as the approximation is of reasonably high order – a best assessment based on realistic and objective outlook. The role of quantitative analysis is subsidiary to the role of institutional analysis, and analytical foundations remain more important than mechanics for number crunching where too many unknowns and unknowables exist, as in the complex long term climate dynamics and related economic dynamics. So-called "optimal" policy prescriptions derived from most of the formal economic models tend to neglect the role of institutional factors and realism in underlying assumptions is often lacking.

The next chapter explains the foundations of relevant economics for devising GEP, including the role of new institutional economics and transaction cost economics; the analytical features are explained in Chap. 3; Chap. 4 explains improvements and the parallels of criteria of efficiency, equity and optimality often explored in neoclassical economics.

Institutions and policies are given priority over sectoral issues and these are explained in Chap. 5. The need and role of a new world body on environment is suggested. Later chapters deal with the scope for improvements in the policies of the

World Bank, World Trade Organization and other major organizations. The adoption of ecosystems approach facilitating the adoption of GEP is suggested in several contexts, including in multilateral environmental agreements. Reform of institutions, focus on the roles of stakeholder participation in devising and implementation of GEP, and on the role of transaction costs at various for devising cost-effective strategies are some of the themes examined in relation to various thematic and sectoral strategies. A policy framework is also summarized in Chap. 9, followed by concluding remarks.

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Chapter 2
Basic Elements of Green Economics

Abstract The role of New Institutional Economics (NIE) in the design of institutions, efficient governance and formulation of policy framework for GEP are explained. The distinctions between various imperatives of environmental sustainability, sustainable growth, and sustainable development are examined in the context of devising GEP. Ecosystem approaches and ecological economic approaches are explained with applications in various sectors, including international trade. The roles of unsustainable production and consumption systems are summarized. The roles of environmental taxes are also examined. After examining the limitations of conventional economics, role of NIE (including transaction cost economics) as well as of revised neoclassical economic in GEP is explained.

Green Economics is built on the approaches of New Institutional Economics (NIE), Neoclassical Economics and its applications in Environmental Economics, including Sustainable Development Economics. Green Economic Policies (GEP) are devised using these methods, firstly qualitative but analytical, and secondly quantitative and comprehensive in their use of mathematical models. This book does not deal with the specifics of quantitative models and offers approaches and foundations, with the presumption that it is more important to be on the right track than be accurate in prescribing policy solutions with shaky foundations.

2.1 Role of New Institutional Economics

Institutions matter. NIE is an approach to expand the neoclassical economic methodology to include the role of transaction costs economics (TCE) and of institutions. It attempts to integrate the working of political and non-political institutions, varying economic institutions (including the roles of property rights, incentives, law and its enforcement, and so on). How is this done? Not necessarily by a formal optimizing model of the neoclassical economics type. A series of policy alternatives, and comparative analysis of organizations (and of institutional arrangements to the extent these are amenable for flexibility in the real world), and followed by the specifics of policy settings and parameters enable a rather comprehensive and realistic economic and institutional analysis that can contribute to the design of pragmatic policies.

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Let us define two relevant concepts here:

Institutional environment: The set of basic political, social and legal ground rules that establishes the basis of economic production, and various other transactions.

Institutional arrangement: An arrangement between economic or other units that governs the ways in which entities interact with each other, and offer a structure for potential changes.

These two aspects of governance determine the relative efficacies of market and non-market factors in meeting objectives of GEP. A "properly" designed institutional environment and institutional arrangement contributes to the attainment of objectives of GEP at least (total) cost. A conscious effort to design these and complement the operations with quantifiable methods of ranking of alternative choices (of instruments of policy and institutional arrangements) enables selection of policy instruments and implementation mechanisms.

Let us define important approaches and interpretations of transaction costs (TC):

1. The total (financial and economic) costs of undertaking a transaction, usually excluding direct production or other price-based costs. Typically, these costs include costs of obtaining and processing relevant information, monitoring and assessment of appropriate parameters in connection with the design and implementation of a policy or program, and other costs of pursuing a specific action.
2. Costs of undertaking a transaction, including search and information costs, negotiating costs and monitoring and enforcement costs, plus the opportunity costs of non-fulfillment of an "efficient" transaction.

One of the key factors in the above approaches is to examine the role of TC of various types (some measurable but others can be qualitatively ranked) and assess relative efficacies of polices in meeting the desired objectives and goals. For example, some of the recent studies of the European Union's Emissions Trading Scheme indicate that the Scheme carries significant TC in its operation, even if its design improves. Those who object to carbon taxes on grounds of costs of administering such taxes may have to reflect on specific options. Clearly, TC can form only one of the considerations in the choice of instruments for GEP.

NIE comprises a configuration of an institutional environment and its governance via institutional arrangements, with the application of analysis of TC. Application of NIE is a combination of first-order economizing to get the institutional environment right, and of second-order economizing to get the governance structures right (Williamson, 1998, 2000). The third-order economizing is what is often addressed in neoclassical economic models, for example seeking marginal conditions for efficiency in a utility or profit maximization problem and so on. NIE strengthens economic formalism for incorporating real world features.

The governance of resources takes different shapes, summarized in Box 2.1.

Box 2.1 Resource Regimes

Resource Regimes are generally classified into the following groups: state property regimes, individual property regimes, common property regimes, and open access regimes. The critical element of any property classification is the institutional governance mechanism. The institutional mechanism that is deemed to protect a property regime should be effective in the performance features in relation to the system characteristics, and remain cost-effective. In practice common property resource (CPR) regimes can transform into private regimes or open access regimes if the state or other institutional arrangement fails to devise and enforce proper governance mechanisms. If we ignore the initial or set up costs of provision and enforcement of rights, it is easier to interpret the merits of private property regimes. On the other hand, if the set up costs of institutional reforms are too high (or politically inconvenient) to effect reforms, these costs should be compared with the recurring costs of loss of efficiency under unreformed regimes. It is useful to recognize the existence of these elements and to take pragmatic reform measures that gradually move in a direction of "efficient" resource governance.

Nobel Laureate Elinor Ostrom contributed significantly to the governance issues of CPR and to the "design principles" for collective community roles (see, for example, Ostrom, 1990). The significance of local institutions in the governance processes has been demonstrated in theory and in several case studies. The role of monitoring has been integrated as part of collective participation problem. Dietz, Ostrom, and Stern (2003) argued that it is easier to achieve effective governance of the CPR when, among other elements, the resource users support effective monitoring and the rule of enforcement. Community-based SD management is an important aspect of the applications of these aspects.

2.2 Economic and Environmental Externalities

Stern described CC as "the greatest market failure we have ever seen" (Stern Review, 2007, p. 1). In other words, CC is an externality (environmental but with economic dimensions) over time, space and states of nature. In a relatively smaller or simpler setting the standard recipe (although not always effective or successful) has been to rely on taxes-subsidies and regulations as well as creation of markets for externalities themselves. To some extent this recipe still applies in addressing CC, but a comprehensive and equitable approach is hard to come by – because of complex multiple sources (and sinks for emissions) and mechanisms affecting CC (with varying degrees, geographically). Let us define various aspects of externalities, given Box 2.2.

Box 2.2 Classification of Externalities

Externality: the phenomenon of generating products/outputs that are not intended in an interrelationship among specified entities; example, ozone depletion as a result of use of the chlorofluorocarbons.

Economic externality: this characterizes the economic aspects of an externality.

Environmental externality: this refers to environmental features of an externality.

Positive externality: this refers to the role of an externality in its positive contribution in relation to a specific context or objective; example, regional (but not necessarily global) cooling effects of production of aerosols.

Negative externality: the converse of the above; for example, the greenhouse effect of continued emissions of carbon dioxide.

Stock externality: the externality that arises from changes or accumulations of the inventory or stock of a specific commodity or other physical entity; similar concept holds for a "flow" externality. An atmospheric concentration of greenhouse gases is a stock pollutant with negative externalities. Urban smog is a stock externality as well as a flow externality.

Strategic externality: the impact of strategic behavior on other components of a system in relation to specific activities undertaken by direct participants; this occurs especially in the resource to resource consumption with limited liability or cost-sharing.

Static externality: this refers to an externality for a given period of time arising out of a single instance or single period process, for example the role of local high temperature on dry forest fires.

Dynamic externality: this refers to an externality that is carried over time, as in the process of deforestation and its externality on biodiversity of species.

In relation to the provision of property rights and externalities, it has been observed (Rao, 2003):

1. imprecisely defined property rights contribute as a source of externalities; the process of mitigating externalities can itself be source of derived externalities (p. 47);
2. even when rights (such as emission allowances) are assigned and the environmental externality dimension is brought into the tradable category, the trade itself will be so thin as to negate the virtues of market institutions in many cases; even after the assignments of such rights there remains the problem of effective public policy and governance (pp. 54–55); and,
3. that political internalization of environmental externalities exists and it contributes toward a reproachment of the taxation and market-based interventions as solutions to the problems on hand (p. 59).

2.3 Classification of Environmental Dimensions

An important clarification on the environmental dimensions of SD is provided here. There are broadly three groups of environmental resources/factors that we are concerned with. This is not the usual greenhouse gas (GHG) or GW – based approach to environmental governance. This classification seeks comprehensive environmental packages that include all dimensions of the environment, some of which have major roles in the emissions of GHGs directly, and other have major roles in fulfilling the socio-economic objectives of GEP. Reduction of GHGs alone will not address the imperatives of GEP, a primary requirement for addressing short-term and long term objectives of SD, with inclusive development features. Whereas reduction of GHGs is a necessary requirement for SD, it is not a sufficient one. A world of endemic poverty and unsustainable exploitation (of wide varieties and intensities) of various sections of societies is not only unfair to the vulnerable but is not sustainable for others.

The first group is environmental amenities: these include fresh water for human consumption, clean air for survival, and physical facilities such as proper housing and sanitation.

The second group of resources is the primary environmental assets that lead to the first, and these include ecosystems, ozone layer, marine fisheries and marine resources, biodiversity, tropical forests and other habitats for biodiversity, and biogeochemicals that offer a wide variety of environmental resources from planet Earth's multiple sources and sinks. The sinks provide absorption and renewal capacities, which vary with influx and ouflux of influencing factors.

The third group of environmental factors may be called "environmental bads" as opposed to environmental goods in the first two groups. These disamenities in the third group include such items as toxic chemicals, greenhouse gases, acid rain, air pollution, and land/water contamination.

The general objective of an environmental governance policy is to maximize the potential for the first two while minimizing the risks of the third, on a sustainable basis (that is, seeking environmental sustainability).

Among the critical issues of human survival are those of health and prosperity or human well-being. What rights can be articulated for the purpose of relating and integrating these in the context of environment and development? This issue is addressed below.

2.4 Sustainability Concepts

A number of broad policy measures were sought to be prescribed under the Rio Declaration of the Earth Summit 1992. The measures included eight "Economic Principles", including the following three:

(a) The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations (Principle 3)

(b) All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world (Principle 5)
(c) To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies (Principle 8).

All of these principles emphasize economic development in addition to sustainability. The concept of sustainability admits varying interpretations and applications. The concept of development is a broad-based specification of economic progress. The resulting concept of SD is thus fraught with a multitude of potentially conflicting requirements, and the critical requirement here is the balancing of varying objectives and their operational constraints.

2.4.1 Sustainable Development

The concept of SD comprises an integration of economic and environmental objectives, present and future generations (with the non-exclusivity of the two because of overlapping generations in existence at any given point of time). The issue is not merely one of sustaining one or more assets of what we have to day but that of ensuring their equity for the present and future generations as well.

The 1987 World Commission on Environment and Development (WCED) in its Report advocated the original concept of SD and clarified the imperatives of such a criterion where it requires meeting the needs of the present generation without compromising the resource potential for the later generations. Because of the coexistence of about four generations of human population at any given time, sustainable development is not merely to be posed in terms of present versus future generations. It should be viewed as a process affecting multiple generations simultaneously.

The WCED Report (1987, pp. 43 and 332–333) asserted the concept of SD in its entirety: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of ‘needs’, in particular the essential needs of the world’s poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet present and future needs”.

Clearly, in addition to stating concerns for the future generations, this approach does address the issue of intra-generational resource distribution, with expressed concern for the poor. Nonetheless, it has become a very common practice that the debate on the issue is very substantially centered only on the intergenerational dimension. Most analyses and policy applications on the theme of SD quote the first sentence, and make no mention of the attendant vital explanation and interpretation. Those writings are inconsistent with the spirit of the original concept and its definitional integrity. The poverty dimension has not drawn enough attention

even to the extent that it adversely contributes to the quality of environment and to any measure of quality of life – present as well as future. The needs of future generations have to be understood based on information available at current time. The current structure of the economic and environmental systems needs adjustments and reforms before seeking to preserve them in tact forever, as some applications of sustainability requirements would indicate.

The avoidance of abject poverty and extreme deprivation of some sections of the society deserves highest priority within the concepts and applications of SD and more generally of GEP.

Development can occur only with the conjunctive use of economic factors and ecosystem services. Is there a reasonable and meaningful way of defining development without recognizing the interdependencies of the environment, economy, and human well-being? When "greening" is suggested, it is at times misunderstood in some sections of the society as a biased view to adversely affect the conduct of various functions and business transactions. To appreciate the green dimension in the life activities on this planet it does not take a staunch environmentalist to draw attention to the implications of negligence of ecological aspects of consumption and production, among other aspects. Can there be a meaningful "quality of life", and can there be good health (a major component of quality of life indicators) for sustaining and enjoying human life if we do not care to conserve environmental resources? Can ever-increasing per capita incomes alone lead to prosperity and quality of life that would satisfy reasonable people? The answer to either question is No. These are some of the pertinent issues that deserve further attention in this book and beyond.

2.5 Poverty and SD

About 2.6 billion people living less than $2/day (of which one billion live on less than dollar a day), and three-fourths of the poor live in rural areas. Thus, any attempts to uplift these standards of living in conjunction with environmental protection must examine the role of poverty-environment nexus and devise GEP accordingly. The WCED (1987, p. 8) Report stated:

> Poverty is not only an evil in itself, but sustainable development requires meeting the basic needs of all and extending to all the opportunity to fulfill their aspirations for a better life. A world in which poverty is endemic will always be prone to ecological and other catastrophes.

These people depend on natural resource systems for their livelihood. *World Resources 2008* (World Resources Institute, 2008) argues that scaling up incomes from environmental systems for the rural poor could pave the way for reduction of poverty on a sustainable basis. Unless poverty and environment are tackled as an integrated system and appropriate green economic policies are devised at local and higher levels, it is unlikely that we will attain sustainable and significant reduction in poverty, especially in the regions where it matters most Africa and South Asia. As the *World Resources 2008* stated: "If the natural resource base is not managed for

the long term, if it is exploited and polluted for short-term gain, it will never provide the fuel for economic development on the scale demanded to relieve poverty".

The WCED (1987, p. 28) stated that the "poor and hungry will often destroy their immediate environment to survive: they will cut down forests; their livestock will over-graze grasslands; they will overuse marginal land; and in growing numbers they will crowd into congested cities." Much of these predictions have been taking place during the past 20 plus years.

Roughly, one in every two persons in the world with $2 a day or less income live in India and China. Any measures to alleviate poverty and to protect the environment should be inextricably linked and strategies devised to exploit the synergistic mechanisms to address both the objectively. To argue that countries like China and India should reduce greenhouse gas emissions even if it means ignoring poverty reduction is an unrealistic assertion. Also, by various estimates, it appears the proportion of poor relative to non-poor may improve slightly over the years, as it did in the past 20 plus years, but the absolute number will perhaps remains near one billion earning one dollar a day or less; this number has remained almost unchanged and may stay on for years unless more sensible socio-economic and environmental policies are devised and properly implemented. The start for this to happen is to ensure that poor have property rights and income generating assets – as in for example, the "inverted banking" methods of the Grameen Bank of Bangladesh. A cooperative peer monitored and result-oriented approach to microeconomic projects and dovetailing these to a larger economic plan of action, beyond safety net provisions, will pave the way for sustainable eradication of poverty.

The following is a simplistic yet relevant statement (FAO, 2006, p. 13): ". . .an important factor may be that hunger itself acts as a barrier to escaping poverty (the hunger trap) . . . hunger is not only a consequence but also cause of poverty, and that it compromises the productive potential of individuals, families and entire nations."

There has been negligible progress, or even reversal in some countries such as in Africa, in attaining the World Food Summit 1996 declared goal of reducing the number of hungry people by half by the year 2015. This remains challenge as long as the efficient governance of natural resources and environmental assets remains an elusive goal in most developing countries.

For developing countries it is the alleviation of poverty that remains a top priority (with or without foreign aid) and the route to environmental governance is through the former. It can also be seen that the later provides the main route to poverty reduction if only the policies are properly formulated for development effectiveness.

Mainstreaming rural development, institutional reforms and social safety nets in terms of environmental resources and their governance will provide a sustainable basis for poverty reduction and environmental upkeep. National governments and international institutions have an important role to play in such mainstreaming, involving stakeholders at all stages of planning and implementation of GEP.

Deterioration in asset base dislocates the income base for the poor. Nature-based income constitutes about half the total income of rural poor; the fact that environmental income is critical to the livelihood of the rural poor is rather well known, but precious little has been done to protect or enhance these sources of income.

In a scenario of worsening resource base and income support for the poor, it is relevant to note that the annual net change in forest area and corresponding ecosystem decline has been most significant in Africa and South America. The obstacles to raising sustainable livelihoods in rural areas include, among other things, quality of local institutions (formal and informal), capture of benefits by the powerful and inequitable distribution of the benefits of natural resources. *World Resources 2008* documents extensively the role of environmental resilience and linkages with poverty reduction. It has been suggested to scale up: environmental income from ecosystems; access to use ecosystem resources to support livelihoods and skills; and community-based natural resource management (CBNRM). The roles of ecological, social, and economic resilience have also been examined in the above report. A few (if isolated) case studies of relative success in addressing these requirements, largely through CBNRM are also documented there. Sustaining a combination of all resilience is ideally desirable but hardly achievable. The examples of success are useful but it is not always possible to formulate a portable model for replicability in a different region or society. What is needed is very much unique to the local features of institutions, in addition to the geographical and agro-economic variations.

Since CC affects the poor more adversely than the others, for reasons such as vulnerability and lack of economic resilience, it is most important that the poverty-climate change – environment links are fully understood and availed for devising better economic and environmental policies.

Any of the marginal improvements that occurred over the years of slow progress toward reduction of poverty and improvement of human well-being may be reversed due to accelerated CC and neglect of the environment-poverty linkages. A billion plus people's lives tend to be more vulnerable (see for example, the collection of papers enunciating this aspect in Brainard, Jones, & Purvis, 2009).

SD cannot be seen as a meaningful approach when formulated totally independent of prevailing economic inequalities and income distribution policies within and across countries. There may not be such a thing as "perfect inequality" or "perfect equality". Excessive inequalities induce negative economic and environmental externalities to the disadvantage of all. Such features also add to the overhead costs or transaction costs of implementing socially and economically desirable policies. Less expensive options in the form of reduction of poverty and environmental degradation exist, and these options can be utilized only with a collective will at national and international levels.

2.6 Inclusive Sustainable Development

Human capital and human development are among the important prerequisites for the attainment of SD. Human development is a goal in itself: it seeks to enhance the capability of people to lead worthwhile lives. To quote Anand and Sen (2000, p. 2030), "A universalist approach cannot ignore the deprived people today in trying to prevent deprivation in the future. . ." Similarly, Rao (2003, pp. 185–186) argued that a socioeconomic system that pays attention to the dire needs of the relatively

deprived population by creating productive capacities for the full enjoyment of life enhances potential for enhanced economic productivity, besides moving on a path for egalitarian and harmonious economic development on a sustainable basis.

These arguments form some of the foundations for GEP. This issue is closely linked to the institutional configurations within which socio-economic systems are governed and political decisions are made.

2.6.1 Sustainable Economic Growth and SD

Although many economists seem to have neglected to pay attention to critical issues in their advocacy for neoclassical approaches, it is useful to recall an important statement at his 1971 Nobel Lecture of Nobel Laureate Simon Kuznets, one of the founders of modern economic growth approaches (Kuznets, 1973, p. 247):

> A country's economic growth may be defined as a long-term rise in capacity to supply increasingly diverse economic goods to its population, this growing capacity based on advancing technology, and the institutional and ideological adjustments that it demands.

Perhaps the above statement does not address environmental aspects directly but the critical role of institutions and of the need for sustainable productive economic capacity or base is clearly stated. As long as the environment is seen as limiting factor of such productive capacity, the definitional aspect of economic growth itself calls for an integrated approach rather than exclusion of environmental considerations in the processes. The roles of institutions and governance have drawn only limited attention over the years.

Measures of national economic product and the corresponding economic growth rates in traditional practices are misleading because there is the important role of non-market production. Besides, distortions arise due to varying TC (for example, big bonus payments to speculators – not to be called "productively earned") that are expenditures to support transaction activities but not the actual economic output itself. In general, the traditional methods of estimating economic growth are overstating the real economic content of growth, due to the role of TC (Fuess & Van den Berg, 1996). Rising TC constitute a drag on the economy but the economic accounting methods currently in use depict them as a component of economic output.

Regarding the limitations of market mechanisms in the context of environment and SD, as early as in 1930s, well-known economist Arthur Pigou (1932) argued that if markets are allowed to have unrestricted access to transactions (in response to demand and supply), this feature might have structural limitations in the protection of future interests of the society, including protecting natural resources.

The patterns of ownership of resources and the processes of governance under varying institutional environments, or under varying property rights and legal entitlement regimes are critical in this context. These play an important role in the consumption, production and efficient use decisions with direct implications on the features of SD. Since any redirection of existing resource and income distribution patterns cannot be achieved within a reasonable time frame, and major changes

entail enormous socioeconomic costs (and other TC), it is necessary to devise what may be considered pragmatic. This requires reforming existing legal entitlements and property rights regimes.

Quality of growth matters. The role of GEP is to taken this requirement fully into account. Sustainable economic growth is akin to the concept of economic growth that possesses the features reduction of abject poverty, protection of the environment, reduction of economic inequalities, and thus enables sustaining economic growth in the current and future time.

Economic growth can be attained by several means but the means of attaining growth as well as the objectives of growth are very important for policy clarifications, formulations, and implementation. Some growth patterns are founded on excessive exploitation of natural resources, including labor. Lopez, Thomas, and Wang (2008) constructed various indices of human development and environmental quality, used these for analyzing data for 128 countries and noted that per capita income growth is positively related to human development but negatively related to the environmental quality. Also, as poverty is reduced, socio-economic inequities are reduced, environmental degradation is reduced and economic growth is sustained, thus qualifying for high quality growth or sustainable economic growth. One of the key requirements of sustained economic growth and SD is the resilience of the economic, environmental and social systems.

There may be scope for sustainable economic growth only if the natural resource use declines over time (see analytical details in Akao & Managi, 2007). That is, decline in unit natural resource use per unit output constitutes a necessary but not sufficient condition for sustainable economic growth.

2.6.2 Resilience and Vulnerability

Vulnerability and resilience are two sides of the phenomena of stable equilibria, whether economic, environmental or social. The former refers to how unstable a given scenario is and the latter refers to its ability to restore itself to the original equilibria. The IPCC (2007) defines vulnerability to climate change as the degree to which natural and social systems are susceptible to, and unable to cope with adverse impacts. Loss of resilience results in vulnerability to changes or perturbations that could previously be absorbed (Folke et al., 2002). Related aspects of resilience are the capacity to adapt and self-organize in the presence of perturbations. Sometimes resilience is restored with external inputs under conscious effort. A fundamental aspect of the resilience feature is normative assumption of need for preservation of the specific system under reference.

Ecological or environmental resilience is a measure of disturbance that can be absorbed before the system undergoes (involuntary) structural changes. A detailed description of these phenomena in the context of GEP will be given in a later section of this book; it suffices now to state here that we have convincing studies that indicate lack of environmental resilience in several respects. For example, loss of coral reefs, extinction of species, and desertification are outcomes of unsustainable

use of resources that lead to loss of resilience. Some of the insightful studies (see for example, Parmesan, 2006) indicate extinction of species (about 70 species of frogs gone extinct, and about 100–200 cold-dependent species such as penguins and polar bears in severe stress) even beyond what was somewhat suspected due to GW and CC. Irreversibility of some of these phenomena constitutes the most serious features of consequences of loss of resilience. The role of economics (as developed so far), once this paradigm shift occurs, is minimal since no amount of market price can restore *ex ante* resources.

Just as peace and stability are pre-requisites for a functioning economic system, preserving resilience of natural systems (including environmental and ecosystems) is a necessary condition for sustaining economic well-being.

Excessive reliance on market factors to derive economic policies is founded on the fallacy of assuming zero costs for most of ecosystem services, and distortions will occur in resource allocation for the current and future generations as a consequence. Besides, a resilient market system should be built on robust governance principles (such as ensuring markets function efficiently, not merely clearing demand and supply but are reflective of potential uncertainties).

2.6.3 Health and Environment

The links between health, human well-being and quality of life are either not fully understood or addressed strictly compartmentally in devising policies and programs addressing poverty and economic development. Environment and human health are highly correlated. Contaminated water and air pollution contribute to about 80% of all diseases the World Health Organization (WHO) regularly reports; 25% of all deaths in developing countries are attributable to environmental causes, and the corresponding figure for developed countries is about 17% (WHO, 2006).

Malnutrition, water-borne diseases, and malaria could each contribute to increase in death rates due to CC, according to some estimates (see the *Financial Times*, January 24, 2007, quoting the WHO). It is to be expected that these increases accrue in poorer sections of the societies more than elsewhere. Again the point to note is that adverse CC effects are usually inequality enhancing in various ways and this issue needs be addressed as an enhanced urgent need for poverty reduction.

Paucity of drinking water and water pollution cause about 2 million deaths a year. Infant mortality, morbidity and environmental pollution-based disease incidence costs about 3% of total GDP in a developing countries; soil loss and agricultural productivity loss accounts for about 7% of agricultural output in some developing countries. These issues are of concern in GEP.

GEP framework incorporates not only issues of greenhouse gas emissions and SD but also all of the environmental considerations as well, since life matters, and equitable patterns of socio-economic development are ingredients of GEP. Various environmental features are classified and summarized below, since these form part of the environmental problems.

At the global level, among the international environmental agreements that state explicitly the role of environmental protection and human well-being is the 1998 Aarhaus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters. In its preamble, the Convention states, inter alia, that "adequate protection of the environment is essential to human well-being and the enjoyment of basic human rights, including the right to life itself."

Most economic and environmental policies deal with health issues separate from the rest of economic system as the linkages of better health and economic welfare are not yet fully appreciated. It is noteworthy that the 1997 Special Session of the UN General Assembly in its "Programme for the Further Implementation of Agenda 21" stated (Para 31): "...Health issues should be fully integrated into national and subnational sustainable development plans and should be incorporated into project and program development as a component of environmental impact assessments." Operational guidelines need to be devised and incorporated by international financial institutions and other multilateral lending organizations to reflect these requirements. Environmental assets and resources deserve a broader inclusion, not merely to focus on the emissions of greenhouse gases or on climate change, for all practical purposes in the short run and in the long run. Only then an inclusive SD can have a better chance of addressing growth, equity, sustainability and efficient governance of systems.

2.7 Synergies and Conflicts in Economy and Environment

The synergistic influences and connections operate within the environmental systems themselves, just as they do within the economic systems as well. The absorptive capacities of systems due to multiple disturbances tend to decline rather exponentially; tolerance of one environmental stress reduces when other stress factors are also affecting simultaneously (as for example, in habitat destruction in forests – caused by localized forest destructions in neighboring areas or for meat industry). The interactions between environmental problems could be the biggest environmental problem. In relation to global warming per se it is important to recognize that various "climate feedback" mechanisms tend to amplify the rate of warming, such as the changes in the earth's reflection of sunlight as ice glaciers melt.

Generally the potential congruence in economic objectives and environmental objectives is lost when the time horizon over which the policies of respective categories differ significantly, and when there exists disconnect (as it very often does) of who pays for the costs and who gains from specific policies and action programs. Besides, the role of unknowns and uncertainties in the cause and effect relationships among economy-environment systems tend to blur effective coordinated policy design to the advantage of those who stand to gain from such uncertainties and unknowns. Thus came the role of the Precautionary Principle, which suggested being on the "safe side" in policy-making rather than rule out adverse consequences merely because they are not known at a given time to occur with certainty.

2.8 Ecological Economics: Adoption of Ecosystems Approach

Lack of an integrated approach to the management of environmental resources, especially that of ecosystems approach, poses dangers to environmental and economic sustainability in the future. There is need for the recognition of ecosystem interdependencies when formulating international agreements on trade, or on sectoral issues. The maintenance of the health of the ecosystems is a necessary prerequisite for the health and prosperity of the humans, and this suggests close proximity of ecocentric and anthropocentric approaches to SD.

The role of biodiversity is critical in the sustenance of ecosystem services. Biodiversity in ecosystems provides goods and services of economic and social importance. Diminished biodiversity contributes to significant reduction in ecosystem services, and thus in the potential for maintenance of human health as well as prosperity. The concept of ecosystems is a dynamic one.

Ecosystem is a dynamic complex system of plant, animal and microorganism communities and their non-living environment interacting as a functional unit. In the absence complete knowledge about ecosystems and their evolution under perturbations due to anthropogenic influences, it is prudent to adopt precautionary measures to safeguard the biotic species and also ensure the functioning of the system within ecological thresholds. The dynamics of ecosystem processes are often non-linear (which implies sudden changes in the component interrelationships at different levels of operation or perturbation), and possess time-lagged responses to exogenous and endogenous changes in their constituents or influences of other systems.

The ecosystem approach, by definition, warrants adaptive ecological management to deal with the dynamic nature of ecosystems, known and unknown changes in the features of the systems involved. This aspect has also been emphasized during the Fifth Conference of Parties to the Convention on Biological Diversity, held at Nairobi in February 2000 (for details see the UNEP document UNEP/CBD/COP/5/3, February 2000). The Conference suggested 12 principles of ecosystem approach; these principles are complementary and interlinked, and need to be applied as a whole. These include the following:

Recognizing potential gains from management, there is a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management program should:

(a) Reduce those market distortions that adversely affect biological diversity;
(b) Align incentives to promote biodiversity conservation and sustainable use;
(c) Internalize costs and benefits in the given ecosystem to the extent feasible.

Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a policy priority of the ecosystem approach. Ecosystem functioning and resilience depends on a dynamic relationship within species, among species and between species and their abiotic environment, as well as the physical and chemical interactions within the environment. The conservation and, where appropriate, restoration of these interactions and processes is of greater

significance for the long-term maintenance of biological diversity than simply protection of species. Ecosystems must be managed within their threshold limits for their functioning. The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

Among the major shortcomings of the approaches and activities specified under some of the Multilateral Environmental Agreements (MEAs) such as the Convention on the International Trade in Endangered Species (CITES) and other organizations such as the World Trade Organization (WTO) is the absence of ecological interdependencies or recognition of externalities. CITES deals with target species only, and not with the attendant externalities such as "incidental takings" and tends to be authorized in the process of conduct of legal harvesting of other species. In the process of harvesting non-endangered species, the consequences accruing to the bycatch or the effects in terms of various ecological externalities that adversely affect the listed or endangered species must also be recognized. The CITES should prohibit such damages by seeking to protect not only the endangered species themselves but also guide the harvesting of others that affect the targeted species. Most WTO panels involved in resolving trade and environmental disputes between member countries did not demonstrate sufficient competence in handling environmental matters. This was because of the lack of appreciation of ecosystem links with economic factors.

Ecosystems are to be treated as production units and as dynamic systems, in addition to being economic assets; "derivative products" of ecosystems are ecological resources that flow into the economic system and well being of people. Watershed is an ecosystem in itself, and processed water from the system is the flow that is either a marketed product (public utility or private enterprise using resources) or made available for use by residents or other sectors of the economic system. Understanding of the relevant dynamics is important for estimating the appropriate accounting prices or true costs (Maler, Aniyar, & Jansson, 2008). These prices are broadly defined as the present value of the future perturbations of consumption because of a change (assumed marginal change) in the stocks today.

Accounting prices for ecosystem service are to be derived with reference to (Maler et al., 2008): ecosystem dynamics that describe each system separately; concept and assessment of stocks (also system-specific), the nature of services – use in public or private or both systems; institutions that affect the system. It is, therefore, considered not possible to come up with a standardized economic model of accounting prices for ecosystem services.

Economic analysis will suggest rate of return on interventionist policies to be high but apparent lack of resources to the requisite extent are responsible for the sustained misery in may of the regions. The key questions in this context are: are the resource ever priced properly to reflect the resource shortages slowly caused by the loss of ecosystem resilience and of ecosystem services? Are the domestic and externally provided resources for alleviating some of the problems being reasonably efficiently used? What is the magnitude of corruption and self-sustaining and self-fulfilling poverty syndrome? Can green economic policies solve some of these problems and if so how? Any technical analysis seems to fall short if it does

not pay attention to realities such as institutions and their behavioral features, role of incentives and disincentive in directing production and consumption systems as well improved economic and environmental governance, the role of rule of law, including cost-effective legal enforcement mechanisms.

2.8.1 Land Use, Deforestation and CC

The global crises in land use constitute just as much a disaster for humanity as the climate change by itself.

About 6–8% of GDP (as it is being currently estimated by traditional methods) may be lost by 2050 if the current rates and stages of loss of ecosystems persists, states the 2008 study report (UNEP, 2008) *The Economics of Ecosystems and Biodiversity* (TEEB).

Loss of forests and biodiversity are most significant contributors to these losses. If we make biodiversity fundamental to green economic policy, preservation of forests, ecosystems and environmental "hot spots" deserve high priority. An estimate 40% of world trade is based on biological products or processes. The global value of plant-based pharmaceuticals have been estimated between $500 billion and $750 billion, and about half the medicines currently available are derived from natural products. It seems reasonable that pharmaceutical companies (whose market for products is rather stable even under economic down turns) participate more actively in preserving biodiversity and forest systems. This is one of the sectors where public-private participation should merit close attention.

Continued population growth, shifts in food consumption favoring meat intake, increasing needs for biofuel energy all contribute tremendously to the ever expanding pressures on land use and other resource uses beyond sustainable levels, and in the near future.

The massive environmental and ecological impacts of current agricultural practices rival the impacts of climate change (Foley, 2009). Ecosystem degradation, widespread pollution, and GHGs emissions are all exacerbated with unsustainable land use and agricultural practices. For example, the role of subsidies for ethanol fuels in the US is founded on misplaced focus to provide energy supplies at the expense of taxpayer funds, neglect of environmental damages, and creating an additional set of uncorrected environmental and economic externalities. Besides, on energy and economic efficiency grounds also the scheme is flawed (Pimentel, 2003):

a) It requires 29% more energy to produce gallon of ethanol than the energy in a gallon of ethanol; and,
b) Increasing the cost of food and diverting human food resources to the costly inefficient production of ethanol fuel raises major ethical questions.

Detailed assessment of land use changes, consumption and its effects on forestry, and implications on CC are discussed in later chapters.

2.9 Eco-Effectiveness and Carbon Footprint

Since about mid 1990s, the concept and application of the ecological footprint (EF) seemed appealing. EF evaluates the impact of an individual or entity's operations on the planet, in terms assessment of levels of consumption and resource use, converting these elements into the amount of land needed to sustain necessary production levels and lifestyles. The aim of such assessment was to convey the message whether or not the operations seem sustainable or unsustainable, given the fixed resources of planet earth. In some estimates, the ecological overshooting commenced in 2003, as the EF of all activities (production and consumption) indicated the planet's land exceeded in the use-equivalents. The EF measure has more often been used to suggest unsustainability features of production and consumption, rather than provide a measure of sustainability. The EF's numeraire of land is not too convenient for operational interpretations. Instead, a measure of carbon emissions contributions of activities are suggested to be more useful to assess carbon footprint (CF) and try to reduce it wherever possible.

2.10 Limitations of Comparative Advantage Principle

The conventional principle of the economics of comparative advantage is founded on fallacious assumptions and perpetuates inefficiency, mainly because it is static concept: assessing relative costs of production at a given time point and ignoring externalities. This principle also pays little attention to issues of development and equity. Economic development is a dynamic concept but equity is both static and evolving concept. The terms of trade argument that advocated free trade uses the ratios of how much of one product needs to be produced to exchange a specified quantity of another.

The comparative advantage principle has no forward looking component to it, nor has any consideration of environmental or other externalities, since these are not accounted for in the costs of production. In fact, this principle, if used indiscriminately, can lead to 'path dependency' in the sense of foreclosing potential options that would have been available otherwise.

Emerging issues, for example, include the role of factory farming and export of meats: if importers seek to impose ban on certain types of meats based on their perceived assessment of health hazards, it may be tenable in recognizing health externalities, and may be legal under the World Trade Organization (WTO) rules (considering, for example, the asbestos case where France restricted imports of asbestos on health grounds, Canada disputed and lost the case under a WTO ruling). The real issue is here due recognition of externalities in the context of assessment of trade policies and application of comparative advantage principle. A number of major illustrations, such as timber import-export policies and export of chemicals that are domestically prohibited for use also qualify for critical review in this context.

Terms of trade norms and the comparative advantage principle are oversold and underachieved concepts. Although they did merit some role in early stages of industrialization and economic expansion, they are less useful ones at this stage of knowledge of sciences and modern economics. Since the comparative advantage principle in trade is often invoked in promoting free trade and trade liberalization, it is time to reformulate it completely:

Trade liberalization, freer trade and such measures based on the principle of comparative advantage makes sense only when: (a) the principle is seen in a dynamic context rather than applying it based on what relates to current information only, and (b) all economic, environmental and social externalities are fully integrated in such policies.

2.11 Economics of Prevention, Adaptation, and Mitigation

Climate change adaptation (CCA): environmental, technical, economic, social and other adjustments to realized or expected climatic changes

Climate change mitigation (CCM): reduction of greenhouse gas emissions as well as their concentrations, and of other interferences with atmospheric elements

Relative roles of CCA and CCM deserve a great deal of attention, and this is possible only with reference to specific system features and emerging cause-and-effect relationships (even if partly uncertain and unknown). Usually CCA offers results on shorter time scale and CCM needs longer time horizons. Obviously, choice of discount rates on time, assessments of type and degree of uncertainties associated with each aspect that is being addressed will suggest relevant priorities of policies and resource deployment to cater to the effects of CC. A limited degree of substitutability exists between activities associated with CCA and CCM. Besides, significant the role of GEP in each of these can be and should be examined while selecting policy instruments.

The economics of greenhouse gas reductions, adaptation to current CC, and mitigation of CC damages – all require different aspects of GEP. Much of the current focus on the issues of adaptation and mitigation is partly due the UNFCCC's 2007 Bali Road Map and Action Plan, agreed by all member countries, pending further actions in setting and revising targets of emissions reductions. In the frenzy of attempts to set these country-specific targets, much focus needed for devising GEP in synchronization seems to have been sidetracked. The issues simply try to address CC problems. The problem then remains: if we want to solve problems of adverse consequences of CC with internationally set targets for reduction of greenhouse gases (if there is a full agreement on this aspect) – because the consequences can hurt everyone although not in the same proportions and mechanisms – what about the environmental problems outside that framework? In other words, in the absence of an integrated approach to environmental problems other than CC-related aspects at local, national and international levels, rest of environmental degradation may be neglected. This is detrimental to poverty reduction, improving inequalities

and well-being of populations. The role of GEP is important for win-win solutions to the problems.

Adaptation to CC is the additional effort needed to reduce the impact of the additional CC caused by enhanced greenhouse effect. Ensuring adequate adaptation enables greater role of mitigation in developing countries to reduce climate change impacts.

The economics of adaptation is to be seen with clarity on situation-specific, location-specific and phase-specific characteristics of a project/activity. An attempt to answer this aspect must be seen in the context of the question: what are the optimal choices in the above context? Also, none of the cost estimates can be made independent of assumptions about *ex ante* and *ex post* choices in efficient decision making involving the use of an asset or resource.

Estimating costs of adaptation remains a complex exercise in that information may not be readily available in assessing the current baseline and projecting vulnerability levels into the future, and magnitude of likely climate change as well its specific impacts – location wise and sector-wise. Globally, several estimates place the cost magnitudes in the range $28–$175 billion for the next three decades.

Mainstreaming adaptation requires addressing climate change aspects within economic and other planning, sectoral policies, and administrative arrangements including budgeting and fiscal measures catered to this aspect – in addition to other relevant considerations.

Climate-proofing and climate-screening involve the protection of existing assets (natural and other), and ranking alternate projects and their activities in terms of indicators such as carbon footprints associated with each choice.

In the US, mitigation is often used as part of regulation of loss of wetlands under the Clean Water Act and also under Endangered Species Act. Environmental restoration and conservation are also sometimes deemed to include mitigation efforts. Protecting larger scale watersheds and ecosystems is considered cost effective and contributing toward environmental sustainability. This will bring about resilience of the systems in the context of climate change.

The Commission on Climate Change and Development in its 2008 Report on Overview of Adaptation Mainstreaming Initiatives (see details at www. ccdcommission.org) concluded that implementation of deliberated strategies for adaptation remains weak, although high level political endorsement of the ideas seems to be clear.

The Commission also identified a few specific questions for investigation:

When and how is it most relevant and effective to mainstream climate adaptation?

When additional funds are sought or proposed to be offered for the purpose, how to assess the net additional costs and their benefits?

Cost-effective reduction of GHGs and realization of the corresponding co-benefits (such as local air pollution reduction) and ecosystem preservation via adaptation and mitigation strategies involves both market – based and regulatory

instruments of policy. Green economic policies in this framework should avail regulatory standards in governing the markets, and use of stakeholder participation in local issues of governance of environmental assets and flow of resources. Specification of standards and regulations complement the function of markets, for example in ensuring energy efficiency in appliances and transport technologies. Watershed management is better addressed via community participation, and stakeholder roles lead to reduction costs of administering various policies. The much touted capacity building activities being administered by various international organizations are to be reformed to orient the activities toward community-based governance, although this is taking place in a limited way with the help of non-governmental organizations (NGOs).

Capacity building is not to be oriented mainly to train bureaucrats in developing countries as if they have little understanding of the issues. These functionaries are often constrained in their efficacy of functioning by the ruling regimes, limited role of rule of law and accountability.

There is hardly a robust estimate on the costs of adaptation and mitigation, beyond some approximations in the Stern Review and a few others. A recent estimate of the World Bank gives the range $100 billion–$175 billion. Although an estimate is relevant for the purpose of an international financing and participation agreement, lack of precise estimates need not warrant delay in action. A possible rolling plan with 3–5 year horizons may be relevant so that revisions in costs, finances and policy measures can be revised along way as progress is made, and initial deployment of resources may constitute one among several future phases, as the situation warrants. The risk of this approach is that there is greater need for policy coordination and coherence over time, and provision of some degree of flexibility need not imply backing down from commitment to reduce impacts of climate change in an integrated cost effective manner.

The UNEP (2009) policy brief on negotiating adaptation addresses some of the international issues of equity and finance. It seeks to follow (although no specific roles or estimates of requisite adaptation contributions have been suggested) the Bali Roadmap and Action Plan set out in December 2007 by the UNFCCC's Conference of Parties (COP-13). This Plan in its Para 1 (a) stated that "A shared vision for long-term cooperative action" is required with the application of agreed principles for cooperation, especially the principle of "common but differentiated responsibilities". There is little reference to the role of GEP in achieving cost-effective solutions.

Economics of Climate Adaptation (ECA) Working Group Report of 2009 suggests a simple methodology for climate-resilient development, including location/region-specific "total risk assessment", and quantification of costs and benefits of adaptation to climate change (ECA Working Group Report, 2009). The benefit-cost assessment is suggested to examine the feasible alternatives and ranking of options among technological, behavioral, institutional and financial solutions relevant for a given setting or location. Although the ECA Report is a relevant start for the approaches, its proclaimed "methodology" is to be developed further substantially for operationally useful solutions. For example, using costs and benefits

under unsustainable production and consumption patterns is self-defeating exercise; full cost accounting is required at all levels to visualize potential options, besides application GEP approaches. More detailed analyses are provided in Rao (2010).

Earlier, the World Bank (2008) issued a methodology report on the same theme but largely in a government-controlled setting. It suggested that the objective is to select projects so that expected net benefits are maximized in each period subject to a budget constraint (including so-called "full investment budget"). Ironically, the methods seem to use the same traditional assessments of costs that the system obtains under unsustainable patterns of use of resources in given setting.

2.12 Sustainable Consumption and Production (SCP)

The significant problem of SCP has been recognized at the Earth Summit in 1992 in Rio de Janeiro. The Summit Declaration contained in its Agenda 21 (Chap. 4) the statement:

> The major causes of the continued deterioration of the global environment are the unsustainable patterns of consumption and production, particularly in industrialized countries, which is a matter of grave concern, aggravating poverty and imbalances.

After 10 years, at the World Summit on Sustainable Development in Johannesburg, the Plan of action sought to proceed to work on SCP. The UNEP and UN Department of Economic and Social Affairs are currently leading the Marrakech process regarding policies and programs for SCP. The first meeting took place in Marrakech in 2003 and 10 year Framework of Programs for the SCP has been taking shape ever since, slowly but surely. Several rounds of intergovernmental and stakeholder meetings took place and these continue.

The key issues in consumption relate to livestock sector, explained in later chapters. Pampering unsustainable patterns of production and consumption is a self-defeating exercise.

2.13 Economics of Green Taxes

Among the most important fiscal or market instruments for the regulation of the environment are a set of environment-influencing taxes. These taxes have been designed and implemented in many developed countries and in very few developing countries. Some of these taxes have been aimed to mitigate adverse environmental consequences of production and consumption, and some to regulate or influence production and consumption in directions that enhance the quality of the environment.

The terms green taxes, environmental taxes, and pollution taxes are often interchangeably used, although they do not precisely mean the same. Although the above categories include carbon taxes, the converse does not hold. Historically, Pigou (1932) was among the economists who advocated pollution taxes. A Pigouvian tax is tax applied on each unit of pollution output. This tax amount equals the marginal

damage the pollution causes to the economic system at an efficient level of production system or output level. This taxation tradition may have feasibility if the sources of pollution (location or entity-specific), and their relative contribution and damage are known.

Much of the literature on Pigouvian taxes did not address the issue of revenue mobilization or of levying pollution taxes. Pollution taxes promise the potential to offer a better tax structure for any given economy and also enhance environmental quality, if the tax instruments are properly formulated and implemented, thus constituting to a case of potential double dividend.

In recent years, public policy in the industrial countries favored more of some form of ecotax or green tax, partly to offset personal tax burden and simultaneously achieve some degree of dampening of pollution emissions. The revenues from the use of the new tax instruments were proposed to offset relatively heavy income taxes with a reduction in personal tax rates. In a revenue-neutral tax reform, it is possible to increase progressivity elsewhere in the economy or tax system to at least offset the regressivity inherent in the green taxes or carbon taxes. Reductions in the lowest tax rates under the personal income tax system could address this objective. When combined with personal tax reduction incentives, new green taxes sell better at the level of the taxpayers.

The phenomena of "dividends" of various types were also touted in support of various types of environmental tax measures.

(*Single) Dividend:* Environmental taxation increases the total welfare of the society by reducing or eliminating negative environmental externalities.
Double Dividend: Shifting tax burden from personal taxation to environmental resources reduces the relative cost of labor and augments employment.
Triple Dividend: Reduces tax distortions and increases economic output toward more efficient paths – economically and environmentally.

However, in the presence of existing tax distortions, imposition of new green taxes can sometimes outweigh the efficiency gains from revenue recycling; there is no double dividend in such cases. In a survey on environmental taxation, Goulder (1995) examined the theory and empirical aspects and various forms of dividend propositions. Some of the major conclusions are summarized below. Firstly the concept of "gross costs" has been defined as the welfare sacrifices associated with environmental tax policies. The overall efficiency changes from a policy initiative are then defined as the welfare benefit arising from the change in environmental quality (the gross benefits) minus the gross costs. Three forms of double dividend are distinguished:

(a) *Weak form*: use environmental taxes to finance reductions in marginal rates of an existing distortionary tax, cost savings are achieved relative to the case of transfer of tax revenues to the taxpayers in lump-sum fashion;
(b) *Intermediate form*: revenue-neutral substitution of the environmental tax for a distortionary tax in such a way that this results in zero or negative gross cost;

(c) *Strong form*: the revenue-neutral substitution for the environmental tax for typical or representative distortionary taxes involves a zero or negative gross cost.

Traditionally, most of the economic analyses and policies for effecting environmental concerns ignored the interactions of new taxes with the existing tax system. This simplistic approach, including the classic Pigouvian tax method, tends to overestimate the required tax for achieving the environmental goals. The overall effect of the tax consists of (a) the Pigouvian or the partial equilibrium effect; (b) the tax interaction effect; and (c) the revenue recycling, or more generally, the fiscal effect. The basic partial equilibrium analysis of optimal environmental tax invokes the Pigouvian method, where the optimal tax rate equals the marginal external costs or marginal environmental damages (MED); this implies the gross marginal cost or marginal abatement cost associated with an environmental tax equals the tax rate. Parry (1997) results support the above conclusions since the tax interaction effect is of greater magnitude than the revenue recycling effect under plausible values of parameters. The optimal environmental tax works out to about 70% of the Pigouvian tax, or of the MED.

These above analyses indicate the role of preexisting taxes whenever green taxes are considered for their imposition. In general, an optimal green tax induces the level of emissions at which marginal welfare benefits from reducing emissions equals the marginal welfare cost of achieving such reductions. In the absence of preexisting distortionary taxes (which is less likely in most countries), the rule simplifies to that involved in Pigouvian taxes: optimality requires that the green tax be set equal to the marginal benefit from reducing environmental damage. The tax rate is higher when consumption is relatively inelastic to the economic features of substitutes for a specific economic, environmental commodity or resource.

The main findings of recent significant contributions in environmental taxation are: (a) they are useful instruments if devised and implemented efficiently with low transaction costs; (b) because of the tax interaction effect with the prevailing taxes in the economy, the magnitudes of optimal environmental taxes tend to be about 10–30% less than those indicated by traditional (partial equilibrium) analyses; and (c) depending on the revenue recycling or other patterns of utilization of these tax revenues, the net effect of the tax levies can be progressive or neutral or regressive for various economic classes.

In one of the recent national policy developments, the French government has launched recently a major carbon tax initiative (following good examples of countries such as Finland and Sweden that have taken up carbon tax measures several years ago). The new initiative seeks to levy about $25 (Euro 17) per ton of CO_2 emissions by fossil fuels such as heating oil, coal, and natural gas. To ensure that this is not necessarily an additional tax burden on the top of various existing taxes, the new policies will offer a few offsets in personal income taxes and local taxes in case of corporate entities.

Box 2.3 provides a tentative summary of principles and instruments relevant for SD. However, more detailed aspects and expansion of policies and mechanisms are

presented in later chapters. This is only an interim assessment of the relevant instruments, indicative of issues summarized so far and also of some of the aspects to discuss in later chapters.

Box 2.3 Sustainable Development – Principles and Other Instruments

- Reform of institutions
- Adoption of the precautionary principle
- Adoption of polluter pays principle
- Adoption of integrated environmental and economic accounting
- Adoption of market supportive instruments with prudent regulation for practical policy
- Green taxation and other effective instruments for fiscal policy
- Investing in human capital
- Afforestation and control of deforestation
- Reduction of consumption-based environmental effects
- Enhancement of energy efficiency and use of renewable sources of energy
- Adoption of appropriate alternate methods of agriculture and natural pesticides
- Slowing population growth
- Adoption of ecosystems approach
- Life cycle analysis as a basis of recycling, and pricing of goods and services
- Internalization of environmental costs at local and global levels, including in international trade
- Expanded roles of stakeholder participation, community-based resource management and of non-governmental organizations.

2.14 How Not to Use Economics

Many reputed economists indulge in the following invalid assumptions (often implicitly) for economic models and analysis:

(a) there exists the continuity of the same known economic system in relation to environmental systems even when the later are disturbed from one equilibrium to another or lose resilience to revert to original scenarios;
(b) markets are complete (including those elements for which ecosystem services are free) and perfect in the demand balancing supply – with no recognition of the roles of transaction costs that affect market factors;

(c) features of markets enable applicability of the competitive market efficiency rule, viz. marginal costs equal marginal benefits at an equilibrium;
(d) explicitly or implicitly rely on the above characteristics even when treating seemingly uncertain/stochastic/indeterminate/unknown systems;
(e) economic solutions or corresponding policies are independent of the institutional environment and institutional arrangements.

It pays to examine carefully the underlying assumptions of several economic models in circulation that claim to offer "comprehensive" "optimal reduction of GHGs" solutions, most of which fall into the above fallacious approaches.

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Chapter 3
Analytical Methods of Green Economics

Abstract This chapter avails some of the neoclassical economic methods, in addition to transaction cost economics and new institutional economics. Different constituents of economic analyses, with appropriate improvements wherever necessary, tend to constitute a meaningful and workable strategy toward the design and implementation of green economic policies. This chapter focuses on such foundations, and also leads to useful methods/models and techniques of analysis. Limitations of the conventional approaches are also elucidated here.

3.1 Institutional Analytics

Policies emerge in relation to institutions, some of which are amenable to change; these possess features of endogenous evolution. Exogenous influences affect institutions in varying degrees in relation to historical background, cultural and administrative features (including the role rule of law and enforcement), and other factors. Devising green economic policies (GEP) is founded on addressing issues of institutions, sustainable development (SD) with inclusiveness, and efficient governance. Neoclassical or mainstream economics does not normally account for the role of institutions and transaction cost economics (TCE). This shortcoming makes it incomplete as a methodology for addressing economic development policies.

Douglass North stated in his 1993 Nobel Prize Lecture (details at www.nobelprize.org):

> Neo-classical theory is simply an inappropriate tool to analyze and prescribe policies that will induce development. It is concerned with the operation of markets, not with how markets develop. How can one prescribe policies when one doesn't understand how economies develop? The very methods employed by neo-classical economists have dictated the subject matter. ... That theory in the pristine form that gave it mathematical precision and elegance modeled a frictionless and static world ... the analysis of economic performance through time it contained two erroneous assumptions: one that institutions do not matter and two that time does not matter.

Devising GEP is based on the usage of relevant elements of TCE and other methods. TCE is an approach to the study of economic systems and organizations,

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the comparative merits of alternative forms of economic organization, with its focus on institutions and behavioral assumptions governing the statics and dynamics of economic agents and institutions, and based on an integrated perspective of institutions (for related concepts and applications of TCE see Rao, 2003). We first examine the concept and role of efficiency in this approach.

3.1.1 Adaptive and Allocative Efficiencies

Adaptation remains the key factor in economic, environmental, and organizational settings for seeking features of resilience, efficiency, and stability. Perfect functioning markets, for example, possess the features of simultaneous adjustments, or adaptation in response to market signals. Similarly, efficiently functioning organizations are founded on adoption of adaptive efficiency norms, such as responding to emerging information and other changes.

Allocative efficiency and adaptive efficiency are two distinct and not necessarily congruent features of an economic system. Much of economic policy decision-making is concerned with the former in seeking "optimal" allocation of resources to maximize a desired objective function. This "optimality" becomes suboptimal approach as the imperatives of adaptive efficiency are ignored. The role of adaptive efficiency remains very important for a system to cope with emerging changes over time and across different factors in a specific time interval. This applies in the economic systems and environmental systems, besides institutional changes. The role of flexibility over time needs to be recognized in order to allow for adaptive efficiency improvements as new information or other dynamics emerge.

Allocative efficiency and adaptive efficiency may not always be compatible. Much of economics literature focuses on the former aspect only whenever "efficiency" reference is made. Some times this is also seen as productive efficiency, but that also becomes a misnomer when adaptive features are ignored. The former refers, in a formal optimizing model of the neoclassical economics form, to the process of maximizing an objective function such as utility or profits, subject to various constraints, and seeks a combination of allocation of resources for attaining that objective over a given time horizon.

North (1990, p. 80) aptly stated: "Adaptive efficiency is concerned with the kind of rules that shape the way an economy evolves through time. It is concerned with the willingness of a society to acquire knowledge and learning, to induce innovation, to undertake risk and creative activity of all sorts, as well as to resolve problems and bottlenecks of the society through time".

In his 1993 Nobel Lecture, North concluded:

> It is adaptive rather than allocative efficiency which is the key to long run growth. Successful political/economic systems have evolved flexible institutional structures that can survive the shocks and changes that are a part of successful evolution. But these systems have been a product of long gestation. We do not know how to create adaptive efficiency in the short run.

Allocative efficiencies in the short-term may not necessarily be consistent with those of the long term, because of unforeseen changes in the dynamics of the underlying systems. However, if we focus only on adaptive efficiency, some short-term allocative efficiency compromises may be inevitable. A reasonable balance of both types of efficiencies is called for, and there is need for formal methodologies to address these aspects. Clearly, *institutional environment and institutional arrangements should be designed and oriented toward the flexibility to apply the implications of adaptive efficiency, without losing sight of allocative efficiency.*

In order to keep track of economic, environmental, and social efficiency factors, improved accounting mechanisms are needed, and some of these require modifications of the conventional national income accounting as well as assessment of gross domestic product (GDP).

3.2 Net National Product and Environmental Accounting

The recent Report by the Commission on the Measurement of Economic Performance and Social Progress (Stiglitz Commission, 2009) argued:

Green GDP adjusts conventional GDP for the depletion of or damage to environmental resources. This constitutes only one aspect of sustainability; we need an assessment of how far are we from targets of sustainability. This leads to the need for assessing overconsumption relative hat may be sustainable.

Indicators relevant for this purpose include:

(a) adjusted net savings (ANS), defined as change in total wealth (natural resources, physical resources and productive capital, and human capital), although this could also lead to missing the global nature of sustainability;
(b) Ecological Footprints, which have their own limitations for using a common numeraire; these could, at best, be indicators of instantaneous non-sustainability at the global level;
(c) Carbon Footprints (CF) may be more suitable in so far as they are more clearly physical measures of stocks and may convey the information content in terms of over-utilization of the planet's capacity for absorption of various emissions;
(d) There is need for physical-economic model predicting future interactions between the economy and the environment in a reliable way.

The UN Committee of Experts on Environmental Economic Accounting (UNCEEA) has been examining issues related to mainstreaming environmental-accounting and implementing the System of Environmental Economic Accounting (SEEA) in countries.

Net National Product (NNP) in any year for a country, defined below, forms a standard economic measure that aggregates economic well-being of country while recognizing environmental changes. The role of market-based or other valuations of resources remains an important feature here and this could imply some non-unique assessment methods, however.

The following expression represents a reasonable estimate of NNP (see also Dasgupta & Maler, 1994):

NNP	= consumption + net investment in physical capital + value of net change in human capital + value of net change in stock of natural capital – value of current environmental damages.

More generally, the above form admits generalizations such as variations in each component of the environment, and if these are non-commensurable, NNP becomes a vector representation rather than a scalar estimate.

This environmentally adjusted gross national economic product provides a measure of economic and environmental progress and sustainability if adopted and used consistently for consecutive years. The main elements of adjustment are in terms of depreciation of assets and utilization of ecosystem services that are nonrenewable. Economic growth that takes little note of the draw down of environmental and hence economic assets is inherently unsustainable. Sustainable harvesting of resources is usually a prerequisite for sustainable economic growth. However, neither of these features guarantees SD. Additional criteria need to be fulfilled for that end, as deliberated in previous sections.

Green accounting methods such as NNP incorporate environmental values of resources (marketed or other). Green NNP is not necessarily a perfect indicator of a society's welfare but can be a useful statistic if its features are properly interpreted. A word of caution is needed here. A poorly managed economy-environment system can lead to misinterpreted levels of valuation of resources, whether assessing for green accounting or other purposes. A resource's value is low if it is poorly managed (Cairns, 2002).

When projects have long-term effects then NNP (current valuation) does not offer sufficient information to evaluate the project; in such cases, more information on the future "optimal" development of the economy is necessary (Vellinga & Withagen, 1996). Accordingly, NNP may not be used as an indicator of sustainability.

Besides, based on optimizing models, Rao (2000) proved that:

(a) NNP cannot form an indicator of sustainability when the role of technical progress, time-related uncertainties and unknowns exist (as is the normal real world case); and
(b) Pollution abatement should be increased as long as marginal utility of decreased pollution outweighs marginal disutility of foregone consumption, *all assessed into the future*.

This analytical derivation demands more information that is unavailable at any given point of time. But the interpretation is rather a commonsense appeal:

if we forego something now (or later), it should be compared it with the gains at appropriate time of comparisons, in terms of incremental sacrifices and incremental

gains – all assessed as a stream over time at that comparison time instant as well as implications of foreseeable future.

3.3 Economic and Environmental Externalities

Environmental externalities abound with rising GHG emissions, but measures to reduce these can mitigate externalities of other types as well, both environmental and economic. This potential has been recognized in various reports; rather, conversely, the problems contributed by GHG emissions and CC have been largely documented. Yet the synergies between issues like climate change and local air pollution (LAP) policies have not been fully investigated. For example, a reduction of one of the GHGs, methane (arising mainly from the agriculture sector), can lead to a reduction of tropospheric ozone concentration (which has its own role in global warming) and of adverse effects on human health and agricultural crop yields. Unless the benefits are fully estimated, simplistic measures to assess the costs of GHG reductions tend to overestimate the costs because of the co-externalities associated with reduction of emissions of GHGs. One of the estimates (Bollen, Guay, Jamet, & Corfee-Morlot, 2009) shows that if emissions of GHGs are reduced by 50% in 2050 (relative to the levels of 2005), the number of premature deaths caused by air pollution could be reduced by 20–40% (depending on the region) in 2050 (Bollen et al., 2009). Since the co-benefits (or positive externalities) of reductions in GHG emissions are realizable in the shorter and medium run, assessing the benefits of these in relation to time profiles of costs of GHGs reductions over time will convey a better understanding of the trade-offs (if any) and synergies.

Estimates of GHG reduction via phasing out energy subsidies in developing countries are often misleading. OECD (2009) claims the potential for reduction (based on its ENV-Linkages models) in countries such as India could be as high as 10.8% by 2020 and 31.6% by 2050. The report claims that removing fossil fuel subsidies in emerging economies and developing countries could reduce GHG emissions by 10% by 2050 compared to baseline. It is unrealistic to formulate models that assign the same consumption-price effects for a heterogeneous iniquitous economic system and derive various implications with little recognition of varying implications on the usage of substitutes in the household energy sector, depending on rural, urban, poor or non-poor households.

Among the assumptions of the OECD's ENV-Linkages model are the following (see details in Burniaux & Chateau, 2008):

All production operates under cost minimization, perfect markets and constant returns to scale;

Electricity generation is deemed a single technology with no distinction between nuclear, fossil-fuel, hydro and other renewable sources of production.

Also, endogenous responses to investment and consumption are not recognized.

In the absence of recognition adaptive efficiency features and various types of endogenous feedback responses of the economic and environmental systems, it is difficult to arrive at an "optimal" policy prescription with excessive levels of quantification. An indicative policy planning role may be played by such models, and should be subject to additional screening criteria such as robustness and sensitivity of solutions to potential changes, and other externalities.

3.4 Benefit-Cost Analysis Methods

Conventional methods of analysis like Benefit-Cost Analysis (BCA) form only some initial bases to improve upon. This is because these traditional methods did not consider some of the possibilities of disturbing the structure of the economic system and the locus of its equilibrium.

BCA is often carried out at the margin, since it generally takes an existing system as given and assumes its stability or equilibrium. In theory it seeks to maximize a measure of "economic surplus" (the potential benefit of undertaking activity if it is to be undertaken) by choosing a set of policy options (if these exist), and often attempts to rank alternative projects in terms of the likely economic surplus that might be generated.

Assessing costs and benefits at the margin can help in comparing alternative projects of comparable features (social, economic and environmental) but the big question of whether to engage in the project at all – determining whether net benefits are likely even to be positive – is an example of a discrete choice (Goodwin, Nelson, Ackerman, & Weisskopf, 2005).

BCA has an important role in various aspects of decision making. In the context of environmental issues, especially management of global commons and related policies which arise largely in the public arena, the methods require considerable further strengthening because of the following factors:

(a) the time horizon involved is usually hundreds of years or longer;
(b) there is no unitary decision making mechanism;
(c) there are unusually predominant unknowns and uncertainties in the cost and benefit configurations; and,
(d) specifying numerical values to bring the multiple factors to a common scale is complex and founded on many arbitrary assumptions.

The BCA valuations commonly seen in practice have often been based on existing unsustainable conditions while seeking some kind of sustainability. These constitute methods where one can be precise up to a very small fraction but fundamentally wrong on the premise. This is one of the scenarios where one could be precisely right if only one is right at all. It serves no useful purpose to generate such numbers and use them for project valuation and BCA. Both efficiency and equity issues must be taken into account together. Ecosystem-based assessment of

costs and benefits would lead the analysis from relatively temporary, equilibrium-based, economic and environmental phenomena, to a more realistic interdependent valuation. Only such methods can offer some guidance for policy purposes.

3.5 Economics of Valuation and Time-Discounting

Time-related discounting of costs and benefits is a crucial aspect of BCA, since small differences in the rate of discount can make significant impact on these valuations over long time horizons, because of the nature of compounded discounting.

Based on economic and ethical reasoning, Goodin (1982) argued that it is important to weigh the interests of the future far more heavily than in ordinary discounting procedures. Goodin's conclusion on nontradable goods is important: "The discount functions applied to nontradable goods must vary one good to another. How much person's future enjoyment of any particular nontradable good should be discounted depends on how much more of that good will have. The rate and structure of discounting applied to nontradable goods should match the rate and structure of returns on investments in those goods."

3.6 The Stern Review

Nicholas Stern Report (Stern Review, 2006) has carried out an extensive series of studies in the context of the UK government sponsored report. The Report concluded that inaction on climate change (CC) may cost about 5% of global gross domestic product (GDP) whereas the cost of reducing greenhouse gas emissions could possibly be about 1–3% of GDP, in one of the main scenarios of projections.

For a simple comparison of the order of magnitudes of costs suggested, it may be relevant to note that the "total cost of a clean environment" is about 2% GNP in the US (for details of estimation see USEPA, 1991). This estimate includes not merely costs of reducing GHGs, however. An approximate level of doubling of current expenditure levels in developed countries may constitute a rough estimate of needed budget for GHGs reduction in order to stabilize at 450 ppm level (to contain CC with 2 degrees rise in global mean temperatures).

The Stern Review stated that the environmental pressures have now begun impacting global economic processes and that impacts of CC could create losses of 5–10% of global GDP each year, and damages can add up to 20% if we include non-*market* impacts and are weighted for distribution effects including more severe problems for the poor. This calculation includes estimations of damages caused by flooding, lower crop yields, extreme weather-related damages, and other direct impacts on the environment and human health.

Despite some disagreements with this analysis (especially regarding the choice of time discounting), the Review it has a convincing way of looking at some of the options of broad policy to curtail the emissions of greenhouse gases. A number of

aggregate estimates sought to convey the message, for example, that if no active actions are in place for reducing CC contributors and their effects there could occur 20% drop in per capita consumption. If a large number of people could suffer a drastic reduction in consumption and threatens survival, this consequence of CC could lead to instabilities that spiral several other forms of violence and disturbances (with their own additional costs). Some of the costs of adverse effects constitute overestimates of likely costs for the reason that the projections ignore the direct role of adaptation policies.

Much of the debate on the merits (or lack of the same) of the Stern Review stems form choice of discount rate about 1.4% (built on the assumptions of 1.3% consumption growth rate and 0.1% "pure time preference" rate) in valuing future costs and benefits (in assessing total costs/benefits) of interventions to reduce global warming. However, a useful summary of the debate on this aspect is due to Nobel Laureate Kenneth Arrow: ". . .the fundamental conclusion of Stern is justified: we are much better off to act to reduce CO_2 emissions substantially than to suffer and risk the consequences of failing to meet this challenge" (Arrow, 2007).

An important clarification on the role of relative prices in the context of discounting over time for assessing costs and benefits (see Hoel & Sterner, 2007 for details) is that we should discount costs but also take into account the increase in the relative prices of adversely affected ecosystem services. *It is the combined effect of choice of discount rates and of possible relative price changes that should enable a more meaningful assessment of costs and benefits in the medium run and long run.*

There has been a great deal of controversy surrounding the choice of near zero value for social rate of time preference (that is, valuing future consumption at the same magnitude as the current consumption of the same); see for example, Mendelsohn (2007). However, the case for interventions to reduce CO_2 concentrations suggested in the Stern Report remains robustly valid even if the discount rates are chosen at higher levels (details articulated by Arrow, 2007): (a) the benefits of reducing CO_2 emissions and their concentrations include an increase in the economic growth rate from 1.2 to 1.3% during the interval 2010 to 2200; and (b) net present value of benefits of mitigation strategies exceeds that of costs, even for high social time preference that stays less than 8.5% (not even the toughest critics of the Stern Report went that high in discounting over time).

In an empirical analysis, Sterner and Persson (2008) used *relative prices of environmental goods and services in conjunction with the output of person-made goods and services*. This modification makes a lot more realistic sense than almost any economic model has done thus far. They found that the optimal emission path trajectories come close both in the Stern Review (with zero social rate of time preference) and in another canonical analysis of DICE models due to Nordhaus and Boyer (2000) (using higher time discounting rates). This study should settle the time value discounting controversy, along with Arrow's arguments, and it is time to move on from this aspect onto other related issues for the design of GEP.

The real issue of discounting over time seems to be that of some of the political decision makers whose rate of discount is usually high. For some of these leaders a time horizon of ten or more years seems rather high and they are willing to take

decisions for shorter horizon each time and thus perpetuate level of inefficiency that can result in much higher costs to achieve a required level of change.

Much of the application of BCA presumes some type of "commensurability ". "Strong commensurability" assumes the existence of a common numeraire that enables assigning numerical values to each factor and function involved in the decision-making context. This approach could directly contrast some of the requirements of SD. A "weak commensurability" approach relies only on ordinal ranking of preferences amongst alternatives, does not require assigning numerical values to all the parameters involved, but this may not be enough to suggest relevant policies and the scale of operations or interventions in the environmental governance. None of the approaches can make sense in the absence of the institutional implications, constraints and effectiveness.

BCA must take into account sustainability requirements at different stages of valuation of resources, and one of the key elements in this process is to choose an appropriate discount function. Some of the valuations for various resources that generated numerical values seen in part of the literature claiming to deal with sustainability issues, are usually carried out in a very narrow context. The valuations were often based on existing unsustainable conditions while seeking some kind of sustainability. These constitute methods where one can be precise up to a very small fraction but fundamentally wrong on the premise. This is one of the scenarios where one could be precisely right if only one is right at all. It serves no useful purpose to generate such numbers and use them for project valuation and BCA. Both efficiency and equity issues must be taken into account together. Ecosystem-based assessment of costs and benefits would lead the analysis from relatively temporary, equilibrium-based, economic and environmental phenomena, to a more realistic interdependent valuation. Only such methods can offer some guidance for policy purposes.

3.6.1 Revised Benefit-Cost Analysis

"To whomsoever benefits occur" (TWBO) has been the cornerstone of BCA for over half a century, when all project benefits are lumped together in their assessment. The TWBO – indifference in assessing potential benefits of specific programs/projects is not helpful when the effective distribution of benefits accrue often to select groups or individuals. Usually, the TWBO criterion ends up merely enriching those who already possess wealth, power and other resources and ignores equity dimensions (by design). It is not as though most economists have been indifferent to the role of social justice, equity, and income distribution aspects of project appraisal and BCA. Relevant methods have been devised about 30 years ago but seldom applied. These methods tend to become appendages rather than integral part of such analyses, just as environmental considerations have been treated either cursorily or ignored altogether. It is unreasonable to find fault with mainstream economics for its lapses in this regard. It is the large institutions such as the World Bank that devise practice guidelines based on economic research on a selective basis, and it is that practice (which itself is not usually in compliance with stated "Guidelines") that perpetuates

professional standards of select variety rather than wholesome objective approaches. In such cases (which are likely to be the norm rather than exception) the organizational motives and "agency maximands" (including business indicators such as the amount of credit lending targets in a region or country) become the influencing factors, and not necessarily the validity of facts or scientific analyses.

There is good degree of discrepancy between the time horizons of political actors, senior management and decision makers and the time sensitivity of problem diagnosis and problem solving. The rate of time discount of political or administrative set up is usually be higher that of the society as a whole. This factor contributes to gaps in societal best interests and ongoing policy decisions.

Let us briefly review an important aspect of GEP that deals with mitigation of CC.

3.6.2 Climate Change Mitigation

Climate change mitigation policies need to be devised in terms of applications of policy instruments/interventions that of their roles in promoting realization of objectives and goals in a static or temporal sense, dynamic or multi-period set up, and in their relative flexibility in response to evolving state of understanding about the environmental system dynamics, their uncertainties, and the efficacy of intervention strategies over time (feedback evaluation and related information for possible adaptive decision making). Green taxes, emissions trading policies and technology choices, in addition to endogenous behavioral patterns of individuals and economic entities require recognition of the above features in order to remain efficient and relevant.

The following criteria may be used in devising mitigation strategies (for related aspects see also Duval, 2008):

1. Equalizing marginal abatement costs across all emission sources in order to make use of existing opportunities for low-cost GHG emission reductions (this criterion assumes the availability of information for the purpose and also requires assessment of costs in terms of full resource cost assessment valuing all forms of resource use, in addition to direct costs and TC);
2. Promoting efficient levels of innovation and deployment of emission reducing technologies in order to lower future marginal abatement costs;
3. Retaining meaningful flexibility in strategies and the policy measures so that additional information on various climatic and economic uncertainties are reflected at relatively low cost;
4. Minimizing total costs per unit benefit should be a guiding norm, where total costs include the direct mitigation costs as well as TC of designing, implementing, monitoring and evaluation of different policies and resource deployment.

Using cost estimation in terms of market prices adjusted for sustainability premium price, add on elements (where necessary) and valuation of all resources reflecting environmental costs, and recognizing any added externalities (sometimes

called co-externalities, such as local air pollution reduction as a result of GHG reduction) is an important aspect of assessment here.

Global climate change problems seek a paradigm shift in economic approaches and methods. It is seen in this book that a strong focus on complementary approaches of NIE, and revised neoclassical economics methods offer a better way of examining the issues and devising relevant GEP. The current perspectives in national and international policy units seems to shift from sustainable development economics to the economics of climate change, adaptation to CC, and mitigation aspects.

Lest it is lost on policy makers, let us recall that even the attention to SD so far has been confined more to intergenerational settings for environmental sustainability, than for a harmonious integration of environment-poverty-economic development perspectives. If the shift in focus is more toward setting targets and goals for reduction of GHGs, there is likelihood we will miss several other priorities of socio-economic development and may not come out ahead: we may (just may) win the battles but lose the war. The designing and implementation of GEP will have better role for sustainable development as well as meet socio-economic equity aspects.

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Chapter 4
Formulation of Green Economic Policies: Optimality, Efficiency and Equity

Abstract This chapter examines the role and limitations of standard desirable features of formal economic models and seeks to extend them in the context of green economics and formulation of green economic policies. Familiarity with formal economic models of the optimizing type used in neoclassical economic methods is assumed for the discussion here.

Economic models of the common variety in neoclassical economics are generally conditioned by the constellation of institutions and economy-environmental systems at a given time interval. When these conditioning systems themselves undergo rapid or abrupt changes (as in some aspects of climate change and its effects), the models seeking their equilibrium or optimality characteristics do not hold good. The shift in paradigms makes a significant difference in the validity or otherwise of formal models of long term (such as 100 years).

Most of economic literature refers to the concept and application of "optimality" in the neoclassical economic approach. This is based on formal models involving maximizing utility function or other desirable objective function over a time horizon subject to some chosen rate of time discounting and subject to various specifications of structural relationships, constraints and initial conditions; some include considerations of uncertainties and such special features. In simpler models or specific settings such as in corporate decisions, this model can be applied to choice of optimal mix of media for advertising, for example.

4.1 What Is the Problem?

The broad analytical base of this approach and substantially developed models over the past few years enable rather versatile applications in several settings and the seeming tractability of modeling and derivation as well as policy interpretations of optimal solutions sometimes leads to false confidence in a seemingly objective and scientific methodology. For illustration, if an international financial institutions formulates related models (as many of them have been doing over the years) and brings in hundreds of variables for a so-called general equilibrium models but falls short on incorporating some of the realistic requirements such as loss of peace and

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stability due to major structural reforms including drastic reduction of subsidies in a poor economy (without ensuring safety net in place before undertaking such changes), the exercise in deriving "optimality" stands founded on failures to perceive and include dislocation and transaction costs, reliance on market factors with least recognition of the role of non-market factors and so on.

It is not as much the lack of formal role of such institutional factors and disturbances in models that is bothersome, as it is to ignore the destabilizing contributions of some policy actions prescribed or supported by the models that is of serious concern. For example, sudden withdrawal of food subsidies to the poor is detrimental to the socio-economic system (and possibly the environmental system) and has significant dislocation and transaction costs (TC) to the society. These costs are usually not reflected in the formal models (for illustration see a typical study and associated economic model of the International Monetary Fund or the World Bank, among several other organizations). Conceded that most of these institutional factors and non-monetary cost may not admit quantification to enable plugging into the models and to derive quantitative solutions or policy specifications, but that is no justification for ignoring those critical issues that matter to the people, environment and the economy. Most of economic models in use do not even consider the significant role of TC, and thus lead to misleading policies.

The explicit recognition of the institutional factors that are presumed in formulating a model is an important first step. The next step in formulating models would involve aligning institutional arrangements (including incentives for compliance and disincentives for non-compliance – wherever formal rules apply), followed by choice of policy instruments and formulation of objectives of policy, and finally applying using methods of analysis with appropriate application of formal optimizing models or others, as relevant. The appropriateness of parameter selection and assessment of resource costs, for example, should pay attention to the valuation of resources both marketed (making sure that the market prices are reflective of sustainability aspects altogether) and non-marketed.

4.2 Efficiency and Optimality

Efficiency norms in the conventional neoclassical approaches stated above follow from the "optimal solutions" and are supposed to have been derived from the models using appropriate optimizing techniques such as dynamic programming (and stochastic dynamic programming, using Bellman's Principle of Optimality), or optimal control theory (with the application of Pontryagin's Principle of Optimality). These tend to be fascinating analytical results, except that in several cases they obey a kind of forced quantification and oversimplification of reality, even though the models and techniques seem complex and sophisticated enough to impress some readers or followers. Much of these arguments also apply to various large-scale simulation models currently in circulation. However, the illustrative and informative (though not prescriptive) role of such models remains relevant (as long as corresponding TC are not high).

When it comes to equity aspects, the formal models of the above varieties have been paying much less attention. Equity concerns are usually founded on socio-economic and social values, and these have not been formally integrated into models of neoclassical economics for want of quantifiable parameters and or lack of attention to social justice. Unless the paradigm shift occurs, formal models may not pay attention to the requirements: social justice matters, economic justice matters, environmental justice matters.

It is useful to state the foundation of a broad normative approach: fair and equitable governance principles and corresponding practical mechanisms lead to sustainable socio-economic and environmental systems. The first principle of GEP (stated in Chap. 1) becomes relevant in such a framework: attainment of sustainable development on an inclusive basis, where life matters.

It is still possible to draw upon some of the analytical methods and neoclassical economic approaches as long as the second principle of GEP holds: application of realistic economic principles and methods for the design of economic and environmental policies affecting the efficiency of governance in a cost-effective manner, where costs include all resource costs as well as TC.

The third principle of GEP remains an effective and required strategy for realistic application of the above two stands: design and implementation of efficient policies and institutions based on complementary roles of markets, regulations, and stakeholder participation.

The fourth principle of GEP, viz. design and implementation of with policies and institutions addressing short-term priorities consistent with long-term objectives can be handled, with a combination of qualitative analytical and quantifiable approaches. The fifth principle of GEP emerges as a result of the above approaches: efficiency norms include economic, environmental, and social criteria.

Box 4.1 summarizes the role of different forms of capital and sustainability.

Box 4.1 Forms of Capital and Sustainability Assessment

It is important to recognize different components of capital in the general economic production system, resultant economic welfare and sustainability. Broadly, four types of capital may be classified: Person-made capital (based on manufacturing or related economic activities), Natural capital (consisting of non-renewable and renewable resources including the atmosphere, sources and sinks of the planet, and several other ecological resources), Human capital (knowledge, technical know-how, health), and, Social capital (culture, peoples' institutions, efficacy and quality of various institutions, cooperative behavior, trust, social norms, and peoples' participation in decision-making). Clearly, these forms of capital components are partly complementary, and are not always mutually exclusive. The comprehensive valuation and assessment of these features could form a beginning in the interpretation of sustainability.

SD then must incorporate the roles of individual components of capital stocks as well as relevant interrelationships among them for achieving the objectives.

Sustainability assessments are usually defined by the characteristics: assessment of economic, environmental and social impacts of policies (current or potential). The application of sustainable development can be politically sensitive due to the reluctance of governments to be assessed on the actual results of their combined economic, environmental and social policies. Sustainability assessments can reveal the lack of accountability and transparency associated with sustainability assessments can also be uncomfortable for governments. This has been the view at the Finnish National Commission on Sustainable Development (FNCSD) sponsored a Workshop on *Assessing Impacts of National Strategies for Sustainable Development* on 11 February 2009 in Helsinki.

The Workshop rightly suggested that academic efforts to develop sustainable development indicators and assessment tools and methodologies should be geared more towards policy processes. The institutionalization of sustainable development through strategy processes could help overcome political sensitivities and the sacrifice of sustainability goals to shorter-term political objectives. Combined efforts should be fostered between the separated activities on national sustainable development strategies (governance), sustainable development indicators (measurement), and sustainability assessments (analysis).

4.3 Basic Approach

The next issue is to devise GEP that recognize the above broad aspects while catering to the economic objectives: minimize poverty and maximize the quality of life on a sustainable basis for the current and future generations (that is seeking economic sustainability and recognizing the imperatives of SD). The operational policy problem is one of mapping economic and environmental resources toward meeting the above objectives, and of devising efficient transformation mechanisms applicable at local, national, and global levels. These involve and depend upon human and technical elements, institutions and organizations, countries and geographies with differential characteristics (socioeconomic, anthropological, political and other). It is thus important to identify the important prerequisites of these ingredients of transformation that can potentially achieve the objectives in an "efficient" manner. The criteria of efficiency are generally closely related to maximizing positive objectives at the least total cost (including costs of adjustment and transaction costs, in addition to direct costs) over desired time period.

Several economists contributed a variety of econometric and optimizing models to derive so-called "optimal" paths for greenhouse gas emissions reductions, so

as to minimize costs of such reductions over time. Admittedly there are a number of unknowns the authors acknowledge but sought to explore some approximate specifications, however. For an analysis of the shortcomings of oft discussed and rather frequently cited models of Nordhaus, see Dore (2009). A "pre-commitment" to the criterion of marginal benefits (of climate control policies) need be equal to marginal costs as an "efficiency" criterion (as often done in microeconomics assuming competitive markets) constitutes a misapplication of relevant economic criteria.

4.4 Equity Aspects

Resource control and management need to be related to principles of ethical fairness and economic justice. Two aspects are relevant here (Rao, 2000). Firstly, a just society must remain sensitive to the background conditions against which markets function. Secondly, existing distributions and preferences should not be taken as the fairest or inflexible. These are very important normative and ethical issues. These considerations must be recognized when issues of resource valuation and income distribution are considered. In the extreme, abject poverty degrades human dignity and also leads to deterioration of the ecosystem.

As early as in 1930s, well-known economist Pigou argued that the markets might have structural limitations in the protection of future interests of the society. Pigou (1932, pp. 29–30) stated: "there is wide agreement that the State should protect the interests of the future in some degree against the effects of our irrational discounting and of our preference for ourselves over our descendants. . . It is the clear duty of Government, which is the trustee for unborn generations as well as for its present citizens, to watch over, and if need be, by legislative enactment, to defend, the exhaustible natural resources of the country from rash and reckless spoliation."

When some governments themselves undertake just the operations that were often attributed to market forces, and when these have negative externalities across generations of people within and across countries, the role of alternative forms of governance becomes clear. The role of community and stakeholder participation (with appropriate mentoring and evaluation of activities) is important deliver the results in a cost-effective and accountable manner. The role of TC is to be recognized here too. Often, it is possible to internalize these costs with the active participation of stakeholders and the community in effective governance of resources.

On the issue of equity between high consumers and low consumers of resources, there is significant lack of equity in causing the climate changing and its cost implications on others, whether evaluated at the aggregate national levels or between the rich and poor sections of a given society. Rich countries have focused attention on ways to reduce carbon emissions to some extent but have largely ignored assisting poor nations in effecting better reductions or in coping with adverse consequences of climate change (for a scientific basis for various elements of CC in relation to

human activities using recent information see Pittock, 2009). In general, poorer sections in any society tend to contribute least to CC but have the most to suffer for its adverse consequences. Any assessment of costs and benefits of CC and its intervention strategies tends to mask the real costs on the lives and basic survival of majority of the global population, especially the poor. Thus the equity needs to be examined in several dimensions.

4.4.1 The Role of Trusteeship

Historically, the "public trust doctrine" has been based on the Roman law concept of *res communis*. That is, by natural law, non-private assets belong to all of the society. This premise adhered to the ethic that global common resources belong to mankind and deserve to be protected under the doctrine of public trust. The public trust doctrine recognizes the role of the state (not necessarily a government bureaucracy) in environmental protection and the use of appropriate regulatory instruments for this purpose. As an illustration of the trustee concept in a national context for environmental management, the US National Environmental Policy Act of 1969 states (at Art. 101 (b), 42 U. S. C. 432): "It is the continuing responsibility of the Federal Government . . . to the end that the Nation may fulfill the responsibilities of each generation as trustee of the environment for succeeding generations." Trust law foundations require that decisions for others (future generations, in the present context) be made with greater consideration of risk factors and their consequences than we normally undertake when we make decisions for ourselves. This provision of additional care and due diligence is sometimes interpreted as a requirement under the application of the Precautionary Principle. Application of trusteeship concept and provision of appropriately devised Trust Laws for various governance settings can form a basis for the protection of current and future interests in local, national and international levels. As an augmented mechanism of resource governance, promoting efficiency can help address some of the equity issues as well, although less directly.

4.4.2 Recognition of the Needs of Future Generations

One of the common grounds of environmental concern expressed in various bilateral and multilateral agreements (economic and environmental) is the concern for the protection of interests of the future generations, including the preservations of options available for the future generations. These concerns impose a set of constraints and allowable limits of international free trade affecting the exploitation of environmental resources, and are thus of relevance.

The 1972 Stockholm Conference on the Human Environment endorsed a few Principles in its Declaration that have paved the way for the formation of guidelines and non-binding (soft law) commitments to environmental policy among states, including responsibility to protect and improve the environment for present and

future generations. The 1975 UN General Assembly Resolution formally endorsed its mandate on the environmental responsibilities of states. The 1975 UN Charter of Economic Rights and Duties of States specifies "Common Responsibilities towards the international community" provides in its Article 30 (UNGA Res. 3281, U. N. Doc. A/9631, 1975; reprinted in 14 ILM 251, 1975):

> The protection, preservation and enhancement of the environment for the present and future generations is the responsibility of all States. All States shall endeavor to establish their own environmental and developmental policies in conformity with such responsibility. The environmental policies of all States shall enhance and not adversely affect the present and future development potential of developing countries. All States have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction. All States should cooperate in evolving international norms and regulations in the field of the environment.

The above assertion forms an element of international environmental law. This recognizes the roles of environmental externalities and state responsibility. There is also a direct implication that the policies of developed states should not hamper the pace of development or development aspirations of developing countries. This is one of the ingredients of the foundations of the "common-but-differentiated responsibilities" (CBDR) principle that evolved over the years.

Box 4.2 provides relevant summary extracts illustrative of the explicitly stated provisions depicting recognition of the need to protect the interests of the future generations.

Box 4.2 Recognition of Future Generations' Interests

1. International Convention for the Regulation of Whaling, 1946

   > Recognizing the interest of the nations of the world in safeguarding for future generations the great natural resources represented by the whale stocks (p. 74).

2. The Stockholm Declaration, 1972

   > man . . . bears a solemn responsibility to protect and improve the environment for present and future generations (Principle 1).

3. UN Charter of Economic Rights and Duties of States, adopted by the UN General Assembly Resolution 3281, 1974
   Article 30, stated in the text above.
4. Convention on the Conservation of Migratory Species of Wild Animals, 1980

   > Aware that each generation of man holds the resources of the earth for future generations and has an obligation to ensure that this legacy is conserved and, where utilized, is used wisely (Preamble, p. 1).

5. UN Convention on Biological Diversity, 1992

   Sustainable use means the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations (Definition).

6. Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of all Types of Forests, UN Conference of 1992:

   Forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual human needs of present and future generations (Principles).

7. The Rio Declaration on Environment and Development, 1992

   The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations (Principle 3 of the Declaration).

8. The United Nations Framework Convention on Climate Change, 1992 Article 3 (1) Principles states:

   In their actions to achieve the objective of the Convention and to implement its provisions, the Parties shall be guided, inter alia, by:
   The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common-but-differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.

9. North American Agreement on Environmental Cooperation, 1993

   The objectives of this Agreement are to . . . foster the protection and improvement of the environment in the territories of the Parties for the well-being of present and future generations.

10. Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, 1998 (in the region of the United Nations Economic Commission for Europe (ECE); it was signed by 35 states and the EC).

The Preamble states, inter alia, that "every person has the right to live in an environment adequate to his or her health and well-being, and the duty, both individually and in association with others, to protect and improve the environment for the benefit of present and future generations"

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Chapter 5
Institutions and Policy Design

Abstract This chapter focuses on relative use of market and non-market institutions, economic and environmental organizations, environmental agreements, laws and institutions; highlights issues of coordination with the objective of suggesting efficient design of institutions and policies that draw on synergies of economic and environmental assets. Also included are reorientation of institutions that can integrate policies for sustainable growth and development.

5.1 Markets and Society

In the context of the dominance of market institutions in modern economic life, let us recall a statement of 1940s due to Karl Polanyi (1944, p. 57):

> Ultimately ... the control of an economic system by the market is of overwhelming consequence to the whole organization of society: it means no less than the running of society as an adjunct to the market. Instead of economy being embedded in social relations, social relations are embedded in the economic system.

Realization that market institutions can and do fail more often than not is useful. However, it is not automatic that when failures occur, government intervention is the alternative mechanism, since these mechanisms can often bring in their set of inefficiencies, such as high transaction costs with relatively limited adaptation efficiency. There is need for a reasonable mix of forms of stakeholders' participation that can alleviate some of the informational problems in decision making and monitoring relevant activities to ensure efficient governance.

Various pre-conditions for markets to operate even approximately efficiently are often ignored in real world policy making, either because of lack of attention to the fundamentals of market structures or because of the deliberate interests of rent-seekers to install policy mechanisms that remain amenable to maneuver and capture. Market failure, elucidated below, arises often because of ill-structured markets, that is, the failure is often due to faulty design and not always an accident. Since these issues are important when we refer to market-based or market-supported instruments of policy such the Emissions Trading Scheme (ETS) for the reduction of greenhouse gases, we need to revert to basics of markets.

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Let us recall the First Fundamental Theorem of Welfare Economics: If there are enough market markets and market participants, if all consumers and producers behave competitively, and if a market clearing equilibrium exists (in the sense of demand equals supply), then the allocation of resources in that equilibrium will be Pareto-optimal.

Market failure occurs when the underlying assumptions do not hold good. In other words, it is likely that whenever market failure occurs, it is traceable to the design of market institutions, and to that extent it may be foreseeable and to a large extent avoidable failure.

The theory of mechanism design is useful for the design of pragmatic policies. Let us summarize below a simple sequence of priorities in the design of institutions and policies in a total perspective.

5.2 Design of Institutions and Policies: Sequential Presentation

1. *Assess and define governance mechanisms*. This step involves the relative roles of polity, stakeholders, and bureaucracy in the design and implementation of GEP, in addition to the roles of international institutions (if any).
2. *Get the institutions right*. Here we clarify the role of the market institutions, regulatory functions and enforcement methods in fulfilling the objectives of proposed policy components; seek the possibility of involving the stakeholders and community as meaningfully as possible; ensure the proper laws and other formal and informal mechanisms exist and operate at reasonable speed and low TC; provide measures such as incentives for compliance and disincentives for non-compliance, in addition to appropriate information reporting and processing systems.
3. *Get the property rights right*. At this stage define the rights and entitlements of community, stakeholders, private and public resource owners and devise mechanisms of cost effective conflict resolution; define the objectives of policies and their mechanisms for implementation.
4. *Get the prices right*. Devise guidelines for the operation of the markets for various commodities and services (locally and import-export sector) in a competitive environment, set pricing guidelines for public sector units, and devise tax/subsidy schemes that ensure sustainable use of resources, including adoption of ecosystems approaches for pricing non-market goods and services.
5. *Get the feedback systems right*. Devise cost-effective institutional arrangements for obtaining information and updating the information system on various aspects of the functioning systems of the economic, environmental and social segments, and diagnose problems if any.
6. *Get the adaptation and adaptive systems right*. At this stage evaluate options for improvement in policy choices and their implementation, based on the feedback information, and devise revised strategies that are consistent with long run requirements.

In relation to the last element above, it is useful to refer to the need to improvise endogenous institutional response (EIR). This feature refers to the phenomenon of institutional responsiveness to changing information and situational characteristics in the continued pursuit of the stated or normal mission of an institution. Adaptive efficiency feature is better addressed when EIR exists.

5.3 Global Economic Coordination

It is feasible to align short-term intervention measures with broader socio-economic objectives of economic growth and development. A well-planned judicious mix of market and regulatory institutions tend to provide the best direction for financial stability, inclusive and sustainable growth, and sustainable development. The precise nature of the mix is to be examined with specific country settings of political, legal, administrative, and socio-economic features, in addition to other institutional factors that affect choices of policies as well as the efficacy of governance in relation to choice of instruments.

An important forum for global economic and environmental policy coordination is the Group-of-Twenty (G-20) nations, which account for overwhelming share of the global economic output and emissions of greenhouse gases.

The November 2008 Washington Declaration of G-20 nations did not explicitly address, among others: deteriorating abject poverty, neglect of the environmental assets and their effective governance as consequences of current financial turmoil. Financial recessions and economic contractions affect the poor more adversely. It is feasible to take advantage of synergies between short-term interventions and broader objectives of economic growth and sustainable development, with the use of well conceived and integrated financial, economic and environmental packages.

Later in September 2009 the Pittsburgh Summit of the G-20 leaders focused on some of the important environmental issues, in addition to a few other elements of policy that belong under GEP. Noting that G-20 group of countries account for about 80% of global energy use, policy imperatives for energy use efficiency improvements, promotion of renewable energy and development of efficient technologies have been emphasized. The Summit Resolutions recognized the need to protect the financial hardship for poor consumers, phasing out fossil fuel subsidies – with compensatory mechanisms for the poor.

Among the key decisions of the G-20 Summits in most recent events has been to augment the funds for lending by the IMF, with addition of about $500 billion. What impact, if any, will this contribution make on GEP or related aspects of economic development? We briefly look into this aspect.

5.4 Role of the International Monetary Fund (IMF)

The IMF charter is too archaic and procedures too opaque and inefficient; for example, the word *environment* does not exist in the articles and functions of the

IMF. Borrowing from the IMF entails a stigma for most countries that can ill-afford capital markets' negative perceptions on such signals.

Some lender countries tend to believe that resources offered for the IMF are not risky investment since loan recovery via the multilateral institution is assured; borrowers cannot afford to default (although some cases this occurs as well). The important question in this context is: is this the best use for resources and for the desired objectives and end results? Is this a cost-effective mechanism for the stated (and unstated) goals? A close scrutiny would indicate the answers in the negative.

The role of the IMF in global economic surveillance has been faulty and has been contributing to pro-cyclicality and thereby to accentuate financial crises. Recent major errors in the IMF estimates of externals debts of several East European and other nations is just one instance of counterproductive operations of the IMF. For example, the external debt to reserves ratio of the Czech Republic has been first shown as 236% and later revised to 89% within a few weeks of issuing the estimates and admitting major errors in 2009. The corresponding numbers for a couple of other countries are as follows: Estonia ratio corrected from 210 to 132% and Ukraine form 208 to 116. These are not small aberrations in only one phase of analysis; the track record of the IMF on several forecasts has been awfully weak.

A number of important ingredients of medium term financial and economic recovery need to be focused, even though these usually do not attract the attention from central bankers and finance ministers: availing synergistic links of environmental asset formation and upkeep, reflecting green economic policies in financial projects, sustainable economic development, and major reduction in abject poverty as well as unreasonable wage inequities. Being the largest shareholder in the IMF, the US has an obligation to ensure its reform in to ensure its efficient functioning and enhancing goals of public interest. No society can afford to ignore such important considerations that can only haunt the economy and the people with time-lag. It is important that the multilateral and bilateral financial institutions fully incorporate environmental and social considerations when devising stimulus packages as well as devising credit lending policies.

Among Group-of-Eight (G-8) Summits of industrial countries, the Gleneagles Summit is noteworthy for its attention to climate change issues. The G-8 countries in their 2005 Gleneagles Plan of Action on Climate Change listed a set of measures for mitigating climate change and promoting sustainable development, with focus on clean energy development. The Plan included 38 specific activities for possible implementation: a meaningful set in itself but there has been little focus on the role of Debt-for-Nature-Swaps (DNS).

Apart from G-8 Environmental Ministers meetings, and G-20 Summits, the role of the Global Legislators Organization for a Balanced Environment (GLOBE) may be useful to build greater support and consensus on green economic policies and formulate programs for their implementation, in coordination with respective governments. Besides, there may be need for top 20 environmental emissions contributor countries to form a forum E-20 to address urgent issues of policy and implementation, in coordination with G-20 Summit and UN bodies.

5.5 What About the World Bank Policy?

Although a detailed presentation of the environmental governance issues vis-à-vis the World Bank are presented in Chap. 8, we take up a brief case study of the policy of World Bank lending to fossil fuel industry and implications on CC. Box 5.1 offers brief insight.

Box 5.1 World Bank Loans Exacerbate Climate Change?

Regarding matters of top level governance, it is useful to note that the US Executive Director on the World Bank's Board during Bush administration was instructed by the US Treasury Department to abstain from project decisions that involved incorporating environmental considerations in power project lending to various countries. Agreed that fossil fuel-rich countries also need to avail their resources to sustain their economic systems, but the issue is at what cost to others and to themselves? What compensatory mechanisms exist, if any, for these externalities? Or, if other industrial countries could get away with little compensation for adverse effects of GHG emissions, why isolate these countries? Is the issue arising merely because of the participation of the World Bank and its multilateral funds for promoting such fossil fuel-based emissions? The main answer is that the World Bank has been proclaiming one set of policies and proceeding with the opposite direction in reversing policies subtly. A better sense of adoption of GEP will be helpful to the fund borrowers as well as creditor institutions and the global community.

An assessment study of the Bank Information Center (BIC) of February 2009 finds that even with important gains in renewable energy and energy efficiency in recent years, the World Bank Group's overall lending approach to the energy sector does not support developing countries' transition towards a low-carbon development path. The Study highlights World Bank's financing of fossil fuels and finds that even with important gains in renewable energy and energy efficiency in recent years. Some of the main conclusions are summarized below.

1. World Bank fossil fuel lending is on the rise:
   During its 2008 fiscal year, the World Bank and International Finance Corporation (IFC) increased funding for fossil fuels by 102% compared with only 11% for new renewable energy (solar, wind, biomass, geothermal energy, small hydropower). On average, fossil fuel financing by the Bank is still twice as much as new renewable energy and energy efficiency projects combined and five times as much as new renewable sources taken alone.

2. Bank fossil fuel projects have a clear impact on global CO_2 emissions:
   When the fossil fuels involved in the World Bank and IFC lending projects for the 2008 fiscal year are combusted, the project lifetime CO_2 emissions from this 1-year of financing will amount to approximately 7% of the world's total annual CO_2 emissions from the energy sector, equivalent of more than twice all of Africa's annual energy sector emissions.
3. The Bank must carefully reassess its approach to financing the development of fossil fuels:
   The Bank's continued lending focus on fossil fuels commits many developing countries to fossil-fuel based energy for the next few decades. The Study suggests that the World Bank takes greater responsibility to assess each project's full contribution to climate change because of inter-regional and global environmental externalities these projects contribute, and could negatively affect developing countries and the poor of the world disproportionately – the very countries Bank programs are trying to benefit.

   Source: BIC (2009).

5.6 Globalization and the Environment

Globalization is essentially an integration of national economic activities with international economic systems, and this implies financial and trade liberalization, deregulation and privatization, among other things. The economic paradigm of globalization gained its momentum after the so-called Washington Consensus (WC) that was publicized in a summary paper by John Williamson in 1989 in the context of revival of some of the Latin American economies. After about a decade of experimentations, Williamson admitted in 2000 that the originally stated premise of the WC was "flawed" in some respects. The flaws and their adverse impacts have been more pronounced in the finance sector and proved extremely costly for some of the developing countries. The same phenomenon of globalization then leads, in turn, to negative effects on the export earnings and on job growth in industrial nations. Williamson (2003) stated that the phrase "Washington Consensus" has "become so hopelessly ambiguous as to constitute an obstacle to clear thought".

An important byproduct of misplaced focus on economic principles of first order effects only led to demanding by international credit lenders and multilateral finance organizations to insist that a borrower or beneficiary country liberalize trade – and not assess environmental costs. These short-sighted policies succeeded in promoting trade at the expense of substantial neglect of environmental assets and resource efficiency on a broader scale of the system. The resulting externalities include: loss of forest base and biodiversity, desertification, neglect natural resource base that perpetuated poverty, contribution to global warming and climate change, and vulnerabilities to adverse consequences of these changes. Globalization that takes

into account social and environmental costs remains relevant process for expanding economies around the world – although possibly at less rapid pace but stays on a sustainable path.

Globalization is not an end product for socio-economic development, but merely a merely a means of achieving desired economic goals based on fulfilling a few qualifying conditions. Globalization attempts should be preceded by the provision of effective legal and regulatory mechanism for the transition and for the governance of new economic entities with sustainable development objectives.

The elusive reform of the international financial architecture is closely linked to the provision of meaningful elements in the policies and processes of globalization. Some of the important steps required in this context are the following (see also Rao, 2003):

1. Financial liberalization must follow, not precede, prudential financial regulation.
2. Alternative economic organizational arrangements must be evaluated before jumping to privatization. The requirements of efficient organizational arrangements, including efficient regulation, remain relevant even after privatization if Enron-like disasters need to be avoided. Public accountability and active role of all major stakeholders is important for ensuring transparency and consensus-based economic governance.
3. Standards, norms, and codes of conduct of activities, financial accounts as well as environmental responsibilities of corporate entities, both private and public, need to be spelled out and relevant regulations effectively enforced.

International debt management should be restructured to enable developing countries cope with volatilities of their export earnings; debt servicing should be made flexible and sensitized to an index of export prices and access to export markets. Rather than trumpeting the urgency of globalization all around, organizations such as the IMF should recognize and address the prerequisites for reaping potential benefits of globalization, and seriously devise strategies to ensure such benefits accrue to all sections of the society.

There is no such dichotomous choice of markets or regulation; it is a judicious mix of both that enhances economic efficiency. A balanced mix of market and regulatory institutions offer the best direction for financial stability, inclusive SD (Rao, 2009).

The combined effects of globalization-related marginalization and environment-related marginalization can wreak havoc on whatever resilience poor communities might otherwise have possessed (for detailed cases see Najam, Runnalls, & Halle, 2007). An illustrative example is the case of small fishers in the Caribbean (Breton, Brown, Davy, Haughton, & Ovares, 2006); several cases around the globe are documented in Macfadyen and Corcoran (2002).

The role of stakeholders and local communities needs to be enhanced in almost all country settings. The role of non-governmental organizations (NGOs) is important, and these should be actively encouraged to contribute toward policy implementation and provide feedback mechanisms. However, since some of the

NGOs could function under little public accountability, guidelines are required for their adherence.

5.7 Multilateral Environmental Agreements

In international environmental governance, multilateral environmental agreements (MEAs) are generally feeble instruments of international law and remain weakly monitored and implemented. The United Nations Environment Programme (UNEP) has been mandated by its Governing Council to address these common features as a way of strengthening and facilitating effective implementation of various MEAs. As part of this effort, UNEP organized in Colombo in January 2006 a High-Level Meeting on Envisioning the Next Steps for MEA Compliance and Enforcement. The following "deficits" (rather exhaustive list) have been listed to contribute directly to deficient information in terms of monitoring and evaluation, in addition to limited enforcement of various provisions:

- Implementation deficit
- Institutional deficit
- Deficit in technical, financial and human resource capabilities
- Trust deficit
- Deficit in effective participation in negotiations and ownership of its outcome
- Partnership and cooperation deficit
- Governance deficit
- Deficit in the integration of implementation of MEAs with poverty reduction and economic development
- Deficit in the application of innovative approaches to compliance and enforcement such as the use of appropriate economic instruments and other tools
- Public information dissemination and education deficit

With the list so extensive and rather fundamental, one wonders if any success if ever feasible in the near future. The above list largely comprises elements of TC that have not originally been fully addressed in the design of the MEAs and observed as shortfalls in later stages, incurring larger TC and letting opportunities be foregone in the process. In summary, this situation is an illustrative example of inefficient design and implementation of relevant policies, including failures to address the imperatives of GEP.

Since all relevant parameters are not known with desirable levels of certainty, and in fact, some factors or their relevant parameters are themselves unspecified and evolve over time, it is rather premature to offer policy advice based on excessive quantification of different unknown or uncertain parameter in the environmental systems as well as economic systems. The key issue is monitoring and obtaining feedback information, where the role of community-based organizations NGOs can be very useful.

5.7.1 Ozone Protection and Synergistic Policy Measures

Ozone depletion aspects have been addressed rather successfully during the past 20 plus years (after the Montreal Protocol of 1987) by phasing out culprit chemicals. Hydrochlorofluorocarbons (HFCs) were presumed to be less harmful substitutes for Chlrofluorocarbons (CFCs) that deplete ozone layer. However, these are also powerful greenhouse gases and are tending to constitute a major part of climate problem because of their expanding use in developing countries. They are being used as refrigerants and also for making products such as insulating foam. It is estimated that the emissions from the use of HCFCs could add up to about 19% of global CO_2 emission-equivalents by the year 2050. Molina et al. (2009), in their recent analysis, suggested greater use of the current Montreal Protocol for the Protection of the Ozone Layer. Considering that there are already a variety of options for replacing HCFCs, provision of incentives to avail these is important. A modified agreement under the Protocol can effectively offer incentives for phasing out HCFCs and for appropriate provision of financial resources as well as technology transfer from developed countries in promoting such shifts. Additional measures for speedier intervention to reduce climate change suggested by Molina et al. (2009) include reduction of black carbon (soot) particles from the emissions of diesel vehicles, coal-burning and solar cooking stoves with the use of filters. A reduction of about 50% of black carbon emissions with the use of technologies that are already available, it could help slow down GW effects of greenhouse gases by a decade or two (Wallack & Ramanathan, 2009). The G-8 Summit held in Italy in 2009 also called for "rapid action" to reduce black carbon and tropospheric ozone (G-8 Declaration, 2009).

5.8 Complementary Measures

Eradication of abject poverty that leads to desperate use of environmental resources deserves highest attention. Drudgery brings down human dignity and with it the ecological stability. This priority needs to be followed by reduction and eventual elimination of poverty, as we understand this phenomenon today.

Some of the key elements of win–win policies that reduce poverty and enhance the governance of environmental resource include:

1. Creation of nature-based assets in the process of augmenting incomes and asset holding rights of the poor: examples include social forestry, horticulture development, watershed management, water supply and sanitation, and harvesting minor forest produce on a sustainable basis;
2. Creation of community-based resource management organizations, including formation of responsible networks of cooperative organizations;
3. Joint stakeholder approach for the poor: the poor should have rights in the plantations or other assets created by them even while earning for their livelihood;

4. Poor receive priority in the assignment of community services and community-based quasi-commercial and commercial activities: examples include sale and distribution of drinking water in urban areas, promotion of kitchen gardens, participation and management of urban services such as local transportation, building maintenance and civil work contracts of local authorities.

The role of the NGOs remains important in most programs in their implementation and cost-effective monitoring and compliance as well. Some of the MEAs have specified explicitly the potential contribution of NGOs in the processes affecting global environmental governance. The increasing role of the NGOs during the recent years in international economic and environmental governance is of significance. This is not to indicate that some of the early agreements dating back to the mid-twentieth century were oblivious to these aspects. More formal roles have, however, been instituted during the past two decades or so. Box 5.2 summarizes some of the specifications regarding the role of the NGOs.

Currently, the Global Environmental Facility (GEF) is the main multilateral organization financing and funding most of the international environmental agreements, although Carbon Fund and others to address CC effects have also been launched recently. It operates mainly in the areas of biodiversity, climate change, international waters, and ozone protection (in addition to the Montreal Protocol Fund). Based on national co-financing requirements, it supports "incremental costs" of specific projects and activities; environmental education and such other cost-effective software are not included for support, however. The support usually requires the creation or use of physical assets. However, if we could moderate consumption of the rich, and production patterns of all, with appropriate sets of interventions, some of the physical infrastructure under the above set of guidelines of the GEF can be more effective. Hence the environmental literacy at different levels of education should be supported by the GEF as one of the cost-effective infrastructure-creating mechanisms. The roles of community-based organizations and NGOs remain very relevant here again.

Box 5.2 NGOs in International Environmental Treaties

The following extracts are illustrative, though not exhaustive, of the formal recognition of the role of the NGOs in some of the international agreements.

1. 1946 International Convention for the Regulation of Whaling (see 161 UNTS at 62)

> Article 4: . . .the Commission may either in collaboration with or through independent agencies of the contracting Governments or other public or private agencies, establishments, or organizations, or independently . . . study, appraise, and disseminate information concerning methods of maintaining . . . whale stocks.

2. 1973 Convention on International Trade in Endangered Species (CITES)

   > Article 11: . . .any body or agency technically qualified in protection, conservation, or management of wild fauna and flora, in the following categories, which has informed the Secretariat of its desire to be represented at the meetings of the Conference by observers, shall be admitted unless at least one-third of the Parties present object: (a) international agencies or bodies either governmental or non-governmental . . . and (b) national non-governmental agencies or bodies which have been approved for this purpose by the State in which they are located. . .

3. 1987 Montreal Protocol (MP) to the Vienna Convention on Substances that Deplete the Ozone Layer

   > Article 11: . . ..any body or agency, whether national or international, governmental or non-governmental, qualified in fields relating to the protection of the ozone layer, which has informed the Secretariat of its wish to be represented at a meeting of the Parties as an observer may be admitted unless at least one third of the Parties present object. . ..

4. 1992 UNFCCC
   Article 7: same as in Article 11 of the MP, except in the change of subject (from ozone layer to matters covered by the Convention).

5. 1998 Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters

The preamble recognizes, inter alia, "the importance of the respective roles that individual citizens, non-governmental organizations and the private sector can play in environmental protection"

The Convention also stated:

> Article 3 (General Provisions): . . .Each Party shall provide for appropriate recognition of and support to associations, organizations or groups promoting environmental protection and ensure that its national legal system is consistent with this obligation.

5.9 Institutions, Policies and Cost-Effective Mechanisms

In response to calls for a global treaty to address climate change, the UNFCCC was adopted in 1992, including most notably the principles on which climate efforts and actions are to be based. Its Article 2 not only stipulates the ultimate objective of the Convention, to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, but also specifies that this objective should be achieved in a manner that allows sustainable development to proceed.

The main international agreement so far geared toward reduction of carbon emissions has been the Kyoto Protocol (KP), adopted in 1997, and entered into force in 2005 after 55 countries ratified the agreement. Major nations such as China,

India and USA are not parties to this agreement, however. KP seeks to take note of emissions from production activities within a country's territory and to measure changes or effect targets in their reduction. KP operates with three flexible mechanisms: International Emissions Trading, Clean Development Mechanisms and Joint Implementation.

The principle of equity and common but differentiated responsibilities and respective capabilities was made effective in the Kyoto Protocol by seeking industrialized countries to take the initiatives for reducing GHG emissions through quantified emission limitation and reduction objectives (QELROs).

Thus, the Kyoto Protocol imposed a binding commitment on Annex I countries to reduce emissions by at least 5% in aggregate, by the period 2008–2012 relative to 1990 levels.

The Kyoto Protocol defines two main ways to achieve emission reductions: internal measures taken in industrial ("Annex I") countries, and through newly developed flexible mechanisms. Annex I countries are allowed to trade emission reduction units with each other under certain conditions for the purposes of meeting their reduction commitments – referred to as Joint Implementation (Article 6).

Did KP make any appreciable difference to CC? Apparently it did precious little. The KP approach is awfully flawed in its exclusion of some of the GHGs and of emissions from sectors such as the airlines. Countries could shift their emission producing industries to non-participating countries and claim compliance; the populations could continue to indulge in excessive red meat consumption and still show low-carbon economy. As China has pointed out, its high emission production has been taking place on behalf of consumers in developed countries (besides internalizing local hazards of pollution). One can argue that China or similarly placed countries are effectively voluntarily subsidizing exports to fulfill their own national preferences – which may not be consistent with GEP or SD. An international ethical question will then be: is it proper for the importers and consumers to participate extensively in such processes, or allow reverse resource transfer on account of such subsidies to offset damages? Or can there be a role for dedicated funds for mitigating such problems?

KP is flawed in its emphasis merely on production of emissions with no reference to consumption aspects. A country could proclaim low levels of production of greenhouse gases but maintain high levels of carbon-intensive consumption, still claim KP-compliant in meeting sated targets of reduction from production (excluding shipping and aviation sectors, not part of KP). In the UK case, for example, shifting of carbon-intensive production to China and India and exclusion of shipping and aviation sectors helped claiming reduction of emissions beyond KP targets; when all these loopholes are plugged and imports accounted in the consumption sector the emissions estimate increased by 19% during 1990 and 2003 (Helm, 2008).

Even if the 'carbon leakage' problem that allows shifting production to willing offshore countries is taken into account in a revised international GHG reduction agreement, the role of carbon-intensive consumption remains paramount. It is this aspect that deserves substantial new focus.

Although much has been achieved since the early 1970s to assess, prevent, mitigate and adapt to CC, substantial further work remain in each of these areas of

intervention to avert potential crises. As later chapters of the book explain in detail, it is the consumption aspect more than the production aspect of the human system that needs to be addressed urgently in order to devise cost-effective and pragmatic GEP. This approach becomes relevant at individual levels as well as in international agreements for reducing GW and CC. For example, rather than worrying more about the effects of CC on the agriculture sector, it is entirely sensible to reverse the question: what is the relative contribution of the agriculture sector – in terms of resource use for livestock, deforestation, land and soil degradation, methane and nitrous oxide emissions, and what role the dietary patterns of the rich nations and the rich in less developed countries play in accelerating GW and CC?

The US, EU, Japan, Canada and Australia will account for more than 50% of the world consumption economy. Undoubtedly, high consumption levels act to deplete environmental assets and endanger species, independently of the effects of climate change. It is therefore important to attach high level of urgency to the consumption patterns and devise a comprehensive set of policies geared toward moderating such consumption.

5.10 Agricultural Production Affected by Food Consumption?

Climate change effects on agriculture have been investigated. Various reports of The World Resources Institute (WRI) and of the IPCC project that water scarcity is already a major problem for the world's poor, and changes in *rainfall* patterns and *temperature* associated with climate change will likely make this worse. Even without climate change, the number of people affected by water scarcity is projected to increase from about 2 billion currently to 5 billion by 2025. In addition, crop yields are expected to decline in most tropical and sub-tropical *regions* as rainfall and temperature patterns change with a changing climate. A report by the Food and Agriculture Organization (FAO, 2005) estimates that developing nations may experience an 11% decrease in lands suitable for rain-fed *agriculture* by 2080 due to climate change. The role of technical adaptation and agro-economic innovation is not fully estimated in this and other related studies. An enhanced impetus to agriculture research can, for example, reduce adverse effects.

Various studies and reports (including the one summarized below) have not been able to focus on the links between red meat consumption, its rising adoption in different countries, and several adverse effects on the environment and CC. This remains a neglected aspect of the important roles of livestock production and meat consumption in devising cost-effective mechanism to reduce impacts of CC, even after the detailed FAO (2006) Report on these issues; more the details of the report will be discussed in Chap. 8.

A study report by Nelson et al. (2009) from the International Food Policy Research Institute observed that if no major initiatives are undertaken for adaptation and mitigation (not much attention to the need for curtailing meat consumption, however) of the effects of CC:

(a) agricultural crop yields will decline in developing countries (especially South Asia where about half the poor live);
(b) calorie availability averages will decline relative to year 2000 levels;
(c) child malnourishment will increase by 20%; and
(d) decline in cereal consumption will be more than that of meat consumption.

The last finding above is requires a careful scrutiny: why would meat consumption continue to dominate even in such scenarios? This is because of the major proportion of consumption in the developed world. The report also states that since prices are expected to rise, meat prices will go up and consumption will fall slightly. The role of full cost accounting wherein the resource use and environmental costs are made to be reflected in the product prices will do a better job, in addition to consumer education, in bringing down consumption to meaningful levels consistent with an accommodation of food preferences, environmental values, and some degree of equity across various regions and sectors, locally and globally. The role of direct and indirect subsidies in promoting unsustainable consumption remains a significant obstacle in promoting GEP.

Since economic development policies and GEP cannot ensure protection of some specific ecosystems or other natural systems without directly targeting these chosen sectors or regions, it is desirable to address such issues rather independently. Box 5.3 deals with a set of such aspects.

Box 5.3 Focus Targets for Conservation

If we focus on the primary issues of biodiversity preservation and mitigation of GW phenomena, it is desirable to support the critical elements of the plan advocated by Edward Wilson (2002). The financial resource requirements for this are as follows: \$4 billion to secure management of 2 million km^2 of tropical forests (based on an estimate of Conservation International), \$24 billion to manage in perpetuity 800,000 km^2 of protected areas and also add another 400,000 km^2 of areas that deserve protection. It has been suggested that a combination of program-specific treaties, concessions to developing countries, and "low-invasive" use of reserves can potentially make an attractive deal for the countries that govern the land. This is a grand idea that needs further exploration, and soon. The above total of about \$28 billion compares with \$6 billion being currently utilized from all sources for all environmental purposes. In this context it is also useful to note some of the estimates of administered subsidies for agriculture, fossil fuels, water and other utilities around the world. The magnitude stood at about \$2 trillion per annum around the end of the past century, according to Meyers and Kent (2000). In energy sector alone the subsidies stood at about \$325 billion in 2007, according some estimates.

5.11 Cost-Effective Policy Design and Implementation

Two main focus areas of reduction of GHGs are: forestry and livestock agriculture. These two sectors are related. These possess potential to reduce the costs of meeting goals and objectives of reduction of GHGs in cost reduction range between 20 and 30% a year. Policy mechanisms require appropriate actions (consistent with GEP) on:

(a) Protection of forests, promotion of social forestry and afforestation;
(b) reduction of deforestation;
(c) reduction of industrial livestock industry; and,
(d) reduction of animal-based protein consumption.

Some of these aspects are discussed in greater detail in Chap. 8. If worked out with due care, a framework in this approach can curtail costs substantially relative to all the estimates made available so far, including those of the Stern Review.

The role of forestry is summarized below.

Reducing Emissions from Deforestation and forest Degradation (REDD) could possibly reduce costs of GHG reductions globally by about 40%; any adverse impacts on land and food prices must be noted, however. One often cited reason for not taking this cost reduction measure seriously seems to be the measurement of GHG reduction contribution from REDD is still unclear.

The role of REDD emerged in greater focus after the release of the IPCC's Fourth Assessment Report. There are a number of institutional and scientific issues that remain unresolved, however. It is meaningful to visualize the role of REDD policies to reinforce sustainable forest management practices.

Cost-effective methods of reducing GHG involves better understanding of the local costs of GHG reduction in each country, so that an optimal mix of GHG package can be arrived at for each country on that basis. The end products include not only GHG reduction but also its impact on global warming potential (GWP). The marginal costs of abatement of individual gases vary substantially in relation to time horizons and the discounting of future costs in each country; these, in turn, depend on a country's current socioeconomic and other institutional factors. The role of Article 6 of the KP allows for trading of all GHGs (in Annex I countries); this provision should be expanded and fully made use of as a mechanism to enlist the support of more countries in the effective reduction of emissions and concentrations of GHGs. The role of GHGs other than carbon dioxide deserves attention as well.

5.11.1 Removal of Energy Subsidies – As Part of GEP?

Fossil fuel energy subsidies remain high in several industrial and other countries. These subsidies tend to constitute a negative price on carbon and possibly conflict

with attempts to create international carbon markets. It is suggested that elimination of subsidies would free up resources for more direct reallocation to the social objectives being supported by the subsidies, especially in developing countries. According to the OECD (2009), a significant reduction in GHG may be feasible with removal of subsidies because demand would decline in developing countries; this could also reward Research and Development (R&D) efforts for low-carbon technologies with increases in expected returns. However, some of the adverse implications of elimination of subsidies for the poor will be very important, since the result of some of these measures could be negative for the environment when substitutes in energy are resorted to, such as deforestation. When kerosene and gas subsidies were withdrawn in some of the African countries, significant tree cutting and deforestation followed.

Reduction of energy subsidies will reduce GHG emissions by a small percentage, although some claim the numbers to be high. Their claim ignores the role of use of substitutes, and often relies upon price elasticity of consumption unrelated to other effects. The costs of CC mitigation may come down if the subsidies are reduced but greater potential exists in other sectors such as agriculture (including livestock) where subsidies are rampant in developed countries, and removal remains an ongoing contentious issue under the agreements of the World Trade Organization. Besides, a "one-size-fits-all" approach advocating removal of subsidies is not what the objectives of GEP would suggest; a selective and gradualistic approach is what is relevant in this context. There are also issues of inefficiencies in targeted consumer subsidies that need to be addresses locally and nationally, an area again that does not obey "one-size-fits-all" prescriptions from some of the international organizations.

It may be feasible to detail some more international agreements, perhaps more effective in reducing GHGs but the transaction costs of drawing up such agreements, monitoring and evaluation (and other enforcements costs) will be significant, in addition to problems of ensuring every country participates and enforces provisions of agreements. Focusing on select gases and countries alone will not deliver significant desirable results. It is important to bring in the consumption sector and prioritize on issues that offer cost-effective and largely self-enforcing solutions. These involve basic appreciation of improved food and non-food consumption patterns at the individual consumer level, and the governments can provide enabling support policies. These include, among other measures, differential taxation that favors businesses that provide environmentally efficient (or eco-effective) products and discourage extractive production enterprises.

5.12 Where Are GEP in CC?

Even when all countries agree to participate in an international agreements (such as the 2009 Copenhagen Summit and the 2010 Mexico City Summit) on GHG reductions or other related aspects, it is unlikely to be effective in terms of making a difference to climate change itself. This is better than no agreement but is expected

to fall short by far in meeting relevant goals and targets of climate change (prevention, adaptation, and mitigation) and in the required reduction of GHG emissions. Why is this less than optimistic expectation under the current policy regimes and paradigms, and what can be done to improve the scenarios for a better tomorrow? The reasons are explained below.

1. The experiences in the design of international agreements and fulfillment of goals and targets shows that the gaps between promise and realization have been substantial, with the exception of the Montreal Protocol for Ozone Protection;
2. The stated goals and objectives often form the "lowest common denominator" (LCD) because of the imperatives of differing interests of nations at varying levels of socio-economic and environmental systems, in addition to differences in basic polity and institutions;
3. The focus is rather misguided when only GHG emissions are sought to be reduced at production or national territory of participating nations, leaving gaps for leakages all around;
4. Lack of focus on the role of consumption and inclusion of relevant policy framework to curtail unsustainable patterns of consumption leads to selecting not-so-cost-effective mechanisms for influencing CC and in the reduction of GHG emissions;
5. Nations responsible for greater share of historical and current patterns of GHG emissions are not ready to acknowledge their responsibilities to the extent their interventions can make bigger difference in attaining desirable objectives;
6. The policies and goals follow top-down approaches rather than ensure active stakeholder participation, including necessary campaigns to ensure better actions at micro levels (individuals, small producers and small businesses, and so on);
7. Prevailing credibility gap of some of the international organizations drags down the potential for achieving objectives (one can declare supporting a save-a-tree slogan but indulge simultaneously in encouraging deforestation, with little liability on the offending entity itself);
8. Missing recognition for an integrated approach toward: (a) production and consumption systems; (b) poverty reduction and environmental sustainability; (c) inclusive sustainable development; and (d) fulfilling the gaps between promise and implementation of various policies.

5.13 The Need for a World Environment Organization

Environmental protection is an economic as well as an ethical issue. Requiring polluting entities to bear the full environmental costs of their activities constitutes a fair argument. The current structure of markets is not capable of responding to environmental issues with any foresight. We need institutional mechanisms both top down and bottom up varieties.

The phenomena of global environmental interdependence require global cooperation and coordination of environmental and economic policies. Free-riders inflict additional costs on others. The role and responsibility of a new World Environment Organization (WEO) should include rectification of such possibilities, using instruments such as international green tax and user fee for the utilization of the global commons, compensation mechanisms and liability rules for the victims of global environmental "bads", and formation of global trusteeship for resource conservation. Damages to the global environment must be assessed and compensated by the parties involved; user fees for excessive resource use (with reference to threshold limits of each ecosystem) would be appropriate. Harm to the environment will be reduced and resources mobilized for protective measures based on such user fees and additional compensation mechanisms based on specified liability rules that could be devised by the WEO.

Unless the UNEP is upgraded to a universal membership body in the UN system or replaced by a new WEO, there remain serious limitations in effective implementation of relevant provisions of MEAs (several aspects of WEO proposal have been presented in Rao, 2002). The resources made available for the governance of the substantive aspects of objectives MEAs are meager, although considerable transaction costs are incurred by various governments and intergovernmental organizations in devising and agreeing to realize the final shape of a MEA. As a result the monitoring and enforcement aspects of most MEAs are awfully weak to the point of being ineffective. Barring the Montreal Protocol mechanism, the two hundred-plus MEAs secretariats administering their real world operations, their administrative budgets and personnel all put together may hardly equal the resources of the WTO.

Any global environmental apex organization should have capacity to collect and process environmental indicators with an objective of assessing the impacts of various programs and also to forewarn impending environmental problems at regional and broader scales. It should devise policies that use existing and new innovative instruments of market and government institutions to augment environment-enhancing activities that are aimed to promote both economic and environmental facets of life on a medium and long-term scale. This organization should be inclusive of community-based organizations, NGOs, and watchdog panels for supporting the review and feedback mechanisms in several environmental aspects. The following blueprint can form a basis for the formation of a new WEO.

Charter: Intergovernmental Organization, Treaty-based.

Membership: Open to all sovereign states; ratification required without Reservations; potential expulsion from membership as result of serious violations included as a provision.

Objectives (Preambular specifications):

(a) Promote SD with due recognition of intergenerational and intragenerational needs with the adoption of GEP;
(b) Encourage harmonization/integration of economic development and environmental protection policies in member states, with highest priority for problems beset with potential irreversibilities;

(c) Protect the global commons as the custodian and trustee organization; devise liability rules and compensation mechanisms to govern the global commons, and ensure equitable use of global environmental resources;
(d) Coordinate and offer global environmental justice and resolve interstate environmental disputes via a dispute settlement body that functions as the International Environmental Court (IEC); devise, refine and implement international environmental laws and policies;
(e) Closely work with a multi-level network of stakeholders, at local, national, regional, and international levels.

The relationship of the WEO with the existing MEAs and International Institutions are summarized below.

For any member of the WEO, the country/organization membership ceases for various affected MEAs, and so will be the obligations under affected Treaties/Agreements/Conventions. The texts of these instruments will largely remain valid but for revisions to reflect modern scientific and legal developments. The WEO charter supersedes the articles in clash or affecting the existing provisions of different MEAs and the WTO, as per the *lex posterior* norm based on the application of the 1969 Vienna Convention on the Law of Treaties (Article 30). This clarity does not apply when members to the earlier agreements are not yet members of the WEO, however.

The new charter will specify the relationships between the WEO, WTO, and major intergovernmental organizations. The IEC may be formed under the WEO charter and the WEO Dispute Settlement Body may be empowered to resolve eligible disputes between member states.

The IEC functions as the global trustee for the planetary resource utilization with special reference to *res nullius* aspects affecting open access resources and scenarios of legal void *non liquet.* The jurisdiction of the IEC extends to the entire planet Earth, whether affected states are included under the WEO membership or not. Appropriate compensation and liability mechanisms need to be devised and enforced by the IEC and also by the DSB as the cases arise.

Amicus curiae role of a new WEO in the anonymous damages cases and *non-liquet* scenarios remains significant in this context. It is useful to recall that the ICJ in Barcelona Traction Co Case (Belgium vs. Spain, 1970 ICJ, 3, 32; February 5, 1970) recognized the existence of "obligations of a state towards the international community as a whole", and not necessarily confined to the consequences of actions and inactions applicable to the contending parties only. These obligations are *erga omnes.* However, in the absence of provisions for the legal standing of a global entity such as the proposed WEO, such wider ramifications may be harder to enforce.

Among the major advantages of formation of the new world body is to be able to overcome the current dilemmas of resolving disputes between states that are not necessarily parties to the same treaty. Cross-sectoral problems such as those of trade and environment are to be addressed under the new forum rather than under the WTO charter. Also, the GEF is currently functioning as an affiliate of the quasi-commercial entity of the World Bank but should be removed from its influence; the

proposed charter and objectives are significantly different than those of the World Bank which does not even have a word on the environment in its articles of formation. Contrary to some misgivings of a few of the developing countries, it is in their interests to promote the formation of an independent treaty-based WEO which balances the objectives of economic development and environmental protection, and current poverty alleviation requirements as a part of provision of environmental amenities such as safe drinking water and elimination of hunger (in collaboration with the World Bank on some of the economic programs and water facilities, and the Food and Agriculture Organization and the World Food Programme regarding food and malnutrition problems). Another major function that is to be managed by the new WEO is the concessional terms-based transfer of environmentally efficient technologies to the developing countries. Financial and technical assistance for the governance of the global commons can be better addressed by this new entity.

Among the existing organizations, Conventions, and ancillary bodies to be superseded by the new WEO are the following:

- GEF and its implementing arms;
- UNEP and its coordinating Conventions including the Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol;
- Convention on Biodiversity;
- The Convention on the International Trade of Endangered Species (CITES);
- The Convention on the Conservation of Migratory Species of Wild Animals (CMS);
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal & its Protocol;
- Stockholm Convention on Persistent Organic Pollutants; and various related agreements;
- UNFCCC and its secretariat;
- World Heritage Convention (now with UNESCO);
- UN Commission on Sustainable Development (to be abolished);
- International Coral Reefs Initiative;
- International Oceanographic Commission (IOC);
- International Hydrological Programme (IHP) of UNESCO;
- Rotterdam Convention on Prior Informed Consent (PIC) (now with FAO and UNEP); UN Convention on Combating Desertification;
- Ramsar Convention;
- Environmental functions of the International Maritime Organization;
- International Plant Protection Convention; International Forestry Forum;
- UN Convention on the Law of the Sea and its Tribunal;
- Environmental and public health conventions coordinated by the WHO.

5.14 Proposed WEO Structure

The Director General is assisted by Deputy Director Generals and Directors and Staff from the Secretariat of the WEO. Suggested below is the structure of the WEO.

1. Division I houses the Global Commons area consisting of responsibilities for Atmosphere (Ozone, Climate Change, Greenhouse Gases), Biodiversity (Ecosystems; Endangered Species; Wetlands, Coral Reefs and Special Areas) and Oceans (Fisheries, Marine Life).
2. Division II houses Toxic Chemicals and Hazardous Waste area consisting of responsibilities for Agrochemicals, Persistent Organic Pollutants and Hazardous Waste.
3. Division III houses Environmental Public Health area consisting of responsibilities for Air and Urban Pollution, Land and Water.
4. Division IV houses Sustainable Development area that is responsible for Poverty and Environment, Environmental Amenities, Technical Innovation and Technology Transfer, Forestry and Land-based Activities, and Developing Countries and Special Needs.
5. Division V houses International Environmental Law, Monitoring and Compliance area that is responsible for Codification and Development of Law, Training and Capacity Building, Dispute Resolution, and Monitoring and Compliance.
6. Division VI houses Environmental Information Base area that is responsible for Science, Statistics, and Networking.

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Chapter 6
Reform of Policies of Global Institutions

Abstract This chapter offers an assessment of the global trade policies under the WTO framework suggests greater scope for the adoption of ecosystems approach and other relevant mechanisms to enhance trade-environment supportiveness. The roles of the multilateral development banks, generally and the World Bank in particular, have been examined and several measures are found lacking practice of their own declared policies. Examination of the scope for effective integration of environmental features, and identification of enhanced efficiency potential for global coordination of economic and environmental policies constitute other important elements of this chapter.

The direct and indirect roles of global institutions in affecting global economic, environmental and social aspects of governance need a detailed investigation in order to devise necessary reforms in their policies and structures. International trade and environmental policies governed by the World Trade Organization (WTO) are of high significance because of the magnitude of trade activities. Next to this entity, the roles of the International Monetary Fund (IMF), the World Bank and a few other multilateral development banks (MDBs) are of significance as their policies affect relevant features.

6.1 MDBs and Climate Change

Although conceptually MDBs agree on the need to incorporate aspects covering reduction of emissions of greenhouse gases (GHGs), relevant ingredients are not systematically into strategies and project formulations. The role of sustainable development (SD) and of Green Economic Policies (GEP) remains a far cry.

It has been found that more than 60% of financing by the MDBs in the energy sector "does not consider climate change at all" (Nakhooda, 2008). As at the end of 2007 about half the lending for the energy sector by the World Bank did not mention climate change – this is after 6 years of declared environmental strategy that promised otherwise. MDBs in the study by Nakhooda included: World Bank, International Finance Corporation (IFC), Asian Development Bank (ADB), and the Inter-American Development Bank (IAB). Climate change considerations

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in the World Bank seem to have been ignored for 75% of projects during 2000–2007; the corresponding estimate for the ADB stood at 58%; "MDBs must do more to internalize the environmental and social costs of climate change into decision-making" (Nakhooda, 2008).

Carbon shadow pricing or using economic accounting for carbon is a relevant norm to be reflected in various project assessments, across all inputs and sectors – recognizing that such prices are also dynamic and situation/scenario-specific. Thus there is not one global price that can be plugged into projects with significantly varying features.

The European Bank for Reconstruction and Development (EBRD) seems to be the only MDB that takes due consideration of needs in energy sector in terms of enhancing efficiency; under its 2006 energy strategy, project managers are required to assess the costs of not taking advantages of opportunities for energy efficiency improvements (these costs approximate a realistic incorporation of transaction costs defined by Rao, 2003), and also assess the likely gains of doing so.

6.2 The World Bank and the Environment

The World Bank has been paying attention to environmental issues but with mixed results. The entity has been good at preparing handbooks, operational manuals and so on but falls seriously short on its efficacy of translating objectives into practical operations in its set of projects or their management policies. The organization needs a significant retooling of itself before trying to lend "capacity building" resources to its client countries. The latter tend to agree with the Bank's lending terms with the knowledge that either the Bank's prescription is not necessarily accurate or that the borrower country will find its own way of implementing (possibly to suit its domestic political or other requirements), or both.

The Poverty Reduction Strategy papers and National Development Plans for developing countries formulated over the years by the World Bank fail to link environment and poverty issues in any comprehensive manner (see for example, Lawson & Bird, 2008), and so is the corresponding unrealistic economic analysis. After decades of operations in the environment sector, and claiming to be right things to protect the environment, a recent Report (World Bank, 2010) admits serious failures (even if the number of such cases is statistically small) in the adoption of GEP or its won directives and guidelines:

(a) In a few cases the Program Documents did not indicate whether specific policy and actions conducted in its funded projects possess significant effects on a country's environment, forests, and other natural resources; and,
(b) "Further efforts are necessary to determine whether the policies supported by the operation are likely to have a significant poverty and social consequences, identify who will be affected and how they will be affected, and discuss borrowers' systems for reducing adverse effects and enhancing positive ones".

The World Bank Group, while devising guidelines for environmental management, went ahead to offer substantive loans to coal or other mining industries in the extractive industries category for a number of years. In recent years a loan of $90 million in 2008 by the International Finance Corporation of the Bank Group, for a leading beef exporter from the Brazil at the expense of deforestation in the Amazon region became a glaring example of the Bank's inconsistencies between some of its operations and proclamations of "sustainable forest management, including reduced deforestation", and of "Strategic Framework" for addressing climate change aspects.

6.2.1 World Bank Evaluation Report Findings

The use of economic analysis of environmental projects (and other projects) at the World Bank has been in a "sharp decline", according a recent assessment (IEG, 2009). Of the 51 projects reviewed, none attempted to assess the monetary value of their environmental impacts. The IEG Report of 2009 stated (pp. 70–71):

> There are clearly untapped opportunities to incorporate analysis of the costs and benefits of environmental outcomes in projects outside the environment sector. . .. The costs and benefits of the environmental outcomes of irrigation and drainage schemes can also be measured. . .

It is suggested that the required assessment "should account for externalities, including the net impact on greenhouse gas emissions, and should seek to measure indirect and policy-related impacts which could be much larger than those related to projects."

Independent Evaluation Group (IEG) of the World Bank concluded in its 2009 Annual Review of Development Effectiveness with regard to environmental sustainability:

1. For about one-eighth of the projects in each year, "there is a disconnect between the Bank's self-assessments and IEG project performance ratings. For these projects, the internal supervision of project performance through the life of a project frequently appears to be overly optimistic and sometimes lacks candor regarding risks to development projects."
2. The cost-benefit criteria are being used far less as a basis for project funding decisions.
3. Although environmental project outcomes have been improving, projects in other sectors with significant environmental components lack systematic reporting of environmental outcomes.
4. Mainstreaming of the environmental strategy has declined in important sectors such as agriculture, energy and transport; ". . .the promise of mainstreaming that emerged from the Bank's Environment Strategy has not been realized" in about 75% of projects of the Bank.

5. The Environment Sector Board "has not generally followed through on its commitments in the 2001 Environment Strategy to effectively monitor its engagement in global partnerships".

It is relevant to note that the issue of mainstreaming (summarized by the Bank in 2001 as "improving cross-sectoral links") cited in item 4 above was stated as new element in the Bank's 2001 "Environmental Strategy", only to go in the reverse direction!

The Bank Group's support for environmental sustainability for 15 years starting in 1990s was evaluated by the IEG earlier as well (IEG, 2008). The Report stated the following:

(a) many Bank-supported interventions do not go far enough to recognize spatial externalities of environmental problems nor seek cross-sectoral linkages;
(b) because of the "demand-driven nature of bank programs at the country level, global environmental quality and sustainability, tend to receive insufficient priority" (p. xxi); and,
(c) poverty-focused analytical and other framework gives insufficient attention to linkages between rural livelihoods and natural resource base; as an illustration, the experiences in Senegal and Uganda suggest that poverty-natural resource management links have been largely neglected in Bank lending there.

6.2.2 Basic Problems

Rather familiar sounding reverberations, unfortunately, arise from several years into the Bank's activities as well. The Bank's role seems to have been rather consistently shaped by its practice of quantified lopsided rate of return (in financial terms, often only to suit the outcome) for project selection, in addition to several political factors for endorsing credit lending at the management level. Social and environmental costs are generally either ignored or examined in a less than preliminary manner. During the 1970s and 1980s, the Bank supported rainforest colonization schemes in Brazil and Indonesia, cattle ranching in Latin America, tobacco projects in Africa and cattle farms in Botswana – all which led to deforestation and desertification (more on related historical programs see Porter & Brown, 1991).

There is another issue to be reflected further. What is the role of lender liability on large scale damages, even if the lender happens to be a multilateral finance or development organization, whether the IMF or the World Bank or some other similar entity? Are these above the soft laws and hard laws of the international environment (more seriously global environment)?

These questions need not be seen in relation to the project area or specific region but also in the international context when environmental damages propagate on global scale, such as the emissions of GHGs – especially if the scenario was foreseeable but the lender went ahead to support the project anyway and/or if there has

a repetitive deviant practice to the extent of constituting gross negligence – perhaps to serve their agency relationships between country units and headquarters, or other agency maximands. What is the role of public trust and due diligence here?

These are not resolved here in this book but require further scrutiny by stakeholders-globally and locally.

The World Bank has not been consistent in applying its environmental assessment standards across countries and sectors while approving and implementing various projects around the globe. This fact has been noted in its IEG's 2008 Report. Beyond grand standing it is very doubtful if the World Bank has been able to help improve the environmental governance in its member countries. Many of the projects remain "demand driven" and do not adequately reflect environmental safeguards. There are several systematic failures in reflecting issues such as climate change in several of the Bank's projects.

A recent study by the World Resources Institute documented in detail the fact that about 60% of the Bank's energy sector projects do not recognize their impacts on climate change. It has been found that opportunities to mitigate carbon emissions or related aspects have not been properly incorporated into projects. If these do not ring alarm bells, let us see what the US government has been doing in complying with its own laws governing the relevant aspects. Box 6.1 offers some details of governance.

Box 6.1 Governing the Environment by Abstaining at the World Bank?

Under the US law, Title XIII of the International Financial Institutions Act of 1977 outlines the US government's basic obligations in the review and assessment of environmental and social impacts of multilateral development banks, including the World Bank. This is supposed to be done via the Treasury Secretary who should instruct the US Executive Director on the World Bank's Board, if the matter relates to activities of the World Bank. An Amendment to Title XIII, in its Section 1307, referred to as the Pelosi Amendment, directs the US government to ensure that a proposed project with potential for adverse consequences (a) be made public an assessment of the project's environmental impact at least 120 days before the Board takes up for voting decisions on such projects, and (b) not to vote in favor of the project(s) if this timeline is not complied with.

During 2007, even after the World Bank identified 95 project proposals as having potential environmental impact, the US Treasury chose only 14 of these for a review at interagency meetings, according to a very recently released Report of the Government Accountability Office (GAO). The Report (GAO-09-99, International Environmental Oversight, November 2008) observed that "the World Bank Group consistently approves projects

with potentially significant adverse impacts without US government support". The Report also found that during the interval January 2004 and May 2008, all of the 34 projects the US Executive Director did not support for their lack of adherence to Title XIII and its Pelosi Amendment, were still approved by the World Bank's Board of Directors and moved toward implementation. In some cases, the projects have already been in implementation before voting!

Of these 34 projects, 23 were identified by the World Bank as possessing potentially adverse environmental impact, and 11 were identified on its own by the Treasury Department with similar potential. What has been the role of the US in complying with the Pelosi Amendment? The Treasury Department instructed the US Executive Director to abstain from voting in 34 cases that did not fulfill the requirements of the Pelosi amendment, and the World Bank Group went ahead to approve and implement all such projects. The failure of the Treasury Department is partly because of its relative low priority of attention to the issues. The defeating of the letter and spirit of Title XIII and its Pelosi Amendment constitutes non-compliance with the US law, to the detriment of the quality of governance and efficacy of the World Bank. It is important to recognize that multilateral institutions also have obligations to fulfill toward their members and have a responsibility to act as trustees of current and future generations toward a sustainable world.

6.3 WTO and the Environment

The articles of formation of the WTO recognized the interdependencies of trade and environment. The first paragraph of the Preamble in the Agreement for the formation of the WTO recognizes one of the objectives: "...expanding the production of and trade in goods and services, while allowing for the optimal use of the world's resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment..."

This should normally "inform" the interpretations of various articles of agreement under the WTO. The WTO charter contains several Agreements, including GATT 1994, Technical Barriers to Trade (TBT), and Sanitary and Phytosanitary (SPS) Agreement. Some of these contain features allowing for environmental protection subject to certain requirements. This background allows for use of certain environment-related trade measures (ERTMs). The roles of ERTMs under TBT and SPS notifications in 96 countries (EU counted as one unit here) have been examined by Fontagne, von Kirchbach, and Mimouni (2005) who observed that only 1,022 products, of the 5,134 products considered in the study, do not face any ERTMs. Thus, a majority of products involve trade and environment interface directly or indirectly. This does not imply that the interface arose as a result of concern for

environmental sustainability or SD, but as result of considerable use of natural resources and other environmental factors.

Information on about 270 international environment-related treaties/other agreements is given in the UNEP Register of International Treaties and Other Agreements in the field of the environment provides. These details are provided at www.unep.org/DPDL/law/register_int_treaties_contents.pdf

About 40 of these agreements maintain the role of specific trade obligations (STOs) or general trade restrictions for environmental objectives. Some of the MEAs containing potentially significant trade provisions for environmental governance include the following:

- Convention on International Trade in Endangered Species (CITES)
- Montreal Protocol to the Vienna Convention on Ozone Layer (simply known as the Montreal Convention)
- Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal (simply called the Basel Convention)
- Cartagena Protocol on Biosafety of the Convention on Biological Diversity (simply called the Cartagena Protocol)
- Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (simply called the Rotterdam Convention)
- Stockholm Convention on Persistent Organic Pollutants (POP) (simply called the Stockholm Convention)

6.3.1 WTO Jurisprudence

In the absence of sufficient details and guidelines for trade and environment interface under the WTO rules, there is need to interpret case law and rulings of various disputes that arose in trade disputes involving environment as a causal factor of the dispute. Highlights of landmark cases and their verdicts are summarized below. These indicate that, subject to several other covenants of agreements under the WTO framework, the role of protection of the environment also merits its consideration.

The 1944 General Agreement on Tariffs and Trade (GATT) in which there is no word *environment* but has reference only to "exhaustible natural resources" under its articles of formation, and which has always remained a "Provisional Agreement" until it has been merged into series of covered agreements under the new WTO charter, has its determining role in all these trade and environment disputes. Some of the case laws given below. Detailed reports and related contents are available at www.wto.org.

In the *US – Gasoline case (United States – Standards for Reformulated and Conventional Gasoline, WTO case Nos. 2 and 4. Ruling adopted on 20 May 1996. Case brought by Venezuela and Brazil)*, the Appellate Body stated as follows (Appellate Body Report, p. 28):

> It is of some importance that the Appellate Body point out what this does not mean. It does not mean, or imply, that the ability of any WTO Member to take measures to control

> air pollution or, more generally, to protect the environment, is at issue. That would be to ignore the fact that Article XX of the General Agreement contains provisions designed to permit important state interests – including the protection of human health, as well as the conservation of exhaustible natural resources – . . . WTO Members have a large measure of autonomy to determine their own policies on the environment (including its relationship with trade), their environmental objectives and the environmental legislation they enact and implement.

In the *US – Shrimp case (United States – Import Prohibition of Certain Shrimp and Shrimp Products, the "shrimp-turtle" case, WTO case Nos. 58 and 61. Ruling adopted on 6 November 1998. Case brought by India, Malaysia, Pakistan and Thailand)*, the Appellate Body stated (at Paras 129 and 130):

> The words of Article XX(g), 'exhaustible natural resources', were actually crafted more than 50 years ago. They must be read by a treaty interpreter in the light of contemporary concerns of the community of nations about the protection and conservation of the environment. While Article XX was not modified in the Uruguay Round, the preamble attached to the WTO Agreement shows that the signatories to that Agreement were, in 1994, fully aware of the importance and legitimacy of environmental protection as a goal of national and international policy. The preamble of the WTO Agreement – which informs not only the GATT 1994, but also the other covered agreements – explicitly acknowledges 'the objective of sustainable development' (. . .).
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> From the perspective embodied in the preamble of the WTO Agreement, we note that the generic term 'natural resources' in Article XX(g) is not 'static' in its content or reference but is rather 'by definition, evolutionary'. . .. It is, therefore, pertinent to note that modern international conventions and declarations make frequent references to natural resources as embracing both living and non-living resources (. . .).

It is important to delineate a three-step analysis to determine the applicability of environmental exceptions offered under the GATT Article XX (b). These involve (Fletcher, 1996; Rao, 2001) examining:

1. Whether the policies/actions in dispute are primarily designed to "protect human, animal, or plant life";
2. Whether these are "necessary" for attaining the stated objectives; and,
3. Whether the stated measures lead to an arbitrary or unjustifiable discrimination between member countries where similar conditions prevail. It is also important to recognize that the ranking of GATT-inconsistent measures may be required in order that least GATT-inconsistent measure is adopted to qualify under "necessary" test above.

Some of the GATT Panel decisions on case disputes are reflective of the declared position in the preamble to the GATT Articles, which states that GATT is meant to facilitate the "full use of natural resources of the world". This position does neither imply nor require "optimum use" of resources and thus remains inconsistent with requirements of sustainable development stated explicitly in the preamble to the WTO Agreement.

A later case under the WTO jurisprudence offers more insights into the role of protecting the environment.

European Communities – Measures affecting asbestos and asbestos-containing products (WTO case No. 135. Ruling adopted on 5 April 2001; WTO Ruling adopted on 5 April 2001, Case brought by Canada) – Case summary given below.

The Panel and the Appellate Body in this case both rejected Canada's challenge to France import ban on asbestos and asbestos-containing products, reinforcing the view that the WTO Agreements support members' ability to protect human health and safety at the level of protection they deem appropriate. The Appellate Body (Report at Para 168) asserted that it was each WTO Member's "(. . .) right to determine the level of protection of health that [it] consider[s] appropriate in a given situation". The Appellate Body did not question France's goal of reducing the spread of asbestos-related health risks. In an added clarification, in the Australia – Salmon case, the Appellate Body asserted (Australia-Measures Affecting Importation of Salmon, WT/DS18/AB/R, Para 200, adopted on 20 October 1998): "'appropriate level of protection' established by a Member and the '(. . .) measure' have to be clearly distinguished. They are not one and the same thing. The first is an objective, the second is an instrument chosen to attain or implement that objective".

One of the areas where trade and environment could mutually support each other in the WTO regime is in promoting environmental technologies. Concessions/ subsidies for environmentally efficient technologies (EET) have been suggested in several international agreements, including the WTO in its SCM Article 8.2(c). There is a need for a new specification of agreement under the WTO to cover subsidies relevant for technology adoption for addressing urgent needs of climate change adaptation and mitigation.

Among MEAs, the CBD Article 16.2 provides that developing countries be provided access to and transfer of relevant biotechnologies "under fair and most favorable terms, including on concessional and preferential terms where mutually agreed upon". Also, the Montreal Protocol to the Vienna Convention on the Protection of Ozone Layer provides a rather comprehensive set of measures for developing countries based upon transfer of environmentally efficient technologies under concessional terms. One of the important areas where economy, technology, and environment features meet to enhance their mutual supportiveness is international trade in EET.

The role of STOs in MEAs can be useful and effective when there are clear definitions of STOs, scientific and economic justifications for their use, mechanisms for information reporting, compliance and dispute resolution. This will minimize perceptions of arbitrary, discriminatory or unjustifiable application of STOs in trade policies (see also Hoffmann, 2003).

The GATT 1947 articles of formation did not include the word "environment", yet the GATT jurisprudence remains relevant in the current WTO adjudication process. Most of the environmental exceptions have been attempted over the years seeking cover under GATT exceptions via Article XX.

Although the WTO charter recognizes the need to protect the environment, its application of economic principles avoids due recognition of the value of non-market environmental resources. In other words, the environment is treated as a "free resource" and the environmental externalities of expanded international trade

are not accounted for. The role of "polluter pays principle" or a reasonable variation such as costing along a value chain or life cycles of product sis still not adopted in the framework. This implies externalization of trade costs and creation of large-scale environmental problems.

Some authors tend to oversimplify trade and environmental issues by seeking one-to-one correspondence between the primary objectives of an organization at the expense of other highly interrelated facets of life on this planet. For example, Frankel (2005) suggests: "It is appropriate that WTO focuses on trade and that other institutions focus on the environment. Trade policy is not the right tool and WTO is not the right place to bear the primary responsibility for pursuing environmental quality." This suggestion does not address the implications of three types of environmental externalities: local, transboundary, and global. It is not an issue of "primary responsibility" or secondary responsibility but is one of reasonably reflect relevant costs whenever free trade mechanisms are advocated. Any economic activity must be seen as an array of economic, financial, environmental, social, and institutional factors; this vector allows some trade offs but those trade offs should be consciously made. The role of green economic policies belongs in that arena.

Although the WTO is not an environmental protection agency, it is not bestowing favors to the global community when it respects public international laws and recognizes the spirit of its own charter of formation, viz. governance of international trade with due consideration of environment and sustainable development.

Well-defined and objective STOs tend reduce tensions and also the need for disputes and this is required in some of the MEAs. Even though WTO may not be the most suitable forum for upholding global environmental objectives, this may be the most effective institution for resolution of disputes arising out of STOs in MEAs and trade regime envisaged under WTO, until better institutional arrangements are made (Rao, 2007).

Defining rules and standards still remains a largely unexplored area when it comes to the global environment in relation to international trade. In general, *ex ante* specification of rules and standards tends to minimize ex post costs of implementation of agreements. It is important to recognize that the specification requirements (including provision of rules and regulations to avoid potential disputes) should be such so that the total *ex ante* costs of such provisions is not excessive or greater than some measure of ex post costs accruing to the system as a result of these provisions. Clearly, there is scope for fruitful practical use of Transaction Cost Economics in the governance of international trade and global environment policies. The role of Green Economic Policies (GEP) needs to be explored further, and this involves modification of various agreements as a collective agreement by member countries.

In terms of an application of the theory of the economics of contracts, it is meaningful to state that the incomplete contracts perspective of the WTO Agreement suffers from substantive incompleteness as well as jurisdictional incompleteness. This feature entails considerable ex post costs of justifying or rejecting trade measures launched from to time by one or more member countries. It is useful to devise clear guidelines that set rules for ERTMs and adoption of GEP for addressing relevant socio-economic features of international economic policies.

6.4 Adoption of Ecosystems Approach

One of the major shortcomings of the WTO as well as some of the MEAs such as CITES is the absence of ecological interdependencies or recognition of externalities. CITES deals with target species only, and not the attendant externalities. The latter are sometimes referred to as "incidental takings" and tend to be authorized in the process of conduct of legal harvesting of other species. In the process of harvesting not-endangered species, it seems to be of little consequence if the bycatch or ecological externality is such as to significantly and adversely affect the listed or endangered species. When some of WTO Panels suggest the exclusive role of the MEAs and no role for trade regimes in the governance of the environmental features and ecological resources, their lack of understanding of the functioning of relevant ecosystems and linkages becomes a hurdle in judicious decision-making. Even after some concern professing protection of the environment, some of these reports fall short of due recognition of the fundamentals of the ecosystem and the need to interpret laws in recognition of scientific principles. Most WTO panels do not depict concern for the environment nor demonstrate competence in handling environmental matters. Even when the panels tend to agree with the environmental concerns, the operative parts of the reports are lopsided with diminished role for the application of the substance and spirit of the Preamble of the WTO Agreement in playing its guiding role.

Application of relevant ecosystems concepts and international environmental law suggests that for environmental law the common denominator is (Lazarus, 2000) the "ecological injury that serves as the law's threshold." The roles of irreversible consequences, latent and/or distant injury, and tradeoffs among monetary and non-monetary values are among the important features relevant when examining the reconciliation of environmental and economic aspects of international trade, and also in the resolution of trade disputes relating to the protection of the environment.

6.5 Relevant International Laws

On the issue of state responsibility (including shared responsibility) for the governance of the global commons, states have obligations under the international environmental law both for some results (as in the case of the Montreal Protocol) and also for deploying certain means of achieving desired objectives or their exercise of sovereign rights (as, for example, stipulated in the 1995 Driftnet Agreements for Fisheries). Under international public law and corresponding obligations, a state can be held accountable for actions/inactions of its direct conduct and of private entities under its jurisdiction. The Trail *Smelter* Arbitration of 1941 (US v. Canada, 3 R. Intl Arb Awards 1905, 1941) was perhaps among the first international adjudications to recognize the role of accountability for externalities and precautionary behavior even within the state arena exercising its sovereign rights. The international arbitration panel in this case observed (Id. at 1965): "under the principles of

international law ... no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein. . ."

Trade expansion generally raises incomes and creates potential to offset environmental damages or other costs. The potential to offset environmental damages is seldom availed to effect such compensation at national and international levels. Thus, economic growth (partly enhanced by trade) is a necessary but not sufficient condition for ensuring environmental sustainability, nor sustainable development. GEP at domestic and international levels need to assist in devising trade and environmental governance.

A recent UNEP-WTO (2009) report summarizes several provisions under the WTO framework that allow or disallow environmental considerations in trade policies. The critical issue that needs to be resolved is how far and what kind of ecological and environmental cost accounting will be reasonable to determine national and international policies under border taxes without attracting interpretations of discrimination by importing nations. This also relates to the provisions and implementation of rules and policies affecting "dumping". The WTO needs to examine more of these issues that are relevant for trade-environment relationships and allow for the application of green economic policies under the WTO framework.

One of the key elements of further progress is R&D and technical progress is elucidated in the following section.

6.5.1 Research and Development

Government support and intergovernmental consortium formation may be justified on the grounds that there is under-investment in environmental R&D by firms due to the following factors:

(a) externalities associated with environmental research, where individual firms are unable to capture sufficient benefits from R&D to justify their expenditure but social returns on investment are high;
(b) possibly larger than normal business uncertainties about the existing markets and future markets for new products;
(c) uncertainties in local and international regulations and environmental laws affecting products and processes in demand from time to time.

Concessional funding at national and international levels is expected to offer stimulus to enable greater R&D efforts at various levels. Some of the WTO rules may need modification when trade between members is involved with concessions allowed for R&D aspects, and when product – process specifications attract some of the conflicting provisions of the WTO rules on its technical barriers to trade (TBT) agreement. Environmentally Sound Technologies (EST), as applications for the deployment of R&D output, deserve special attention.

6.5.2 EST Transfer

EST transfer constitutes one of the important areas of win-win scenarios for developed and developing countries, for international trade and global environment, and for public and private institutions.

The Stockholm Declaration of 1972 Principle 20:

> Environmental technologies should be made available to developing countries on terms which would encourage their wider dissemination without constituting an economic burden on the developing countries.

The Rio Declaration of 1992 Principle 9:

> States should cooperate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies.

The Convention on Biological Diversity (CBD) provides (Article 16 (2)) that developing countries be provided access to and transfer of relevant biotechnologies "under fair and most favorable terms, including on concessional and preferential terms where mutually agreed upon." The Montreal Protocol to the Vienna Convention on the Protection of Ozone Layer provides a set of rather comprehensive measures for developing countries. Their commitments under the agreement are essentially conditional upon the provision of EST at concessional terms from developed countries.

The UN Conference on the Law of the Seas (UNCLOS) addresses EST transfer in its Articles 266–274 that also deal with development and transfer of marine technology. Article 202 of the UNCLOS provides:

> States shall, directly or through competent international organizations: a) promote programmes of scientific, educational, technical and other assistance to developing States for the protection and preservation of the marine environment and the prevention, reduction and control of marine pollution. Such assistance shall include, *inter alia*: training of scientific and technical personnel; . . .; supply them with necessary equipment and facilities; and, enhancing their capacity to manufacture such equipment.
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> The CBD Article 16 (1) provides that parties should facilitate EST transfer to enhance conservation and sustainable use of biological resources, under fair and favorable terms including the financial arrangements contemplated under Articles 20 and 21. In respect of indigenous communities and local traditional knowledge, the CBD Article 8 (j) seeks to "encourage the equitable sharing of the benefits from the utilization. . ." of bioresources and traditional (uncodified) knowledge.

Article 4 (2) of the 1985 Vienna Convention on the Protection of the Ozone Layer provides: "Parties shall cooperate . . . in promoting, directly or through competent international bodies, the development and transfer of technology and knowledge. . ." Similar provision exists under the Basel Convention of 1989 on the Control of Transboundary Movement of Hazardous Wastes.

Since more urgent and effective actions are required for technology transfer, the WTO, in addition to other organizations, need to take initiatives to set guidelines for such concessional trade.

6.6 Cost-Effective Coordination of Policies

In general, regional and global coordination of policies governing the global goods (including biodiversity and greenhouse gases) is useful in the interests of efficiency and sharing of relative responsibilities. For example, if uncoordinated actions were not in place to protect biodiversity in the Mediterranean Basin (which encompasses over 20 countries) the same resulting protection could cost an additional $67 billion, that is a saving of 45% of total costs when undertaken by each country separately (for details, see Karka, Levinc, Granthamb, & Possinghamb, 2009). Usually there exist significant TC when deploying a multilateral agency but some of the institutional structures that are already in place in the European Union seem to effect savings in coordination costs in the EU-Mediterranean countries. However, large scale centralized agency operations may not be the best solution to coordination of policies. Let us recall as an example, that some years ago the World Health Organization could offer only 2% of its program costs directly to provide resources in malaria eradication program, and the remaining 98% of program budget was used up (for star hotel stay and high costs of travel and several other overhead costs) on its own staff activities.

It is important that global organizations pay attention to the need for reducing TC of their own policy design and operations. Cost-effectiveness and substantive effectiveness with reference to the stated objectives and goals rather than uneconomical levels of resource deployment to procedural aspects will be a productive direction for reform in enhancing efficiency of governance. The number of meetings, travel and other logistics, and other costs incurred in devising even simple policy frameworks (or often merely an approach toward a simple prelude to a framework) lead to an unreasonably high TC for member countries and for the general economic systems. In addition, there are significant carbon footprints associated with these sets of transactions. The international organizations and member countries need to draw up guidelines to minimize these costs and direct resources for cost-effective mechanisms of coordination.

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Chapter 7
Green Economic Policies: Corporate, Local and National Levels

Abstract Roles of producers, consumers, and of governments at local, regional and national levels in improved environmental and socio-economic governance consistent with Green Economic Policies are explored here. Market and regulation methods come into play here, especially in relation to the design and implementation of the emissions trading scheme (ETS). The relevant theories and some of the experiences on these aspects are examined. It is argued that the ETS may not deliver results in a cost-effective manner unless several institutional aspects are fully addressed. In terms of policy actions for addressing climate change and sustainable development, it is suggest high priority be accorded to influence consumer choice in food consumption which has implications on resource use intensities and deforestation. Other policies examined here include energy sector choices and corporate case study reports, livestock sector reforms, and related institutional reforms.

Two main policy instrument choices for Green Economic Policies (GEP) at national (and to a limited extent at international levels and at regional or sub-regional levels) comprise taxes and cap-and-trade systems (emissions trading scheme, ETS). The role of environmental taxes has been discussed in Chap. 2. This chapter provides a summary view of the role and limitations of ETS.

Among top priorities for reduction of greenhouse gases (GHGs) are: energy efficiency improvement and adoption of low-carbon technologies (LCTs), reduction of deforestation and industrial livestock, improved consumer food consumption patterns in relation to the emissions of greenhouse gases (GHGs), and supply chain management. These elements make significant impact on climate change (CC) as well as on the patterns of sustainable development (SD), and are discussed in this chapter.

7.1 Design and Implementation of Emissions Trading Policies

The original theory behind emissions trading follows arguments in property rights and internalization of environmental costs via bargaining and creation of markets for trading of assigned rights. The seminal contribution of Nobel Laureate Ronald Coase (1960) led to Coasean-bargaining approaches that indicate social costs can

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be resolved without governmental intervention – provided appropriate rights are assigned to the participating entities for negotiation and resolution of conflicting interests. However, Coase propositions, including the so-called Coase Theorem, hold good only under specific and defined settings; these will be briefly stated later in this section (for more details see Rao, 2003).

The basic premise of cap-and-trade or ETS is to allocate through a regulatory agency quotas for each polluting entity (based on their production and emissions features and history) and let them pollute within those limits and/or trade quotas with others depending surplus or deficits between quotas of participant entities, presumably leading to "efficient bargaining" and functioning of the market. Emissions trading scheme in sulfur dioxide has been administered by the US Environmental Protection Agency (USEPA) under the Clean Air Act and its Amendments, starting in the 1990s.

This has been tried initially in California to reduce acid rain and smog has been often cited as a success story, and seems to inspire more of the trading schemes. The European Union largely imitated the US design of emissions trading and launched it for greenhouse gases, with a substantive element of free emission quotas based on historical emissions of production entities. A few other countries have also taking similar initiatives, partly because the Kyoto Protocol for reduction of GHGs included provision for emissions trading. The performance outcomes are rather mixed, and these have been ineffective in effecting significant reduction in GHGs in participating countries. Yet they are better than doing nothing about reduction of GHGs.

A high-level meeting of environmental regulators of several countries concluded in October 2009 that greater resources are needed to ensure comprehensive and accurate reporting of greenhouse gas emissions data in developing countries. The task of monitoring and evaluating national policies and measures to cut emissions is central to the negotiations and is at the heart of the Bali Action Plan's call for "measurable, reportable and verifiable" plans and commitments to mitigate global warming. Although this suggestion is relevant, it is also time to reflect on the complexities of procedures and institutional arrangements in order to reduce TC.

A detailed study of the experiences with the EU's ETS in Phase I (during 2005–2007) carried out by the US Government Accountability Office (GAO), observed (USGAO, 2008):

1. the effects on emissions, the European economy, and technology investment are uncertain;
2. although the ETS mechanism led to setting a price on carbon emissions, it has been highly volatile, and the supply of allowances or the total quota allotted for emissions exceeded demand leading collapse of price for pollution reduction;
3. trading programs must create enough demand for allowance trading to create incentive for technical innovations as a better and longer term fix of environmental pollution problems;
4. free allocation may distribute wealth to covered entities but auctioning could generate revenues for the government.

The limited effectiveness of the mechanism gives no surprise, given the basic foundations of these schemes, which have been designed with imperfections added to the theoretical underpinnings – which, ab initio, are severely constrained by assumptions.

Some studies indicate that the experiences with emissions trading in the US have been successful in lowering the costs of meeting emission reduction goals, and also in achieving environmental goals, especially when the rules of the game of trading are clearly defined.

Are there costs to the consumers under emissions trading? Since polluting entities have to incur costs to stay within limits of their emission quotas, they incur costs either in innovations to reduce their rate of GHG emissions per unit production, or buy credits to cover larger emissions, or a combination of both. In reality, the innovation aspect seems to have been availed less than the potential, mainly because of a good dosage of initial free allowances based on historical emissions ("grand fathering" in allocation of quotas). Hence the current need for incentives such as subsidies for innovation still stands to warrant attention. If ultimately taxpayers have to pay for higher costs of products, it is because the environmental damage costs are internalized in the costs of production, and environmental benefits are reaped by the public in the form of environmental health improvements and less of climate change – induced damages to the economic system. The cost estimates at consumer level vary but in the US, according to a recent Congressional Budget Office report the cost may be $1,600/year (in one of the cap-and-trade scenarios) in the next few years. There are also some estimates of possible production losses and job losses due to this emissions trading mechanism. It is rather ironic that climate change could lead to production losses and economic damages to the extent of hurting employment potential itself, but here comes an indication that mechanisms to correct potential problems also have similar unwelcome outcomes, according to some of these reports.

The key is the extent and pace of innovation that the mechanisms promote in theory and in reality. Given the role of "increasing returns" to technical innovations, the costs of provision of environmentally sound technologies tend to fall rather significantly with the expansion of the markets. The critical issue then is to provide incentives for such innovation, including incentives for enhancing the demand for such products and services. None of this will be achieved if the allocation of quotas (including free allocations and "grand fathering") is too generous, and the functioning of the market is inefficient.

7.2 Coasean Bargaining and ETS

Let us first recall Coasean propositions:

> 1. if market transactions were costless, all that matters (questions of equity apart) is that the rights of the various parties should be well-defined and the results of legal actions easy to forecast (Coase, 1960, p. 19); and,

> 2. if factors of production are thought of as rights it becomes easier to understand that the right to do something which has a harmful effect . . . is also a factor of production (Coase, 1960, p. 44).

The existence of property rights, such as emission allows under ETS, is a necessary but not sufficient condition to resolve environmental externalities.

It has been noted (Rao, 2003):

> in the absence of effective competitive markets, the thin market problem scenarios for ETS could reduce the efficiency of pollution trading markets, and a reasonable mix of market and non-market methods of intervention may be relevant (p. 169).

7.3 Sectoral Policy Priorities

Five priority sectors have been identified for the "Global Green New Deal" suggested by the UNEP in its October 2008 report, as part of its Green Economy Initiative. These are suggested as priority sectors that tend to address the features: economic returns, environmental sustainability, and job creation. The sectors are:

Clean energy and clean technologies, including recycling;
Rural energy, including renewables and sustainable biomass;
Sustainable agriculture, including organic agriculture;
Ecosystem infrastructure;
Forestry.

According to Stern (2009), actions to cut GHG emissions fall broadly into three categories: energy efficiency, law-carbon technologies, and halt to deforestation. Policy measures to include: taxes, carbon trading, and regulation; increased technology support; and a set of measures that halt deforestation. Stern would be accurate if the energy efficiency category of actions includes human energy derived from alternate sources of food. As discussed later in this book, there is a real need to change people's food consumption habits, albeit slowly. Even a moderate switch to plant based foods will reduce substantial GHG emissions at negligible cost and also reduce health costs (public and private). These details are given later in this chapter, and related aspects are also given in Chap 8.

7.3.1 Energy Sector Policies

OECD/IEA (2009) suggests substantial investment in the energy sector to promote faster development of LCTs, switching to renewable and nuclear energy generation, and phasing out low efficiency vehicles and appliances. Expanded and revised Clean Development Mechanism (CDM) formed out of the Kyoto Protocol is suggested a useful mechanism to use for energy improvements incentives and credits to reduce GHGs.

IEA (2008) estimated that energy sector continues to take a lead role in GHG emissions and that an efficiency improving system of interventions can possibly contribute by 2030 toward a reduction of a fifth of GHGs relative to status quo scenario. Incremental investment of $10 trillion may be needed between 2010 and 2030 for stabilizing GHGs at 450 ppm levels by 2030, constituting 0.5% of GDP in 2020 and 1.1% in 2030. The estimate of fuel savings is about $8.6 trillion between 2010 and 2030. It has been suggested that much of the cost will be paid for by the energy savings, and the investments contribute to substantial reduction of GHGs, in order to target limiting possible climate change within rise of global mean temperature increase below 2°C.

If we take a broader view that is not confined only to the energy sector role, and consider production as well as consumption aspects to look for cost-effective choices that include some reasonable or minimal adjustments to consumption patterns, there is considerable scope for bringing down the costs of achieving desired objectives and goals.

The 2008 Summit of G-8 Group of countries, assisted by the OECD and IEA policy studies, came up with a list of 25 detailed recommendations for improved energy management (see details at www.iea.org/textbase/papers/2008/cd_energy_efficiency_policy/index_EnergyEfficiencyPolicy_2008.pdf). These are summarized in Box 7.1.

Box 7.1 Improved Energy Management

OECD/IEA (2008) recommendations on energy efficiency improvements have been listed in 25 elements, and these include:

Cross-sectoral investments to enhance energy efficiency, formulation and monitoring of desirable performance indicators, energy management in the design and management of various types of buildings, mandatory energy performance requirements for appliances (domestic and other), lighting to undergo changes for improved energy efficiency, transport sector (which accounts for more half the world oil) to gear up mandatory fuel efficiency standards, enhancement of energy use efficiency in industry (via improved electric motors, formulating implementing policy packages to save energy), energy utilities to promote utility end-use energy efficiency standards (and reduce losses of transmission or other).

7.3.2 Employment Expansion and Green Economy

Productive gainful employment base remains an important element of green economy and GEP. Job creation (green jobs) in the greening of the economy is only

one aspect of the total system, and accelerated employment creation need to be limited to economic stimulus-based effort to seek economic recovery from downturn at national and international levels.

A recent study (summarized in Box 7.2) by the Global Climate Network (GCN), among others, suggests that creating markets for low-carbon technologies will contribute toward job creation at levels that exceed the number of jobs lost in carbon-intensive sectors. Since such job creations may not be confined to national boundaries, appropriate international policy coordination may be useful. Complementary domestic policies of national governments, in addition to any modified regime that is needed to encourage concessional international transfer of environmentally sound technologies under the WTO framework, will strongly support rapid diffusion of relevant technologies in the interests of reducing GHGs and promoting green economy.

Box 7.2 Creating Opportunity – Low-Carbon Jobs

The analysis by the GCN suggests policy makers should adopt a guarded approach to predictions of job numbers and focus on measures to stimulate LCT markets. Experience from other technology sectors, such as information and communication technologies, suggests the dynamism of technology is inherently unpredictable and that numbers of jobs created by LCT could be greater than current predictions suggest.

A UNEP (2008) study estimates that about 2.3 million people were employed in renewable energy industries in 2006, but a big proportion of jobs belong in the controversial biofuel sector. According to UNEP and the SEF Alliance (2009), renewable energy programs will generate, per dollar, "an order of magnitude more jobs than will expenditures for fossil fuel plants or tax cuts".

Active government policy to trigger the expansion of clean energy industries is a key driver of low carbon employment opportunities (UNEP, 2008). Important policies include setting renewable energy targets, increasing funding for R&D, creating technology testing facilities, introducing economic support mechanisms such as feed in tariffs, phasing out subsidies for carbon intensive industries, and putting a price on carbon emissions.

Among the other suggestions of the GCN's report are:

New markets for LCT will create new jobs.
A stronger policy response makes net benefits more likely.
Jobs will, however, be lost as economies shift to low carbon.

It is therefore very important to ensure policies are in place to assist people who lose jobs, including financial and retraining support, and better still if job losses are minimized through a strong government policy response.

Low-carbon job creation has become a positive reality as a result of government policies, with the illustrative example of Germany.

Predictions of numbers of jobs that will be created depend on public policy, technology adoption and related factors.

Source: Global Climate Network (2009).

The current levels of R&D efforts are very inadequate; sectors such as telecommunications and pharmaceuticals devote substantially greater percentages of their revenues for R&D, compared to the energy sector. The explanations could range from relative lack of incentives for enhancing efficiency, and the role of sunk costs in older technologies such as coal power plants with high emissions of GHGs.

Given the role of increasing returns to scale in new technologies and their adoption, it is possible that there will be positive multiplier effects in the estimates for job creation in green economic systems. The key, however, is devising mechanisms and resources for deployment of efficient technologies. Focus on Research and Development (R&D) should also simultaneously maintain great priority for adoption of technologies, including the means to do in the initial phases of technology diffusion. The key emphasis here should be on research-development-deployment (RDD), since R&D efforts may not by themselves deliver the results.

7.4 Energy Efficiency: Illustrations of Corporate Successes Cases

Corporate Social Responsibility (CSR) is a feature of progress and innovation combining the social, economic and environmental dimensions in an integrated approach; CSR plays a role in developing better social and economic governance.

There are important issues of technical progress that can at times bypass the life cycle problems with the utilization of environmental "bads" for environmental goods, and at other times promote prevention of environmental damage without foregoing production efficiency. Corporate environmentalism encompasses not only the issue of internalization of environmental costs, but extends innovativeness to augment resources and provide for substitutes in a profit-maximizing and environment-enhancing sense.

The World Business Council for Sustainable Development (WBCSD) offers a few guidelines and promotes corporate efficiency in dealing with environmental sustainability issues. CSR is also partly addressed in this context. We illustrate below two success stories of energy and environmental governance, one from Europe and another from Asia. More detailed information is available from www. wbcsd.org

7.4.1 Volvo Europa Truck Company Case

Volvo has become the first manufacturer in Belgium to operate without net CO_2 emissions and the first carbon-neutral automotive plant in the world. Box 7.3 offers details.

Box 7.3 Zero Net CO_2 Emissions: GDF Suez/Electrabel/Volvo

Located in Ghent, Belgium, the Volvo pilot factory collaborated with Electrabel to find a solution capable of ensuring enough electricity and heating for the entire complex without producing any CO_2. GDF Suez's subsidiary Electrabel has outfit a cost-effective pilot plant for Volvo in Ghent, Belgium with the necessary renewables technologies to reduce their net carbon dioxide emissions to zero and reduce the amount of electricity they use while increasing production by nearly one-third. The pilot plant uses hydroelectric electricity from the grid, a wood-burning heater to meet basic needs and an oil-based bio-heater for extra needs in winter and summer, three windmills and 150 photovoltaic panels to meet their daily needs in electricity and heating, and even sells spare electricity to local consumers.

Since September 2007, Volvo Europa Truck in Ghent has been producing more than 40,000 trucks a year in Europe, making it the Swedish group's largest truck plant. It is seen as the first automotive plant in the world to operate without any net CO_2 emissions.

The project to make the entire plant carbon-neutral by the end of 2007 was conceived and carried out with Electrabel, subsidiary of GDF Suez, a French energy company. This collaboration matches the numerous efforts by both companies over the past few years aimed at reducing their impact on the environment.

Electrabel proposed the combination of four types of energy:

- Green electricity from the grid and produced onsite through a contract with AlpEnergie that guarantees renewable energy from hydroelectric plants (via the Compagnie Nationale du Rhone);
- A 5 MW wood-burning heater to meet basic needs and the transformation of an existing heater into an oil-based bio-heater for extra needs in winter and summer;
- Three windmills of 2 MW each installed onsite to provide 14 GW/h of electricity yearly; and,
- 150 photovoltaic panels with an electricity production of 28 MW/h/year on the roof of the new biomass boiler house.

Environmental considerations remain prominent at all stages in the production process, based on three key principles:

- Reducing the overall energy consumption
- Gradually reducing CO_2 emissions to zero
- Abandoning the use of fossil fuels for heating.

Reducing energy consumption is a total approach covering almost all aspects of production, and involves a range of projects. As a result, energy consumption was reduced by 23% between 2001 and 2006, although production rose by 33% during this period.

Measures were undertaken to reduce CO_2 emissions, with Electrabel being involved at all stages:

- Two gas-fired boilers were replaced with a new thermal system fired by biomass pellets. The new installation covers the basic heating needs of the plant.
- A third gas-fired boiler was converted to run on bio oil. This boiler meets the additional demand for heat in the winter, and when demand is very low during certain periods in summer it can be used alone.

The CO_2 balance of these renewable fuels is entirely neutral: their emissions are offset by the carbon dioxide removed from the atmosphere by the plants used to make the fuels.

Volvo Europa Truck generates half of its own electricity usage from three wind turbines, each with a capacity of 2 MW. These three turbines – the maximum number that can be built on the site – cover half of the plant's energy consumption.

For the rest, Volvo Europa Truck relies on Electrabel AlpEnergie or "green energy" produced by hydroelectric power stations in the French Alps. In collaboration with Electrabel, 150 photovoltaic panels producing 28 MW of electricity per year were fitted on the roof of the new biomass building, such that the CO_2 reduction project makes use of all possible forms of environmentally friendly energy sources.

Some of the lessons of the pilot site are:

- Shows that the commercial synergies between energy offerings and energy efficiency
- CO_2 emissions down from 14,000 tCO_2 each year to 0

- Annual energy consumption reduced by 25% although production increased by about 33%
- Provides a source of electricity supply to employees and those living around the plant.

7.4.2 Osaka Gas Case: Combined Heat and Power Systems

This success story described in Box 7.4 relates to increasing efficiency of gas-fired combined heat and power (CHP) systems.

The development and dissemination of gas-fired CHP is one of the most important measures in the Kyoto Target Achievement Plan of the Japanese government. The Japanese government promotes dispersed energy systems such as CHP and fuel cells, as part of its policy to achieve a 6% reduction of emissions of GHGs compared to 1990 levels. Leading gas companies in Japan and equipment manufacturers have been pursuing cooperative research and development (R&D) to effect cost reductions and efficiency improvements. Government policy and financial support have also helped dissemination of knowledge.

Box 7.4 Combined Heat and Power Systems

Osaka Gas develops CHP systems fueled by natural gas for power generation and thermal energy utilization through recovery of its waste heat. In order to reduce initial equipment costs and disseminate CHP systems more widely, the company engages in industry-wide cooperative programs and collaboration with equipment manufacturers for R&D and product development.

A gas-fired CHP system is an on-site power generation system whose exhaust heat is effectively used for water/space heating and other purposes. In this system, a natural gas-fueled gas engine and turbine generates electricity. Waste heat from the generation process of the system is recovered for thermal applications. While the average energy efficiency of a conventional centralized power generation system is below 40% due to the disposal of exhaust heat and transmission/distribution losses, the overall energy efficiency of a CHP system (combined electrical and thermal) reaches approximately 80%.

With a rise in the system's electrical efficiency, CHP's market opportunities grow further. Its scope of dissemination in the commercial market is being broadened with the development of systems for space cooling uses. The company is able to effect cost reduction over time after decreased incremental costs. The market for CHP systems has grown steadily since 1990. The number of CHP systems sold in Japan by the manufacturer reached 66,000 between 2003 and March 2008, of which 45,700 are installed in the *Osaka*

Gas service area. R&D efforts are continue to achieve greater efficiency in power generation and general energy utilization and reduce cost.

The power generation efficiency of CHP reaches 41.7 and 33.5, which are the considered among the world's highest levels in the capacity range of 1,000 and 25 kW, respectively.

7.5 Consumption and Environmental Impacts: Livestock Sector and Meat Consumption

Let us use a simplified framework for environmental impact (I) assessments in terms of factors that include population (P), income levels (A), consumption structures (C), and production technology (T) is given by (Waggoner & Ausubel, 2008) the "ImPACT" Identity

$$I = PACT$$

An annual 3–5% progress in consumption (for example reducing meat consumption) and technology (for example renewable energy and fuel efficiency upgrades) can bring in a significant impact on desirable impact on the environment and contribute toward sustainability over decades.

Income and economic affluence adds more than population growth to the consumption influence on environmental problems such as greenhouse gas (GHG) emissions; this is because of the average per capita elasticity of CO_2 emissions with respect to GDP per capita is about 1.2, with the implication that each doubling of income could add more than each doubling of population. Changes in consumption patterns are important cost-effective and self-enforcing mechanism of SD.

Livestock industry a major threat to environment, and is an "underestimated and overlooked" source of GHG emissions. For comparison, let us note that energy sector is responsible for 21% of GHG emissions, and livestock sector 18%, compared to transport sector at 14%. The livestock sector contributes 18% of emissions of GHGs. With increased prosperity, people are consuming more meat and dairy products every year. Global meat production is projected to more than double from 229 million tonnes in 1999/2001 to 465 million tonnes in 2050.

Fiala (2008) estimates that the consumption of meats is likely to increase by 50% by 2030, under BAU scenarios. GHG emissions impact of this pattern leads to about 1,500 million tCO_2 in 2010 and 1,890 million tCO_2 in 2030.

The global livestock sector is growing faster than any other agricultural subsector. It provides livelihoods to about 1.3 billion people and contributes about 40% to global agricultural output. But such rapid growth exacts a steep environmental price, according to the FAO (2006) report, *Livestock's Long Shadow – Environmental Issues and Options*: "The environmental costs per unit of livestock

production must be cut by one half, just to avoid the level of damage worsening beyond its present level".

When emissions from land use and land use change are included, the livestock sector accounts for 9% of CO_2 deriving from human-related activities, but produces a much larger share of even more harmful greenhouse gases. It generates 65% of human-related nitrous oxide, which has 296 times the Global Warming Potential (GWP) of CO_2.

As forests are cleared to create new pastures, it is a major driver of deforestation, especially in Latin America where 70% of former forests in the Amazon have been turned over to grazing.

The FAO report argued that resource use efficiency must to be improved, while regulating about the scale and inputs deployed in the industry. Internalizing environmental costs will be relevant. "An important general lesson is that the livestock sector has such deep and wide-ranging environmental impacts that it should rank as one of the leading focuses for environmental policy: efforts can produce large and multiple payoffs." Mitigating and preventing the environmental harms inflicted by this sector require "immediate and substantial changes in regulation, production practices, and consumption patterns." (Koneswaran & Nierenberg, 2008).

A global transition to a less meat-diet at the levels recommended by the health perspectives would reduce the carbon mitigation costs of stabilizing CO_2 emissions at 450 ppm by about 50% in 2050, relative to BAU scenario (Stehfest et al., 2009). These changes can enhance health and lower costs of provision of public health, and medical costs incurred by consumers, contribute to rise in real incomes for other consumption activities.

Marlow et al. (2009) estimated, using California data, that on an average, non-vegetarian diet required 2.9 times more water and 13 times more fertilizer. A tax of about 9% of unit price could offset some of the environmental damages of beef production, according to an estimate offered by Subak (1999). Although indicative of the external cost valuation, the estimate needs to revise be upwards to incorporate a comprehensive and updated externalities of red meat consumption.

Public health implications of meat production and consumption has been investigated by Walker, Rhubart-Berg, McKenzie, Kelling, and Lawrence (2005), who concluded, inter alia, that the following actions may address some of the health and environmental hazards of large-scale commercial livestock industry, also called industrial animal production (IAP): devise policies to change dietary patterns sway from high levels of meat intake; create regulatory mechanism that captures externalities of meat production and include these costs in price of meat; provide incentives for more healthy production and consumption; ensure wage and environmental conditions of workers in the industry are improved – this could lead to product price increase and decrease in consumption. It has also been suggested that public health professionals should lead in making the connection between food and the health of the public.

An integrated study of food, livestock production, energy, climate change, and health has been published as a special focus on "Energy and Health" of the journal

The Lancet (see McMichael, Powles, Butler, & Uauy, 2007). It has been concluded that "rational use" of resources and their sustainability warrants several urgent measures to be undertaken. The average per capita consumption in developed countries has been seen at five times the corresponding average for developing countries. A substantial reduction in meat consumption in high-income countries, which will improve environmental sustainability and also benefit health aspects, has been suggested. *Carbon footprint of this consumption alone in developed countries compares with the combined carbon footprint of all food intakes in developing countries.*

The agriculture sector, especially livestock production, accounts for one-fifth of total GHG emissions globally (McMichael et al., 2007). Livestock production, including transport and feed, accounts for nearly 80% of the sector's emissions.

The average American consumes approximately 124 kg of meat each year, compared to the average worldwide consumption of 31 kg/year (FAO, 2006). If current consumption patterns remain, meat consumed in 2030 will be 72% higher than the amount consumed in 2000. Production of this amount of meat will potentially generate an estimated 1.9 billion tons of GHG (Fiala, 2008).

More than 30% of all greenhouse gases are contributed by the land use sector. A part of this contribution is essential for basic food and survival but another segment can be substantially reduced with zero or minimal costs. Livestock-related emissions of carbon and methane currently account for about 15% of total greenhouse gases – more than those arising from the transportation sector. A reduction in livestock farming of the factory variety can help minimize emissions, and this needs to be facilitated with modified food consumption of the meat eating populations. Land conversions and deforestation due to enhanced meat production is the wrong way for environmental sustainability and human health.

Just to drive home the point: if people switched from meats to plant-based protein starting in 2010, an area of the size of Russia and Canada combined would be free from use of pasture and croplands – enough to grow back forests and absorb CO_2, thus reducing the costs of mitigating CC by about 70%; less drastic change food consumption that gives up red meats and adopts healthy diet recommendations would still reduce the above cost by 50% (see details at www.climatecongress.ku.dk, March 2009).

On an average, 28 cal of fossil fuel energy to produce 1 cal of meat protein for human consumption, it takes 3.3 cal of such energy to produce 1 cal of protein from plants for human consumption (David Pimentel, quoted in the *World Watch Magazine*, July/August 2004). It takes 550 l of water to produce enough flour for a loan of bread but about 7,000 l of water to produce 100 g of red meat (UN Commission on Sustainable Development, 2004). This assessment also reminds us of Einstein:

> Nothing will benefit human health and increase chances of survival of life on Earth as much as the evolution to a vegetarian diet – Albert Einstein (quoted in the World Watch Magazine, July/August 2004).

Box 7.5 provides brief summary based on a detailed study by the Humane Society of the USA.

Box 7.5 The Impact of Animal Agriculture on Climate Change

According to a 2004 report by the Center for International Forestry Research (CIFOR), rapid growth in the exportation of Brazilian beef has accelerated destruction of the Amazon rainforest. The total area of forest lost increased from 41.5 million ha in 1990 to 58.7 million ha in 2000. In just 10 years, reports CIFOR, an area twice the size of Portugal was lost, most of it to grazing land (Kaimowitz, Mertens, Wunder, & Pacheo, 2004). Latin American region has been undergoing largest net loss of forests and contributing to carbon fluxes with the releases of stored carbon from vegetation and soil into the atmosphere. The FAO estimates that animal agriculture-induced desertification of pastures releases up to 100 million tCO_2 per year.

The US Supreme Court declared in April 2007 that the EPA has the authority to regulate carbon dioxide and other heat-trapping emissions from vehicles as pollutants. One important step will be accurately pricing environmental services, such as a stable climate and clean air, and animal agriculture experts at FAO agree.

As consumers become increasingly concerned about climate change and global warming, they are choosing more environmentally friendly products, such as energy-efficient appliances, compact fluorescent light bulbs, solar panels, and hybrid vehicles. Reducing animal product consumption constitutes effective strategy for mitigating the impacts of climate change.

> The unprecedented serious challenge posed by climate change necessitates radical responses. . . For the world's higher-income populations, greenhouse-gas emissions from meat-eating warrant the same scrutiny as do those from driving and flying (McMichael et al., 2007).

Dietary patterns constitute low-cost sustainable methods for long-term environmental and economic sustainability, besides improving health and reducing health costs.

Source: Humane Society of America (2008).

7.6 Procurement and Supply Chain Management

Because government entities constitute a major segment of consumption of goods and services, it is important to recognize the contribution this segment can make in reducing greenhouse gases and in affecting climate change. The 2002 World Summit

on Sustainable Development in Johannesburg in its Plan of Implementation sought to "promote public procurement policies that encourage development and diffusion of environmentally sound goods and services".

The potential for climate-friendly procurement policy for government exists under the existing WTO Agreement on Government Procurement (GPA) as long as it is non-discriminatory and transparent. If fully clarified upfront in tender specifications, the rules under the EU policies and Directives also enable greener purchases in the government sectors. The European Commission issued proposals to allow for energy-efficient public procurement and recognition of environmental consideration in government procurement in general.

The critical issues arise when there are few suppliers or uniquely new innovations and products for which thin markets exist. In the absence of standardized specifications for newer products, it may be necessary to overcome the potential problems by issuing appropriate notifications inviting objections for further processing. This might cause some delays and enhance upfront costs of procurement but may work out to be less expensive than protracted litigations and other consequences of non-implementability of greener policies.

Van Asselt rightly concluded (2006, p. 227):

> When considering the economics of their purchasing decisions, public authorities should take the social benefits of greenhouse reduction and innovation into account. Given these considerations, and given the widespread endorsement of green procurement practices at the national, EU and international levels, the integration of climate change mitigation objectives in public procurement should be supported and put into practice to the fullest extent possible.

7.7 Internalization of Environmental Costs

Internalization of environmental costs does mean all or a few of the following: inclusion of true worth (also called shadow price or accounting price) of each of the inputs into the production system, post-production costs to consumption stage, and also the costs of disposal at the terminal stage. In many cases it is not meaningful to include all costs at a single stage. A multi-stage inclusion of environmental costs is one of the direct methods, but a variety of alternatives can also be contemplated. An alternative perspective suggests assessment of the opportunity costs of resources being used in the life cycle of the product or service. The objective of internalization is to enable various economic entities to adjust prices and markets so as to achieve socially optimal consumption and production patterns. No doubt this is easier stated than accomplished. Adoption of this approach needs concerted policy and implementation at different levels of aggregation of economic activities. This approach would minimize some of the free-rider problems and their corresponding externalities.

If select firms reflect the environmental costs in their prices and use the additional income for environmental protection or technological innovation in the form

of dedicated funds it may be meaningful but the competitors could capture the market share and hurt the profitability of the first adopters of the principle. It therefore becomes a matter of larger policy, for example, of levying relevant ecotaxes at a scale and level that relates usage of ecological goods and services to the ecological threshold levels, with due consideration of the impacts of such measures on consumers and inter-regional trade and substitutions in consumption that could occur as a result of such actions.

The process of internalization of costs is relevant and significant both for domestic trade policies as well as international trade mechanisms. UNCTAD (1995) observed that internalization of environmental costs and benefits must be achieved within the country-specific domestic policies, environmental absorptive capacities and time preferences involved. This is not entirely valid, especially when there are unassimilated emissions of pollution that is more of a global externality; CO_2 remains a good example of this pollutant. This issue points to the need for an international coordination mechanism for a market-based, quota-based or target-based reduction of global environmental pollution. One of the ingredients of internalization of environmental costs is their reflection in the costs of producer prices. In the initial phase this can lead to some problems in competitiveness in the export markets, however. When prices of goods transacted in the international market do not reflect the social costs of production, they are effectively receiving a subsidy equal to the uncompensated environmental resource use.

Internalization should only be carried out up to the level where the incremental benefits of avoided environmental damages justify the incremental costs of environmental provisions. This general economic argument could be a step in the right direction, especially when all the costs and benefits are properly taken into account based on an ecological systems assessment of costs and benefits. This approach is different from the generally accepted "polluter pays principle" in the assessment of costs, and the method could apply all over the life cycle of the product: polluter producer, non-polluter consumer, and other intermediaries involved in the sale and distribution. A pragmatic approach would segment parts of these costs so that only environmental impacts, which can be dealt with at the production stage of a product, are internalized at the level of the producer, rather than a front-end load of all the life-cycle environmental costs on the producer. The costs of environmental impacts incurred at subsequent stages of product life cycle can be apportioned and internalized at the level of those who benefit directly from the consumption of products at different stages of the life cycle (Rao, 2000).

7.8 Inefficient Use of Resources

Inefficient production/consumption in most economic activities constitutes the primary source of economic and also environmental misallocation of resources. Examples can be seen in almost every sector and region of the world. Consider transmission losses in electricity – these losses are highest in countries that are already low in energy use and high in energy gaps between demand and supply. The

same holds for irrigation water supply. The automobile sector is not much different either: it is rather common to find low-efficiency automobiles in countries that have the least energy supplies and where costs of petroleum products are high. A free market economics believer would suggest that if the incentives for energy savings are high because of energy prices that are high, fuel efficiency improvements will follow. The facts do not often support this prediction in economies that are capital-constrained, where environmental costs are often externalized and do not seem to matter for the polluter. Often, these systems are also those where there are hardly any fiscal incentives for efficiency. If we turn to marine fisheries, the loss of bycatch approximates to about 25% of the desired (often unsustainable) fish catch, leading to aggravation of the problems of unsustainable harvesting and loss of marine biodiversity.

An economic issue arises: why do the parties involved in the activities in the first place not curtail the losses? It is because either the technology does not permit enhanced efficiency and/or because the marginal cost efficiency improvement does not lead to financial gains sufficient to justify further investments. The next question is one of misallocation implications of the application of traditional marginal cost and marginal benefit principles: as long as the externalities and environmental costs of provision of goods and services at low production efficiencies are not part of the cost calculus of the provider of such amenities, the resultant damages to the environment continue to be borne by the society as a whole or other segments of the system. If the internalization of environmental costs were fully feasible, the marginal costs would have been lower and marginal benefits higher in the broader framework. There may still be some regions of entropy-like scenarios where it is impossible to eliminate inefficiency completely. But an improved efficiency is expected to be a very significant contributor to the reduction of environmental damages in a variety of sectors, especially in the developing countries.

7.9 A Synthesis of Policy Options

The following sets of options are relevant for GEP, and the specific selection of policy instruments depends on specific features (existing social, institutional, cultural, economic, and environmental aspects) and on the scope for reforms at desired levels or sections of societies. Clearly, the selection of instruments can make use of some of the approaches, principles and methods of GEP with particular reference to New Institutional Economics and other related disciplines.

A multi-level approach to the understanding, formulation and implementation of relevant GEP enables a more effective coordination may be facilitated with meaningful clustering of policies. What is suggested below is one such clustering; country-specific and sector-specific application of this approach may be more useful. Although this classification enables a systematic process of analysis, dangers of excessive compartmentalization exist if the non-exclusive nature of these categories and their interdependencies (especially feedback mechanisms) are not fully recognized.

Macroeconomic systems: Integration of economic and environmental policies; integration of domestic and international policies in respect of trade, debt repayment and export obligations; internalization of environmental costs; implementation of various provisions of international environmental agreements and multilateral trade agreements; providing guidance to regional and local institutions regarding various policies for sustainable development; institutionalizing green taxes; adoption of emissions cap-and-trade policies selectively and efficiently; effective fiscal policies for environmental protection with the provision of incentives for protection and phasing out subsidies that adversely affect the environment; reforming institutions for enhanced equity and productivity of resources; reduction of poverty (especially eradication of abject poverty) and fulfillment of basic minimum needs; support of R&D and technical innovations; integration of social, environmental, and economic objectives of development; and internalization of costs of economic and environmental externalities; adoption of GEP with mainstreaming in the broad-based system.

Socioeconomic systems: Ensuring gender equality; according priority of resources to meet the needs of women and children; recognition of poverty eradication and its complementarities with environmental development; investing in people and human capital formation; economic growth with social justice and improved income distribution policies; revitalizing skill formations of vulnerable sections of the society as a priority with subsidized training facilities; constitutionalization of human rights, right to health, environmental rights, economic rights, and the rights of women and children.

Institutions: Support of community-based natural-resource management, democratization and democracy content of institutions, provision of efficient legal infrastructure and the rule of law; codification and development of international environmental law, strengthening stakeholder and market institutions; public or government sector to effect catalytic support and provide complementary rather than substitutory role; encouraging peoples' institutions and genuine non-governmental organizations with accountability at different levels of the governance of social, political, and economic areas; promoting awareness and peoples' participation in planning and implementation of environmental and economic activities; community-based resource management, management of systems with improved integrative efforts to recognize cross departmental linkages and reduce TC; performance accountability at various levels of the government bureaucracy; adoption of GEP.

Consumer level: Environmental literacy and adoption of ecofriedly consumption patterns; moderation in consumerism (or lack of excessive commodification) sustainability; substituting plant-based protein for animal protein; appreciation and promotion of the role of biophilia in enhancing human well-being.

The tools of greening include, among others, the following: design for eco-efficiency at all levels of economic and environmental activities, project appraisal methods that take into account environmental costs and factors arising out of so-called "missing markets" pertaining to environmental resources, adoption of ecosystems approaches, environmental accounting in conjunction with economic accounting, life-cycle analysis in the design of products and processes, pricing

(market-based and administered) to reflect environmental costs, community and stakeholder participation (including non-governmental organizations), and scientific information gathering and analysis of environmental parameters (local and global).

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Chapter 8
Green Economic Policies: Regional and Global Levels

Abstract This chapter focuses on the priority sectors agriculture (with reference to industrial livestock sub-sector) and forestry for their roles in climate change, examines the relationship between Green Economic Policies and the Millennium Development Goals (MDGs), summarizes some of the regional trade and environment agreements and emerging scenarios of global trade reform. An important area of environmental governance relates to the law and application of international environmental law and its role in institutional reforms for better governance of the environment.

Global financial and economic policies are largely influenced by the sovereign nations' policies, and also by the coordination arrangements of the powerful country blocks such as the Group-of-Eight (G-8) and Group-of-Twenty (G-20) countries. In addition, the role and contributions of the United Nations group of organizations, and the Bretton Woods institutions (The International Monetary Fund, The World Bank, and the World Trade Organization), multilateral development banks (MDBs) are significant in policy formulations and operations. Besides, the role of the UN charter bodies such as the UN Development Programme (UNDP), UN Environmental Programme (UNEP), Food and Agriculture Organization (FAO), UN Framework Convention on Climate Change (UNFCCC), and scientific bodies such as the Inter-governmental Panel on Climate Change (IPCC) are important in their policy guidance and/or operations affecting development policy in general and environment in particular. Also relevant are the Official Development Assistance (ODA) being coordinated by the Organization of Economic Cooperation and Development (OECD), and several resourceful private foundations and charity organizations/non-governmental entities.

This chapter deals with some of the critical issues and sectors of significance and urgency in the context of sustainable development and adoption of Green Economic Policies (GEP). The recent policies toward adaptation and mitigation of the adverse effects of climate change (CC) are briefly examined, as well as the activities in relation to the Millennium Development Goals (MDGs) and the scope of environment under some of the regional trade agreements. The role of institutional environment deserves substantial additional attention and this includes the role of strengthened international environmental laws.

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8.1 Adaptation Funding

The productive role of adaptation in the general economic development should be least controversial, relative to the mitigation efforts, for the following reasons:

(a) the recent biogeophysical evidence is abundant and scary enough to convince even the environmental skeptics that the changes must be addressed with several adaptation measures, irrespective of the diagnosis of the role of humans in altering the current phase of global climate change and its several adverse effects;
(b) the reward to resource deploying investments for adaptation measures occur soon and benefit locally and globally, financially and otherwise – in other words, more tangible gains for the costs incurred;
(c) if devised sensibly, the adaptation measures complement, substitute or replace (depending on the diverse environmental and economic settings) the need for long term investment catered toward the mitigation effects of climate change;
(d) it may be easier to bring in greater participation of the international community and stakeholders into the immediate policy and implementation tasks, because of the relative shorter horizon of the tasks handled and to be able see the results in positive light;
(e) contributions these activities make toward economic development, gainful employment creation, institutional reforms such as community-based resource management.

Adaptation Fund (AF) established under Article 12 of Kyoto Protocol is among the first few funds catered to the needs, although in its initial stage and at low level of resources. The estimated level of funding for the AF is about $0.4–1.5 billion during 2008–2012.

Public funding (bilateral, multilateral and national) for mitigation actions in developing countries has been expanding, although not anywhere near the required levels to offer protection against climate change effects. The Global Environmental Facility (GEF) is the UNFCCC's main financial mechanism for both mitigation and adaptation. Mitigation activities are funded through three special funds: (a) the Trust Fund, accessible to all countries; (b) the Special Climate Change Fund, available to non-Annex I countries (under the Kyoto Protocol); and (c) the Least Developed Countries Fund, for the eligible category of countries. The World Bank has about $2 billion spread in ten carbon facility trusts and funds, and over $6 billion in its Climate Investment Funds.

The UNFCCC estimates that for adaptation the funds required may be in the range $60–$182 billion by 2030. World Bank estimates the incremental cost of adaptation may be $10–40 billion/year. A few bilateral initiatives such as Japan's Cool Earth Partnership (expected to deliver about $2 billion in funds) are noteworthy. Climate change aspects are specifically included in bilateral official development assistance under OECD's Development Assistance Committee (DAC), amounting

to about $4 billion in 2006. Box 8.1 summarizes an overview of adaptation funds that are budgeted and utilized or made available in 2008.

The process of mainstreaming adaptation into policy planning is an important component of adaptation planning. Participatory approaches are needed to utilize appropriate local knowledge and for retaining a focus on values important to stakeholders.

Box 8.1 Adaptation Funds (Budget, Expenditure – in Bracket, $ Million)

Adaptation Fund (AF) 33 (0)
Least Developed Countries Fund (GEF) 182.44 (47)
Special Climate Change Fund (GEF) 106.57 (59.8)
Strategic Priority on Adaptation (GEF) 50 (50)
MDG Achievement Fund (UN-Spain) 388.46 (85.5)
Global Climate Change Alliance 77.6 (0)
International Climate Change Initiative (Germany) 147.1 (40.5)
Cool Earth Partnership (Japan) 2000 (0)
Pilot Program for Climate Resilience (World Bank) 240 (0)
Source: UNEP (2009).

An efficient climate policy seeks to find the efficient mix of mitigation and adaptation solutions that limit the overall impacts of climate change. This includes recognizing that many mutually re-enforcing synergies exist between specific mitigation and adaptation solutions that can lead to more efficient allocation of "climate response" resources. Many of these synergies exist in the forestry and agriculture sectors and are relevant to rural livelihoods in developing countries. Synergies are also relevant to social, economic and environmental sustainability.

Choice of strategies for maximizing societal welfare under future climate risk involves an efficient mix of both adaptation and mitigation. The strategy mix depends on the specific contributions of policies in the short-run with implications for the medium and long run time horizons, and possible substitutions between the elements of policy over time and their cost-effectiveness. Monetary and non-monetary benefit-cost analyses are also relevant.

8.2 Millennium Development Goals (MDGs)

One hundred and eighty nine member countries of the UN announced in September 2000 the UN Millennium Declaration, which stated, inter alia:

> We will spare no effort to free our fellow men…, from the abject and dehumanizing conditions of extreme poverty, to which more than a billion of them are currently subjected.

Unfortunately, even after a decade of this Declaration the seriousness of the problem remains almost the same. Given the cross-correlations of various indicators under MDGs the common theme evolves around poverty reduction and environmental quality improvement. No doubt, climate change can only adversely contribute to the present scenarios for achieving some of the main goals under the Declaration.

List of the MDGs is given below.

Goal 1: Eradicate extreme poverty and hunger
Goal 2: Achieve universal primary education
Goal 3: Promote gender equality and empower women
Goal 4: Reduce child mortality
Goal 5: Improve maternal health
Goal 6: Combat HIV/AIDS, malaria and other diseases
Goal 7: Ensure environmental sustainability
Goal 8: Develop a global partnership for development

The Declaration included MDGs and specified 18 targets and led to 48 indicators of achievement sought to be met by 2015. The list of "goals" and "targets" is only partly quantitative in its specifications; others can be floating levels of attainment and be used for self-deception when claimed as mostly claimed. These seemingly segmented elements admit largely one feature in common and suggest the imperative: adoption of GEP, including transaction cost (TC) reducing targeted intervention through public policies (not necessarily government's direct role but largely a catalytic role) on some of the aspects. Let us recognize that the role of the environment in GEP framework of this book is not merely reduction of GHGs or sustaining assets for the future; it addresses concerns of current poverty as an integral part of SD, equity (rich-poor, gender, and so on), quality of life (children mortality, literacy, health and well-being), and other elements of the MDG framework with total cost reducing approach. Clearly, reform of institutional environment and institutional arrangements is an important part of this exercise, and so is provision of human rights and environmental rights, besides active participatory and accountable role of stakeholders.

Targets for some of the MDGs may be achieved by 2015 for some key areas, including poverty and hunger reduction by half (MDG 1) in terms of the proportion to those in 1990.

The World Food Summit 2009 hosted by the FAO the Summit produced "important commitments" including:

1. A firm pledge to renew efforts to achieve the MDG 1 of halving hunger by 2015, and eradicating hunger from the world at the earliest date;
2. A pledge to improve international coordination and the governance of food security through a reform of FAO's Committee on World Food Security, broadened to include stakeholders from both the public and private sector and non-governmental organizations.

The Summit adopted Five Rome Principles for Sustainable Global Food Security including: (1) invest in country-owned plans channeling resources to well-designed and results-based programs and partnerships; (2) foster strategic coordination at all levels to improve governance, promote better allocation of resources and avoid duplication; (3) strive for a twin-track approach to food security including both short-term emergency and long-term development measures; (4) work to improve the efficiency, coordination and effectiveness of multilateral institutions; and (5) ensure sustained and substantial commitment by all partners to investment in agriculture, food security and nutrition.

These Principles are very meaningful, and seem to obey principles of GEP, as these address issues of institutional reforms, institutional arrangements, and the need to curtail TC. However, as the Director-General Jacques Diouf, declared to his "regret", that the official Declaration adopted by the Summit contains "neither measurable targets nor specific deadlines which would have made it easier to monitor implementation. . ."

Also, regarding climate change aspects the resolve of the Summit has been vague: the Summit also agreed to "proactively face the challenges of climate change to food security and the need for adaptation of, and mitigation in agriculture . . . with particular attention to small agricultural producers and vulnerable populations."

Let us examine issues affecting other MDGs.

There are serious impediments to the attainment of goals in regard to the environment (MDG 7), reduction of child mortality (MDG 4), among others. The UNICEF documented in its report (UNICEF, 2008) that there is insufficient progress: whereas the observed progress in the reduction has been of the magnitude of 1.6% per annum during 1990–2006, the required progress during 2007–2015 stands at 9.4% per annum. It is useful to note that child mortality is determined not only by food-nutrition-poverty aspects and medical interventions but often conditioned by environmental public health issues, including safe drinking water, sanitation and pollution factors of local areas. Environmental improvements in local and regional settings are very important here, besides poverty reduction itself.

Official Development Assistance (ODA) continued to drop from an all time high of $107.1 billion in 2005, mainly the result of a decline in debt relief grants; this is a reversal of what is expected under MGD 8. It would be pragmatic to avail the Debt-for-Nature Swaps (DNS) (explained later in this chapter) to realize goals related to MDG 8.

Regarding MDG 7, Carbon dioxide emissions reached 28 billion metric tons in 2005 and continued upward, resulting in increased atmospheric concentrations of CO_2. Globally, emissions increased by 30% from 1990 to 2005, with annual growth from 2000 to 2005 greater than in the preceding decade. Per capita emissions remain the highest in the developed regions, about 12 metric tons of CO_2 per person per year, compared with about 3 metric tons in developing regions and 0.8 metric tons in sub-Saharan Africa.

The problems related to environmental degradation and its adverse consequences (including those arising out of climate change) will continue to haunt the global economic and environmental system. If we continue to stay on no major initiatives

path, it is very unlikely that targets under environmental sustainability (MDG 7) will be met by 2015. The list of target indicators is given in Box 8.2.

Box 8.2 MDG 7 Environmental Sustainability Targets List

Target 7a: Integrate the principles of sustainable development into country policies and programmes; reverse loss of environmental resources

Target 7b: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss

- 7.1 Proportion of land area covered by forest
- 7.2 CO_2 emissions, total, per capita and per $1 GDP (PPP)
- 7.3 Consumption of ozone-depleting substances
- 7.4 Proportion of fish stocks within safe biological limits
- 7.5 Proportion of total water resources used
- 7.6 Proportion of terrestrial and marine areas protected
- 7.7 Proportion of species threatened with extinction

Target 7c: Reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation

- 7.8 Proportion of population using an improved drinking water source
- 7.9 Proportion of population using an improved sanitation facility

Target 7d: Achieve significant improvement in lives of at least 100 million slum dwellers, by 2020

- 7.10 Proportion of urban population living in slums

Source: www.undp.org/mdg

This is the time for a corrective action and greater focus on the sustenance of environmental and ecosystems, using green economic policies. Since various goals and targets are highly correlated and constitute a development paradigm by themselves, it is very useful to see the common underlying infrastructural requirements to address these goals in a cost-effective and sustainable manner.

The recipe for this lies in terms of the following:

1. creating and reforming institutions that better facilitate allocation and delivery of goods and services (including ecosystem services, using for example, micro-credits for providing processed safe drinking water under the set up of small community-based organizations);

2. enhancing human capital with education and training (oriented largely toward gainful employment in the rural and environmental sectors);
3. adoption of GEP that factor in the value of goods and services (possibly involving local governmental policy interventions for attaining the efficient use of resources); and,
4. stakeholder participation and community involvement for local governance of assets and resources.

In general, the current trends indicate greater polarization in favor of the rich and the corporate entities, to the neglect of most others. As long as the recognition of the role of environment as a key development contributor is missing in policy and action, poverty may persist society will lose out over time due to unsustainable patterns of development.

8.2.1 Debt-for-Nature Swaps (DNS)

DNS mechanism of waiving a nation's debt to reduced levels in relation to protection and preservation of natural resources that have global public good, such as forestry or ecosystems, came into operation during mid-1980s. A few projects have been formed, starting with Bolivia in 1987. Non-governmental organizations have been involved in the planning and execution of the projects, as part of bilateral or multilateral agreements among countries. Although some more projects have been added during the subsequent years, the pace of progress has been too small and too slow – relative to the potential to use the mechanism for the realization of win-win benefit scenarios.

The US has been the leading contributor in this series of swaps. The first legislation to enable bilateral debt to be swapped for environmental conservation projects was the Enterprise for the Americas Initiative (EIA) Act in 1990. The US signed seven agreements within 2 years of the Act, with about $875 million debt forgiven and the local currency equivalent of $154 million used for environmental purposes. The Tropical Forest Conservation Act (TFCA) of 1998 extended the schemes in the Latin American and Caribbean region for forest conservation. This Act authorized the President to allow debt reductions, and DNS. Thirteen agreements have been signed under TFCA for 12 countries. There are a few similar examples among other countries. For example, Germany and Indonesia entered into DNS agreement in 2004 and about $30 million debt was nullified for forest protection purpose. Clearly, the scale of operations remains rather negligible. There is a need for careful review and application of the DNS mechanism at this juncture.

DNS should be useful as an effective mechanism for mitigation of the effects of CC and should be offered to as many countries in serious multilateral debt as possible. This should be conditional upon the beneficiary countries availing the resource outflows saved on account of reduced international debt toward providing dedicated and accountable (verifiable) incremental resources for: (a) alleviating poverty; (b) protecting the environment as per a new multilateral agreement on the specifics; and (c) augment resources toward reduction of GHGs.

The donor nations and multilateral entities will also reap benefits of the enhanced quality of the global commons, besides being reasonable in compensating the debtor countries partly for their excessive role in the GHG emissions over the years, in addition to continued unsustainable consumption patterns with their own contributions of externalities.

8.2.2 Transboundary Environmental Impact Assessment

There is no single unified environmental impact assessment treaty in the transboundary context between states. Such as assessment, if covered at all, is either under reference to resource under reference such as biodiversity, or under regional agreement such as those between North American member countries. The leading instrument is the Convention on Environmental Impact Assessment in a Transboundary Context (also known as the Espoo Convention, signed in Espoo, Finland in 1991). This Convention entered into force on September 10, 1997. The Treaty has been ratified by about 40 countries. The existence of any other treaties might imply that the Espoo Convention stipulations seek a higher standard over and above other local agreements.

8.2.3 Ozone Depleting Substances and GHG Reduction Synergy

The Vienna Convention on Ozone Layer Convention as well its Montreal Protocol has 196 countries as members, the largest of international environmental memberships. An accelerated freeze and phase-out of hydrochlorofluorocarbons (HCFCs), chemicals that replaced more ozone-damaging substances known as chlorofluorocarbons (CFCs). HCFCs, promoted over a decade ago as less damaging replacements for the older CFCs, have now become widespread in products such as refrigeration systems, air conditioning units and foams.

New scientific studies (details given in Chap. 5) indicate that speeding up a phase-out of HCFCs and their related by-products could not only assist in the recovery of the ozone layer, but could also play an important role in addressing climate change. It could represent a reduction of about 3.5% of all the world's current greenhouse emissions annually, whereas the much publicized the Kyoto Protocol, which aimed at of reducing developed country emissions by over 5% by 2012 (over 1990 levels). Under the Montreal Protocol, if there are no urgent amendments, under the United Nations Ozone Layer Protection Treaty (which was adopted in 1987), the continued use of HCFCs is set to cease in developed countries in 2030 and in developing ones in 2040.

The urgency of this source of relatively cost-effective synergy is to be facilitated with the role of developed country members of the Montreal Protocol, and its Fund to make available resources to phase out the cited substances. Significant expansion of relevant industries, both input supplying, and appliance manufacturing, and environmental services, expansion of economy and creation of job potential are also

some of the positive economic externalities. This phasing out HCFCs activity (along with its forward backward linkages) fits well into GEP approaches and choices.

8.3 Regional Trade and Environmental Agreements

Since the 1990s trade and environment issues are drawing attention, although the governing framework at the WTO level stalled in adopting relevant changes during the past 5 or more years.

In recent years, the US Trade Representative (USTR) has led the US efforts to address the issues of illegal logging and forest trade. Examples include bilateral trade agreements: the US-Indonesia Trade and Investment Framework Agreement, Strategic Economic Dialogue with China, and the Annex on Forest Sector Governance of the US-Peru Trade Promotion Agreement. Besides, the Environmental Cooperation Agreement of 2005 with the Governments of Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, and Nicaragua and other regional agreements qualify under trade-economy-environment cooperation measures with the US. Box 8.3 provides a summary view of regional trade and environment agreements. Suffice it state that these remain relevant but are feeble forces to integrate trade and environmental considerations.

Box 8.3 Select Cases of Regional Trade and Environment Agreements

The North American Free Trade Agreement (NAFTA) is a well known model, even if it met with limited successes. In continuation previous efforts, the United States, Canada and Mexico sought in June 2009 to encourage greater cooperation between the NAFTA Free Trade Commission (FTC) and the Commission for Environmental Cooperation (CEC) on working to ensure that the trade and environmental policies of each of the three countries are mutually supportive. The three countries pledged to explore new opportunities to collaborate more closely with the CEC to promote mutually supportive policies on trade and environmental protection in North America. When they entered into the NAFTA, the United States, Canada and Mexico also entered into the North American Agreement on Environmental Cooperation (NAAEC), in part, to achieve the environmental goals of the NAFTA. The NAAEC established the CEC. The CEC implements a cooperative agenda set by the Council on various trilateral environmental issues, including work on trade and environment issues.

Besides NAFTA, a few of the regional free trade agreements (FTAs) have also paid attention to the need for integrating environmental considerations in trade. Among them are Trans-Pacific Strategic Economic Partnership

Agreement (SEP), the US-Singapore FTA, the Canada-Chile FTA and others. Among the bilateral trade and environment agreement are the following:

2004 Agreement between Japan and Mexico for the Strengthening of the Economic Partnership: "Cooperative activities may include . . . promotion of capacity and institutional building to foster activities related with the CDM under the Kyoto Protocol to the UNFCCC . . . encouragement of trade and dissemination of environmentally sound goods and services."

2005 Agreement between ASEAN Member States: Parties agree to "pursue . . . on a mutually agreed basis: cooperation in environmental technologies and policies. . ."

2007 Japan-Thailand Agreement: Parties agree to "promote cooperation . . . such as in the fields of agriculture, forestry and fisheries, and science, technology, energy and environment"

2008 New Zealand and China The Environment Cooperation Agreement: "cooperative activities may be in areas including but not limited to: environmental management, environmental remediation, nature conservation, and technologies for environmental benefit. Examples could include: management of water environment, coastal ecological conservation and pollution control. . ., environment and trade, biodiversity conservation."

8.4 Agriculture Sector

Agriculture sector (with industrial livestock subsector included) remains a major contributor toward GHG emissions but has not attracted due attention in devising adaptation and mitigation policies. Also, agriculture will be greatly impacted by climate change and will require substantial adaptation efforts, while agricultural sector is also responsible for a significant amount of global greenhouse gas emissions.

Agriculture is not only a basic human activity at risk from climate change, it is also a major driver of environmental and climate change itself. Agriculture is responsible for 25% of carbon dioxide (largely from deforestation), 50% of methane (rice and enteric fermentation), and more than 75% of nitrous oxide (N_2O, largely from fertilizer application) emitted annually by human activities (FAO, 2008b).

According to the IPCC Report (IPCC, 2007), agriculture accounts for about 13.5% of total anthropogenic GHG emissions. Combined, emissions from agriculture and deforestation – of which agriculture is a key driver – account for more emissions than the transport sector. Agricultural emissions comprise 47% of global anthropogenic emissions of methane (CH_4) and 58% of global nitrous oxide (N_2O). Nitrogen pollution can adversely affect land, water, air, and, consequently, quality of life for residents of communities located near animal production facilities.

Nitrous oxide persists in the atmosphere for up to 150 years and raises two significant concerns. The co-chairs of the Third International Nitrogen Conference in 2004 specifically identified the role of animal based food production in the Nanjing Declaration on Nitrogen Management.

Industrial livestock sector has significant influence in its emissions contributions (both at production and consumption levels) to global warming and climate change. According to the FAO, the livestock sector is responsible for 18%, GHG emissions, greater than the share contributed by the transportation sector.

The "Bali Road Map," adopted at the December 2007 UN Climate Change Conference in Indonesia, calls for "Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries (REDD); and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+)." Since agriculture is a key driver of deforestation, some suggest that a sectoral approach, similar to that of REDD, should be taken for agriculture.

The agriculture sector offers high potential for synergies with climate change adaptation and key co-benefits of relevance to sustainable development (FAO, 2008a). Adaptation policies targeted at improving agricultural productivity, rural infrastructure and rural poverty alleviation contribute not only to food security but also usefully increase the resilience of the agricultural sector (ICTSD, 2009). Agriculture provides an important and relatively cost-effective mitigation option, which must be more fully exploited.

A 2006 study by the FAO highlighted the environmental impacts of livestock production; this sector is "a major player" in climate change and "a major threat" to the environment, with nearly every step in the production chain contributing to air pollution or climate change. According to Henning Steinfeld, lead author of the FAO study, *Livestock's Long Shadow*, "Livestock are one of the most significant contributors to today's most serious environmental problems. Urgent action is required to remedy the situation." (www.fao.org/news)

The FAO study report concluded that a "top priority is to achieve prices and fees that reflect the full economic and environmental costs, including all externalities." The study points to the need to establish accurate pricing within the animal agriculture sector "by selective taxing of and/or fees for resource use, inputs and wastes." Such a system could include fair pricing of environmental services, such as forests and biodiversity.

The farm animal sector contributes approximately 9% of annual anthropogenic CO_2 output. The largest sources of CO_2 from animal agriculture come not from the animals themselves, but from the inputs and land-use changes necessary to maintain and feed them. Maintaining large-scale, industrial animal production facilities, commonly referred to as factory farms, may emit 90 million tCO_2 per year as they can require substantial energy inputs. Farm animal production is a major driver of deforestation, turning wooded areas into grazing land and cropland for the production of feed. According to the FAO, animal agriculture-related deforestation may emit 2.4 billion tCO_2 into the atmosphere each year. Tropical forests act as carbon

sinks, sequestering carbon and preventing its release into the atmosphere. As animal product consumption grows, grazing land, and factory farms replace areas of the forests, particularly in Latin America.

8.5 Forests Sector

Threats to rainforests, including the Amazon, arise from demand for land use change for the purposes of biofuels, livestock, palm oil or other commercial uses (in regions such as in Indonesia). These changes transform the assumed role of forests as sinks for carbon and convert them to release carbon. Static and dynamic arguments of forests and rural poor in the context of land use changes and ecosystem services have been examined in literature (see for example, Wunder, 2001), although policy actions are lagging far behind.

Tropical forests are being destroyed at high rates: between 1990 and 2005, the rate of deforestation averaged about 13 million ha a year, occurring mostly in tropical countries (FAO-UNDP-UNEP, 2008). These trends are a result of land use change, mainly the expansion of agricultural land, the increasing demands for food, feed and fibre and the overall economic development. Addressing deforestation and forest degradation goes beyond the forest sector and is important.

The Fourth Assessment Report of the IPCC (2007) indicates that the forestry sector, mainly through deforestation, accounts for about 17% of global greenhouse emissions, making it the second largest source after the energy sector. In many developing countries, deforestation, forest degradation, forest fires and slash and burn practices make up the majority of carbon dioxide emissions. There are many causes of forest degradation and they vary with locations. They include, among other things, poor forest management practices including overgrazing, overharvesting of fuelwood and other non-wood forest products, illegal cutting of timber, in addition to forest fires, forest pest outbreaks and forest disease.

The Bali Action Plan, adopted by UNFCCC at the thirteenth session of its Conference of the Parties (COP-13) held in Bali in December 2007, adopted a decision on “Reducing emissions from deforestation in developing countries: approaches to stimulate action”. This decision encourages Parties to explore a range of actions, identify options and undertake efforts to address the drivers of deforestation. While the primary cause of deforestation in Latin America was a conversion of forests to large scale permanent agriculture, in Africa deforestation was mainly caused by conversion of forests to small scale permanent agriculture and in Asia there was a mix of direct causes.

The underlying causes of deforestation are complex: governance structures, land tenure systems and law enforcement, conflicting market and cultural values of forests, the rights of indigenous and local communities and conflicts in benefit sharing mechanisms, poverty and food production policies. Solutions need to be

customized to the environmental and socio-economic conditions of each country, location and their institutional arrangements.

Tropical forest destruction causes release of about a fifth of global greenhouse gas emissions. Project's permanence under REDD is usually questionable, in addition to "leakages" (destruction of forests in uncovered areas), and misreporting.

Noel Kempff Mercado Climate Action Project spread over 6,000 mile^2 of protected forest area in Bolivia has been considered a useful project to facilitate its replicability and expansion. Launched in 1997 with the support of some of the oil companies to offset their emissions and claim carbon credits, the project is now found to contribute toward about a tenth of its originally planned reduction of net emissions, according to sources including the Greenpeace organization. The failure in meeting the expectations has been on account of leakages, lack of additionality feature, lack of permanence and negligible percolation of benefits to the local populations.

Deforestation currently accounts for about 18% of global carbon emissions and remains the third largest source of emissions. Conserving forests with that possess large stocks of biomass from deforestation and degradation can contribute toward avoiding significant carbon emissions to the atmosphere, irrespective of the source country (Keith, Mackey, & Lindenmayer, 2009).

Since tropical forests are carbon reservoirs and since deforestation causes carbon released to the atmosphere making up for 12–30% of global carbon emissions per year since the 1990s, reduced emissions from deforestation and forest degradation (REDD) into the future climate agreement is desirable. This aspect is relevant programs could be combined with local and regional development, enabling forested countries to gain from their conservation of such ecosystems, biodiversity and carbon sinks. Since REDD is included for emissions credits under the Kyoto Protocol, the pollution emitting industries have little incentive to undertake projects for forest preservation. REDD was first proposed by a Coalition of Rainforest Nations led by Costa Rica and Papua New Guinea in 2005, and was supported under Bali Action Plan in 2007.

According to recent assessments, deforestation and forest degradation, through agricultural expansion, conversion to pastureland, logging, account for nearly 20% of global GHG emissions, more than the global transportation sector and stands next only to the energy sector in the order of sectors of high GHG emissions. REDD activities in developing countries must complement, not be a substitute for, cuts in developed countries' emissions under the Kyoto Protocol. Inclusion of REDD in a post-Kyoto regime, if treated as a net additionality factor for GHG reduction, will not diminish the commitment of Annex I countries to reduce their own emissions. The two main multilateral platforms for REDD are the UN-REDD Program and the Forest Carbon Partnership Facility (FCPF) of the World Bank. At the country level, the UN-REDD Program and the FCPF work together as the national program develop in Bolivia, the Democratic Republic of Congo (DRC), Indonesia, Panama, Papua New Guinea, Paraguay, Tanzania and Viet Nam.

8.6 Costs and Benefits

Costs of REDD will vary based on opportunity costs of land and other resources. The Stern Review noted that the opportunity costs must include value added activities and export tariffs, and concluded that it could be up to $30 per tCO_2 to completely eliminate deforestation. Estimated for the costs of REDD fall in the region $20–$33 billion/year to halve deforestation. In the very long-term, REDD emissions reductions are not likely to be less expensive than industrial emission credits, as land is a fixed resource and is increasingly in short supply.

REDD is considered a relatively low cost mitigation option, and thus integrating REDD into international emissions trading could decrease costs of achieving emissions reductions. However, this could reduce the carbon price and consequently diminish incentives for investment in high cost industrial emissions reductions. The Annex I cap will be critical in determining the demand and the scale of the carbon markets in the post-2012 agreement. Annual deforestation in two major countries Brazil and Indonesia may be equivalent to 75% of the total Annex I reduction obligations under the Kyoto Protocol.

Direct and indirect benefits of REDD include biodiversity, water regulation, timber and non-timber forest produce. A study by the Environmental Defense Fund (2008) for various scenarios showed that allowing unlimited use of REDD credits reduced the projected price by 13%, and impact increased if the scale of REDD credits increased or if credits from all forestry activities were included (in this scenario, the price is lowered by about 33%). An option for reducing this effect would be to apply a discount factor to credits that enter the market, for example 75% discount on credits, i.e. 100 REDD credits of tCO_2 would equate to 25 tCO_2 emitted by the polluter purchaser.

Parties to the Kyoto Protocol agreed in 2001 that limited land use change activities (afforestation and reforestation) could be eligible for Clean Development Mechanism (CDM) projects, but GHG removals from afforestation and reforestation projects could only be used to help meet 1% of a Party's emissions targets. Avoided deforestation was not included, whereas it is included under the land use change category for Annex I countries.

Can potential credits from REDD of large volumes of credits "flooding the market" and reducing the carbon price? If substantial proportions of emissions reduction targets could be achieved by purchasing REDD credits can the market lead to reduction in incentives for addressing industrial emissions in general? The potential risk of flooding the market is closely tied to the overall cap on emissions by Annex I countries. *A phased approach, with adaptive learning and adaptive planning, will be relevant.*

The Eliasch Review of the UK Office of Climate Change in the Report of 2008 (details at www.occ.gov.uk) estimated that in order to halve by 2030 the emissions (estimated at 5.8 GTCO2 annually) from forests due to destruction and degradation, finances required would range $17–33 billion/year. The Review suggested and estimated that global carbon market could finance about $7 billion a year, and the rest

may have to be funded multilaterally. Regarding benefits, the net benefits have been estimated at $3.7 trillion over the long run; this estimate does not include benefits of all ecosystem services, however.

We now turn to an important infrastructural requirement for institutional environment and arrangements, and this pertains to the provision and enforcement of law at different levels.

8.7 Law and Institutional Infrastructure

In international agreements, whether environmental or financial or other, the role of "properly designed contracts" remains important. The roles of reciprocity and issue-linkages, both in explicit treaty provisions and in implicit contracts remain relevant in the design of self-enforcing agreements. A desirable element of such features is the incentive mechanism for greater cooperation among states, whether or not the legal provisions explicitly warrant the same. Broadly, laws are categorized into those that attempt to seek international actions in a rather preemptive or precautionary approach , and those that address identified global environmental problems to arrest the deterioration and also take further mitigating and/or precautionary measures. The set of parties in each international treaty or agreement comprises different states in different agreements (even after excluding the regional agreements and confining to "global" agreements). It is unrealistic to assume any major significance of each of these laws on a global scale when significant numbers of states are non-parties to several of the agreements. The roles of economic incentives (as in the case of the Montreal Protocol applied to developing countries) and disincentives (as in the case of trade with non-parties in the CITES case) for participation are important.

Hard law in international public affairs arises primarily from customs and treaties. Soft law is where international law, scientific information, institutional development interact to form new norms and expectations. Customary International Law (CIL) is one of the two main sources of international public law, the other being treaty law. Even the hard law instruments lead to "soft responsibility" because of the absence of enforcement mechanisms and state responsibility.

The main elements of treaty design with reference to International Trade and Environmental Laws (ITEL) include (see also Rao, 2001):

- Pre-agreement analyses and informal cooperative understanding among various potential participants;
- Provision of incentives for expansion of membership set of parties;
- Provision of incentives for compliance with agreed terms of treaty;
- Design of disincentives for nonmembers so as to ensure that free-rider phenomena are controlled;
- Meaningful and pragmatic design of terms of review and renegotiation after entering into treaty;

- Effective mechanisms of information-reporting and exchange to enable evaluation over time; and,
- Specification of transparent and effective mechanisms for dispute resolution.

8.8 Common Heritage of Mankind

Among the international agreements, the UNCLOS, UNFCCC and the CBD refer to global environmental assets and ecological assets as "common heritage of mankind" The 1989 UN General Assembly Resolution 43/53 concerning the protection of global climate, and later in the 1992 UNFCCC sates asserted their "common concern for humankind" (Box 8.4).

Box 8.4 The Role of *jus cogens*

In general, *jus cogens* has been interpreted (see Uhlmann, 1998, p. 101) as "those norms rendering void any treaty ... contrary to certain fundamental substantive rules." Article 59 of the 1969 Vienna Law of Treaties defines *jus cogens* as: "a norm from which no derogation is permitted." According to this Article, the norm needs to be "accepted and recognized by the international community of states as a whole." Also, Article 64 allows the preemptory role of fundamental principles, thus allowing the role of *jus cogens* in international public law. This states: "If a new preemptory norm of general international law emerges, any existing treaty which is in conflict with that norm becomes void and terminates." The ICJ refers to the role of potential *jus cogens* in the Gabcikovo-Nagymaros case. There exists a reasonable agreement among states that the most basic norms protecting "fundamental values" of the international community are *jus cogens.* Uhlmann (1998) suggested a few norms for invoking *jus cogens*; one of these is the human right to sound environment. The inclusion of preservation of biological diversity and climate protection as "common concerns of mankind" paves the way for the role of *jus cogens.* This implies that a state could take action against the damaging behavior of another state even when the former did not itself suffer direct and actual damage. Factors affecting the preservation of the global commons could attract the invoking of *jus cogens.* The International Law Commission Draft Articles on State Responsibility (see also Uhlmann, 1998) predicted about two decades ago that the emergence of new environmental norms could form into *jus cogens.*

According to a verdict of the US Circuit Court of Appeals for the Ninth Circuit in the case of Siderman de Blake v. Republic of Argentina (965 F.2d 699, 9th Cir, 1992 at 715) *jus cogens* "is derived from values taken to be fundamental by the international community, rather than from the fortuitous or self-interested choices of nations."

Source: Rao (2001).

8.8.1 The Polluter Pays Principle (PPP)

In general, economic and ethical imperatives suggest that prices, in markets wherever these exist, reflect full costs (both private and social costs, including environmental costs) of resource use, production, and its linkages through the product life cycle. The GATT rules tend to encourage externalization of environmental (and other non-market) costs as a legitimate source of competitive advantage to be exploited with unimpeded processes by states participating in international trade.

The Independent World Commission on the Oceans (1998) in its Report recommended that future policies governing the ocean resource uses must be guided by the adoption of PPP and the Precautionary Principle (PP, explained blow). The Report also recommended (p. 20): "Management regimes embodying the precautionary principle be established at the appropriate geographic level. These regimes should also recognize the importance of a multi-sectoral and multi-disciplinary approach and of on-shore/off-shore linkages."

8.8.2 The Precautionary Principle (PP)

The PP is based on the premise that prevalence of uncertainty should lead to appropriate measure of safeguard. The 1992 Rio Declaration of the Earth Summit in its Principle 15 stated: "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. . .. In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. . .."

The first international formulation of the Principle was at the First International Conference on the Protection of the North Sea in 1984 when the focus was on emissions into the marine environment. The PP has played an increasingly significant role since its endorsement by the Second International Conference of the North Sea in 1987.

The PP has been frequently advocated in governing marine resources and pollution. Some of the key elements of a legal definition rely upon the following: (a) a threshold of perceived threat against which advance action would be deemed justifiable; and (b) a burden of proof on the pollution activity contributor to show that a proposed action will not cause actual harm. The role of the PP is largely confined so far to provide guidance to policy judgment and to provide benefit of doubt in favor of the environmental resources.

The PP is equivalent to "risk averse" behavior in cases that involve irreversibilities or extremely high costs in socioeconomic, biogeophysical or other terms. The risk averse nature of the Principle is relevant if scientific knowledge is too limited to quantify uncertainty (and thus cannot establish probability distributions of potential outcomes).

The PP seeks caution and that uncertainty should be interpreted toward some reasonable measure of safeguard. The PP has been most frequently advocated in

governing marine resources and pollution. The increasing role of PP (for details see Rao, 2001) suggests that it is ripening into a norm of international law; one of the key elements of a legal definition rely upon the following: a burden of proof on the activity contributor or entrepreneur to show that a proposed action will not cause actual harm. The role of the PP is largely confined so far to provide guidance to policy judgment and providing benefit of doubt in favor of the environmental resources.

There is a need to develop detailed rules in the field of responsibility and liability for harm to the environment for acts not prohibited by international law. These rules should adhere to the PP. There are a few illustrative cases relevant for case law development in this regard. The first is from the US and the second from the International Court of Justice (ICJ).

In the US, the Supreme Court ruled in Maine v. Taylor (477 US 131, 148, 151–152; 1986), sustaining the state of Maine's ban on the importation of baitfish. The Court, in a rather rare application of the PP, ruled in favor of the state's ban as the legitimacy of the state's interest "in guarding against imperfectly understood environmental risks, despite the possibility that they may ultimately prove to be negligible." According to the ruling, the state is not required to "wait until potentially irreversible environmental damage has occurred."

In the Court petition of Hungary to the ICJ in the Danube dams case (Gabcikovo-Nagymaros project), the PP was invoked in Para 31 (quoted in McIntyre & Mosedale, 1997, pp. 231–232):

> . . .Art. 2, paragraph 5(a) of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, signed in Helsinki on 17 March 1992, as well as the IUCN Draft Art. 6 and Brundtland Report, Art. 10, provide support for the obligation in general international law to apply the precautionary principle to protect a transboundary resource. . .

The PP has already evolved as a norm of the international law. Some of the important prerequisites for the effective implementation of the principle are: precautionary assessment, setting of precautionary standards, and fulfillment of information requirements both in collating data and conducting relevant research activities. Uncertainty arising from ignorance, inadequate data or indeterminacy should also be considered in the interpretation of the expression "scientific uncertainty"; thus it is prudent to generalize this to include statistical uncertainty as well. It is not unusual that resolution of scientific uncertainties tend to require long time spans, and this should not lead to situations of severe adverse consequences while waiting for greater certainty of information. If prudently applied, PP can contribute toward pragmatic decisions.

The ICJ in the Gabcikovo-Nagymaros Project case of 1997 also stated (Para 140): "Owing to new scientific insights and to a growing awareness of the risks for mankind – for present and future generations . . . new norms and standards have been developed, set forth in a great number of instruments during the last two decades. Such new norms have to be taken into consideration and such new

standards given proper weight, not only when States contemplate new activities but also when continuing with activities begun in the past."

This assertion clearly recognizes the role of evolving science-based norms of modern environmental governance, and the role of state practice *vis-a-vis* new information in this dynamic context.

8.9 Positive Environmental Measures (PEMs)

Positive environmental measures (PEM) (UNCTAD, 1997, Para 2) are mechanisms that include not only the promotion of full participation and compliance on the part of all parties to MEAs, and also "measures which could be used to encourage a dynamic process of continuously improving environmental performance that might go beyond the obligations in MEAs." PEMs include all relevant complementary policies and programs such as capacity building, institutional reform, technology transfer, information management, product standardization, and provision of flexible and efficiency-augmenting economic instruments. These are proposed to invoke dimensions of equity, in addition to efficiency, and enable wider participation of all member countries. It was also noted in this context that (UNCTAD, 1997, Para 4) "failure to comply with the provisions of MEAs is rarely the result of deliberate policies of parties, but rather the consequences of deficiencies in administrative, economic or technical infrastructure." PEM are thus considered important supplements to meet the inadequacies of compliance and effectiveness mechanisms. Some positive measures are already in place in some select MEAs: the UNFCCC, the CBD, and the Montreal Protocol (MP).

MP allows a developing country to notify the secretariat of the Protocol regarding its inability to fulfill its obligations due to the inadequate implementation of Articles 10 and 10A of the MP relating to technology transfer. Two of the major multilateral funding mechanisms for the MEAs are the Multilateral Fund under the MP, and the Global Environmental Facility (GEF) designated to assist in the implementation of the CBD and the UNFCCC.

8.9.1 State Responsibility

The 1991 ILC Draft Articles (ILC, 1991) provide a set of guidelines for the imposition of liability for various injurious transboundary consequences, including environmental damage, caused by a State party. These require the offending State to negotiate (Article 21) with the "affected State or States to determine the legal consequences of the harm, bearing in mind that the harm must, in principle, be fully compensated."

The ILC Draft Article 24 on Harm to the environment and resulting harm to persons or property states: "If the transboundary harm proves detrimental to the environment of the affected State: (a) The State of origin shall bear the costs of

any reasonable operation to restore, as far as possible, the conditions that existed prior to the occurrence of the harm. If it is impossible to restore these conditions in full, agreement may be reached on compensation, monetary or otherwise, by the State of origin for the deterioration suffered." Thus, the role of state responsibility in acts not expressly forbidden under the current international public law needs to be elucidated further. Such a framework may contain the negative environmental externalities contributed by the acts of some states on others and on the global commons in general.

Differential norms tend to circumvent the problem of "least common denominator" phenomena in environmental agreements (see also Halvorssen, 1999) and possibly reduce environmental efficiency losses as well. The CBDR Principle tends to address part of equity issues applicable to developing countries. Financial and technical support for developing countries remains relevant policy instrument in this context, provided the recipient countries agree to abide by the general principles of environmental governance.

Role of trust law and related international approaches for the protection of the global commons requires much more attention from the global community than it ever has thus far. The need to protect the interests of future generations is already an element of *opinio juris*, given the relevant provisions in various international agreements. It is imperative that proper safeguard of environmental resources for the future is ensured with appropriate institutional arrangements.

Application of relevant ecosystems concepts and international environmental law suggests that for environmental law, the common denominator is (Lazarus, 2000) the "ecological injury that serves as the law's threshold." The roles of irreversible consequences, latent and/or distant injury, and tradeoffs among monetary and non-monetary values are among the important features relevant when examining the reconciliation of environmental and economic aspects of international trade.

*Since the global environmental externalities do not distinguish national boundaries, and since scope for invoking non-liquet feature exists under the existing laws to abdicate environmental responsibilities of an otherwise liable party, it is useful to fix this free rider exit (*Rao, 2001 *). There are at least two measures relevant here. These require stipulation of provisions concerning (a) legal standing locus standi of interested parties (state or other legal entities); and (b) provision of amicus curiae. In the global environmental arena, an "injured entity/party" need not be a state party, as often required in various legal institutions (e.g., the International Court of Justice) and international public laws.*

Specifications of compliance features are often vague and unenforceable in most international agreements; such agreements, in effect, are merely "make believe" agreements and are themselves for loaded with considerable transaction costs in designing such ineffective instruments of multilateral policy. Articulation of integrated strategies to bring in erstwhile free riders to comply with various laws is an important aspect of further development of the law. The role of economics has become more important now than ever in the past, given the significance of more efficient global environmental governance.

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Chapter 9
Policy Framework

Abstract This chapter summarizes some of the salient features of Green Economic Policies and relevant priorities in the interests of the efficient governance of the environment, without neglecting the economic and social factors.

9.1 Environment, Economy and Society

Environmental change imposes known and unknown costs to most sections of the contemporary and future societies if proper attention is not paid toward prevention, adoption and mitigation. This is particularly significant when changes in the environmental phenomena are such that the acceleration does not allow sufficient time and resources for adaptation, adoption and mitigation.

Global economic welfare and enhancement and its sustainability requires environmental security and stability. Much of the conventional economic analysis that draws upon principles of "economic efficiency" presumes the existence and stability of resilient ecosystems. In the absence of requisite resilience, an economically efficient solution can result in a small disturbance leading to major environmental and economic losses, and the choice constitutes an inefficient solution.

Global environment possesses the global public goods feature that the benefits of environmental improvement are shared by all but the costs of improvement are not. The costs of environmental damage are often inflicted by relative anonymity of damage causing agents, uncertainty in their magnitudes and probability of incidence in a given sector or region and time. This makes the problem of accountability and fixing responsibility more difficult. Thus there is a need for a general pool of resources that are contributed by the environmentally intensive consuming countries for offering relief to the needy.

It is often hard to achieve effective implementation even when the conceptualization is nearly perfect. It is no surprise that the efficacy of implementation of imperfectly conceived policies and programs remains low. One of the consequences of some of the pseudo measures claiming adoption of the SD approach has been grossly neglected the poverty phenomena worldwide and attenuated economic inequalities (especially between the developing and developed countries).

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It is harder to mobilize resources and enthusiasm at local operational levels for the integrated approaches of environmental protection and economic development. This leads to the conclusion that the policy formulation and implementation of corresponding programs and projects are structurally constrained to under achieve the objectives of environmental and economic development. Besides, the critical links between poverty and the environment are among the least attended issues even after several years of the Rio process that started in 1992 with the agreement at the World Conference on Environment and Development.

9.2 Systems Need Change

"Working only within the system will . . . not succeed when what is needed is transformative change in the system itself" (Speth, 2008). This assertion holds especially in the context of the darning facts such as the loss of about 50% of the world forests (tropical and temperate) and of wetlands, along with alarming rates of loss of biological species, and related problems of large magnitudes.

Relevant changes in systems include: reflection of economic, environmental, and social justice requirements at all levels and sectors of activity; production and consumption systems; international trade and international debt; project financing and evaluation criteria; role of multilateral development institutions; role of stakeholders; the provision and effectiveness of the rule of law.

Leakages – not only carbon when international environmental agreements do not contain escape mechanisms (as in the Kyoto Protocol), but also international capital outflows that enable reserving misappropriated and corrupt funds to the advantage very few and harm of millions – mostly living in poverty.

9.3 Economic Approaches Must Change

Sustainable development (SD) requires adoption of Green Economic Policies (GEP) as an effective integrated approach as it focuses on institutions and draws on guidance form New Institutional Economics (NIE), before using business-as-usual neoclassical economics methods. Balancing of economic, social, and environmental objectives is required.

Upkeep of environment is a necessary good and not a luxury, where environmental governance is not merely confined to greenhouse emissions but includes basic features of survival and sustainability such as drinking water.

Greening of development is compatible with economic growth and its sustainability. It is not presumed here that economic growth generally is incompatible with improvement of the environment. However, it is the quality of growth that matters – it can hurt the environment when properly not founded, and can accentuate inequalities, indulge in self-destructive activities over longer horizons. The quality of the environment can stand to gain, provided the quality of economic growth itself is sensible, and can do just the opposite in other cases. Technical innovations can

be better afforded when the economy itself is prosperous but it is not in itself a sufficient guarantee for the upkeep of environmental assets.

Greening development is a public good and is enhanced with correction of environmental externalities and with efficient governance; it offers benefits locally and globally. Poverty eradication remains a key element of sustainable development.

Generalized economic productivity is enhanced and sustained with green economic policies – a win–win–win result for the economy, the environment, and the people.

9.4 Climate Change Policies

Let us recall a recent statement from the head of the UNFCCC: "The cost of addressing climate change is manageable. The cost of not doing so is unaffordable" – Yvo de Boer, OECD/IEA (2009).

> An efficient, fair, and enforceable international agreement for reduction of emissions of GHGs has been elusive for decades, and continuing to wait may defeat the possibilities of significant adaptations and mitigations in time to prevent tragic disasters. . .. 'global solutions' negotiated at a global level, if not backed up by a variety of efforts at national, regional, and local levels . . . are not guaranteed to work well (Ostrom, 2009).
> Some degree of de-coupling between where abatement takes place and who pays for it, to ensure emission reductions take place where they are cheapest. . ..; at least for the world' poorest countries, support through such a de-coupling will be required (OECD, 2008).

Given the complexity and changing nature of problems associated with climate change, there are no "optimal" solutions that can be used to make substantial reductions of emissions of GHGs (Ostrom, 2009).

The IPCC Fourth Assessment Report (IPCC, 2007) suggests that with reference to the Kyoto Protocol Annex I parties (industrial countries) should take on greenhouse gas reduction targets of 25–40% below 1990 levels by 2020. Besides, non-Annex I countries also need to reduce their emissions in order to keep well below rise of 2°C. To achieve this through inclusion in carbon markets, Annex I countries must commit additional targets, on top of the 25–40% range. This is a daunting task, considering the experiences so far under the Kyoto Protocol. It is all the more important to seriously examine least cost methods of attainment of targets, with a larger set of policy instruments and implementation mechanisms. Attainment of these targets is feasible in a cost-effective manner if and only if an integrated consumption-and-production approach to reduction GHGs is adopted.

There are a number of distractions for a sustained environmental policy. The recent US Congressional Budget Office (CBO) report calls into question the positive role of intervention strategies for climate change, such as cap-and-trade policy for emissions trading. The claim made recently is that the climate change effects will be barely noticeable in the US economy, and that the damages are likely to be not in excess of 3% of GDP, citing other studies which seem to suggest even catastrophic scenarios will only imply no more than 5% of GDP loss – although, admittedly, that could entail 10% of global output.

It makes little sense to convert every outcome in terms of GDP loss. This is like a person's loss of life being expressed in terms of percentage loss of income for the household, little realizing that loss of life is irreplaceable and the percentages – whether low or high cannot convey the full content of well being for the household.

> For a statesman to try to maximize the GNP is about as sensible as for a composer of music to try to maximize the number of notes in a symphony (Hardin, 1990).

9.5 Measuring Economic Progress

Economic approaches should shift their focus away from "standard of living" to "quality of living" issues; these two are correlated but the focus on the latter can bring in greater economic wisdom into material life on this planet.

The recent Report by the Commission on the Measurement of Economic Performance and Social Progress (Stiglitz Commission, 2009) set up by the French government, advanced a number of important suggestions after examining the current state of knowledge on various aspects of policy and governance, including in the environmental systems. The Report has revealed several shortcomings of yardsticks in use for measuring economic performance and environmental sustainability. The Report concluded, among other things:

1. Sustainability index needs to be measured essentially in economic terms (in terms of overconsumption and other factors) rather than monetary value terms;
2. The assessment of sustainability remains complementary to the imperatives of human well being;
3. Physical indicators of sustainability should be composed simultaneously, since economic and financial assessment do not carry full information of the present or the future environmental systems, economic systems, and well-being;
4. There is need for select set of indicators to suggest critical levels of resource stocks and flows that are allowed or not allowed for use in production and consumption if major losses (including irreplaceable losses as in biodiversity);
5. Carbon Footprint (CF) may be better suited than ecological footprint to gauge the impacts and seek reduction at aggregate level and also at any level of disaggregation;
6. Country-specific sustainability analyses have relevance but do not offer guidance on global interdependencies and criticality of global factors.

9.6 International Trade and Global Environment

Greening is compatible with trade liberalization but conflicts in some cases and needs resolution. Conflicts in international trade and environment can be minimal if judicious policies are adopted, such as internationalization of environmental costs, and adherence to multilateral environmental agreements.

Trade is an accelerator of economic growth under some conditions, and it is also a conduit for expanding adverse environmental externalities as long as costs of all resources are not properly accounted for. Subsidies of nature are usually built in, just as in some trade exports, forced labor at low costs is used as an advantage for trade promotion.

Adoption of ecosystems approach in devising the trade and environment policies under international agreements lags far behind science and economics. Among other imperatives for change are: the WTO and CITES, to recognize the role of ecological interdependencies while devising protection policies for endangered species, and many other similar revisions in multilateral environmental agreements.

9.7 Energy Sector and Greenhouse Gases

GEP in the energy sector would focus, depending on the country resource and technology endowments, on upgrading energy efficiency in all sectors of the economy, adoption of renewable sources of energy, and sustained focus on innovation and deployment of environmentally efficient technologies. Reduced subsidies in the energy sector will be important for efficient use of resources (current subsidies are estimated around $310 billion).

Carbon pricing is necessary but not sufficient for addressing the problems of climate change or reduction of GHG emissions. This is because of low price elasticities in the energy sector, and institutional hurdles to achieve required targets.

Transfer of low-carbon and energy-efficient technologies to developing countries is important and the reduction of tariff and non-tariff barriers for low-carbon goods and services could create opportunities to accelerate the diffusion of key technologies (Stern Review, 2006).

9.8 Production and Consumption Systems

In the area of food consumption the role of vegetarianism is significant: it takes about 100 pounds of plant protein to produce less than 5 pounds of edible meat protein. If people consume more vegetable protein rather than animal protein, the demand for consumptive use of water and for irrigation would come down rather significantly, besides enabling positive contributions toward land use and reduced deforestation and a few other ecological as well as health benefits.

The ten recommendations of the UN Task Force on Environmental Sustainability (UNDP, 2005), given in their 2005 Report *Environment and Human Well-Being – A Practical Strategy,* make sense but they miss out, among other aspects, on major issues arising out of unsustainable patterns of consumption (especially meat consumption) in the developed world.

9.9 Multilateral Development Banks (MDBs)

MDBs have long way to walk the talk in integrating climate change issues in terms of their mainstreaming of all sectors with a broad-based commitment. Besides, they should try to adopt GEP for a variety of synergistic benefits.

The new strategy paper of the World Bank for the environment seeks to ensure cross-sectoral approaches for policy formulations, and enhance relevant coordination of projects and policies. The idea seems to be to go beyond "safety guards" (specifications of "do no harm") and adopting systematic approaches (in sector strategies, country strategies and global public goods) to bear on environmental sustainability. This is being publicized by the World Bank as a new task but should have been an old one with several years of related activities.

Also, development assistance and international aid can be greener and more development effective. Climate-proofing aid deserves much greater attention than has been accorded thus far. Aid for trade or other packages also need to ensure that environmental upkeep and technical upgrade constitute relevant components of aid. Mainstreaming of climate change issues, especially adaptation, in aid packages remains to be implemented more attentively.

9.10 Markets, Taxes and Regulations

Market and nonmarket institutions should ensure complementarity. There is nothing automatic about the efficiency of markets in the delivery of desirable results that integrate socio-economic and environmental objectives. Efficient design of emissions trading scheme (ETS) and cap-and-trade mechanisms should be founded on new institutional economics (NIE). ETS can succeed if the design of the policy adheres to the imperatives of the role of transaction costs and of market competition in the fullest sense.

The roe of ecotaxes and of cost-effective regulations with provisions of certification or environmental standard specifications will also be complementary to market institutions. The role of international green tax needs to be fully explored. National green tax measures must be initiated along with income redistribution policies.

Environmentally harmful subsidies need to be minimized or phased out over a period of time (to enable gradual adjustment and thus to minimize the corresponding costs of adjustment).

9.11 Organizations Versus Institutions

Is it necessary create too many more organizations or institutions for handling large-scale environmental problems? Perhaps the efficacy of the existing should be enhanced by a variety of measures (including resource augmentation and ensuring accountability). In the same vein of arguments, it is doubtful if the problem of "missing institutions" is as serious as is presented recently by Walker et al. (2009). However, "legal institutions matter in the choice among regulatory instruments",

and "the economics of instrument choice are embedded in and contingent on the underlying legal system." (Wiener, 1999, p. 681).

Legal infrastructure, rule of law and efficient institutional governance are some of the prerequisites of efficient integration of environmental and economic policies and programs for their mutual reinforcement and advantage. The quality of institutions affects the design and implementation of both domestic and international aspects of environmental and economic policies.

The operational principles of SD should be reflected in the charter and activities of international, regional and national financial institutions – with a provision for environmental liability as it applies to domestic lenders in the developed world.

Adaptation strategies to the vulnerable sections of the society to regions must be devised and financed by the global financial institutions with concessional terms of lending.

National governments need to speed up their ratifications of various pending international agreements as they apply to specific potential members, among others: Convention on Biodiversity and its Cartagena Protocol on Biosafety, the Convention on Persistent Organic Pollutants, the Rotterdam Convention on Prior Informed Consent, and the Basel Protocol on Liability and Compensation.

International environmental laws should fully recognize the role of ecological principles, ecology-economy relationships, and the role of alternative economic approaches and critical concepts for the formulation and effectiveness of various provisions and their operational interpretation.

International environmental agreements are notoriously weak in effective compliance by parties to agreements. The agreements often do not even provide relevant guidelines for monitoring and evaluation. Most agreements have not identified specific performance indicators that the parties could be expected to comply with. There is hardly any scope for enforcement with respect to several international agreements; there is little incentive for compliance and little disincentive for noncompliance. Some of these treaties operate their secretariats with a single digit number of staff and their budgets fall short of the cost of holding a single meeting (incurred by parties themselves). Some of the least developed countries cannot afford to send delegations for series of meetings from time to time to distant locations. The international meetings should be coordinated for cost-effectiveness so that future events take place at a rather common location and also adopt e-consultations of the information age and reduce carbon footprint of travel and other consumption effects. Various Secretariats should ensure better coordination in this regard.

Public advocacy and general acceptance of environmental aspirations, in addition to economic aspirations may be seen as important ingredients of infrastructural requirements and components of capacity building for the effective implementation of environmental and developmental objectives in any system. Equitable and cost-effective implementation remains a key to the legitimacy and synergy-creating approach for the interactive and reinforcing roles of the environment and economic development.

Formal and informal education mechanisms and syllabus contents need to maintain focus on the interdependencies of economy-environment-ecology, and on long

term perspectives of life as well as on the economic systems that draw upon the functioning of ecosystems.

The ultimate critical role of effective environmental governance and adoption of green economic policies will rest with individuals, besides public policy makers. As one of the main messages of the World Development Report 2010 (World Bank, 2009) states (p. ix): "Success hinges on changing behavior and shifting public opinion. Individuals, as citizens and consumers, will determine the planet's future ... the greatest challenge lies with changing behaviors and institutions, particularly in high-income countries. Public policy changes – local, regional, national, and international – are necessary to make private and civic action easier and more attractive."

The role of NGOs needs to be institutionalized in most of the environmental and economic activities; the NGOs must also be subject to requirements of transparency, public accountability, and democratic governance.

People other than whose interests are purportedly addressed attend almost all the international conferences on the issues. If there were a meaningful globalization or global economic integration, the wage compensations of workers with almost identical skills would not differ by a factor of a few dozen across countries. Such wide disparities do not imply that all is well with the results of globalization in its current form. When we turn to the primary producers, from highly skilled carpet weavers (the best of rugs included) to best cocoa bean farmers (providing the raw materials for the best chocolates) derive poor standards of income. These examples should drive home the point: the ultra luxury life of the rich has its origins in the poor earnings of their primary providers of lifestyles. This situation deserves corrective action, first at the international level, and next at the national levels.

The developed countries need to underwrite efforts to contain the GHG stocks and flows in the developing countries. The targeted concessional development financing for the developing countries in the context of offsetting GHG balance (more specifically, that of carbon dioxide), could be among the least cost options to mitigate the greenhouse effects.

Protecting the environment requires changes in attitudes and values (including consumption patterns of food and non-food elements). Public policies, including environmental literacy will also be useful to modify consumer level decisions.

9.12 Priority Policy Approach

Among the measures required to effect changes catered to effective adoption and GEP and effective environmental governance are:

- shift to focus on human well being and quality of life rather than treating economic growth as an end itself;
- reform of institutions and plugging of loopholes that allow corruption (public, corporate, other), since misuse of resources deprives eligible beneficiaries their due shares and also perpetuates poverty;

corporate social responsibility that includes environmental sustainability – preferably mandated by the corporate laws;
change in value system that enabling connecting to nature, biophilia and harmony;
dealing with poverty reduction as an integral part of environmental protection and vice versa;
inclusive sustainable development that pays attention to equity and respect for all forms of life.

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Chapter 10
Concluding Observations

Abstract This chapter concludes with an emphasis on knowledge, role of information for adaptive decision making, institutional reforms, and participatory roles of stakeholders. These will enable cost-effective and pragmatic policy design and implementation.

The dynamics of climatic systems are governed by complex and some unknown interdependencies among biogeophysical, stratospheric, tropospheric, and other segments of the planet Earth and its surroundings. Analytically, the relationships seem to obey a fuzzy set-theoretic description with uncertainties (stochastic fuzzy systems). Relevant economic planning methods include improved adaptive planning and rolling optimization. However, there are no such comprehensive analytical methods in operation at this time. Those of the popular models suggesting "optimal" policies fall short rather severely in their accommodation of the role of institutional change and consumer choices as endogenous responses to environmental awareness. Similarly, the cost-effective mechanism of community-based resource management and stakeholder participation are usually not reflected in mechanisms or costs of governance.

It may be easier to agree on the qualitative rather than quantitative nature of the climate change dynamics. In these descriptions, it may be more pragmatic to work with rational interventions (for example, phase out HCFCS, and reduce meat consumption; both these have several synergistic positive effects) with sufficient degree of flexibility to enable adjustments in light of new information, adaptive learning and enhancement of adaptive efficiency. This will contribute toward policies and programs to prevent, mitigate and adapt to climatic change, and not necessarily worry about what is accurate to the third (or higher) decimal place of quantified assessment, be it the degree of global warming or the consequent environmental or economic relationships (and vice versa).

Much of the mathematical modeling regarding climate and economy models is still in its infancy. However, this does not mean that we can afford to ignore the significant problems or wait until all the unknowns are resolved. This is not merely a problem of the "fear of the unknown" but will soon become a problem of negligence. Some of the urgently required interventions do not need to divert financial resources unreasonably to cause concerns of net additional current costs to the society; this

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need not lead to foregoing important aspects of life in order to gain in the long run for the future generations. *Those who want to wait for more certainty on global warming phenomena may have to feel right by at least paying for current adverse externalities of production an consumption patterns; their recognition and adoption of the role of green economic policies begins there.*

"Society may be lulled into a false sense of security by smooth projections of global change … a variety of tipping elements could reach their critical point within this century…. It seems wise to assume that we have not yet identified all potential policy relevant tipping elements" (Lenton et al., 2008). Need for better understanding of the issues is advocated, so that policy makers are able "to avoid the unmanageable, and to manage the unavoidable" (Scientific Expert Group, 2007).

In his 2007 Nobel Lecture, the IPCC Chairman Rajendra Pachauri stated that the "power and promise of collective scientific endeavour…, can reach across national boundaries and political differences in the pursuit of objectives defining the larger good of human society". In his advocacy of the peace-enhancing role of reduction in climate change and its impacts, Pachauri also stated: "peace can be defined as security and secure access to resources that are essential for living. A disruption of such access could prove disruptive of peace".

Reduction of climate change impacts has its peace-contributing dimensions when it reduces ecologically displaced refugees and unplanned migration of populations, reduce stresses and survival threats arising from water shortages, hunger and malnutrition, disease prevalence, and loss of life or its quality. Thus *there is a peace dividend of climate change reduction*. Besides, several major studies (including that of the US Department of Defense) have highlighted the national security implications of global climate change, largely rooted in the disturbances arising from the impacts of climate change.

Are the current problems of hunger, malnourishment and water shortages are all due to climate change? This is very unlikely to be the case. All these problems get exacerbated, however, due to impacts of climate change. Several of problems of socio-economic inequities exist in most societies of the world. In developing countries, statistical averages of per capita availability of food and nutrition has been reasonably satisfactory but their inequitable access due to income inequalities, ineffectiveness in the implementation of safety net schemes (which include a substantial element of subsidy in staple foods for the poor), and weaker legal enforcement systems. Hunger is not necessarily due to a force of nature but of human institutional choice or default consequence. Conceding the prevalence of low quality policies and institutions, the question still remains: are the problems going to get worse as a result of adverse impacts of climatic changes, especially in the regions where the current problems are already bad enough that significant populations remain poor and vulnerable? The answer is yes. No doubt, beyond addressing climate change issues, *policies and institutions to enable more inclusive systems of societies will pave the way for meaningful sustainable development. Enabling policies for this purpose include institutional reforms (such as inclusion of rights and entitlements, and stakeholder participation in decision making), and efficient adaptation strategies to address adverse impacts of climatic changes.*

The following assertions are from a Copenhagen Declaration:

> More than one billion people in the world live in abject poverty . . . majority of whom are women. . .;. . .; More women than men live in absolute poverty . . . with serious consequences for women and their children. . .

However, these are not assertions of 2009 but those of the declarations of the 1995 Copenhagen Declaration on Social Development (World Summit for Social Development). The fact that most of the socio-economic problems remain largely unresolved is a pointer to the imperatives of an improved global economic order that reduces inequalities and pays attention to quality of life issues.

The critical question arises: how far did economic development progress during the past 25 years? The answer is disappointingly marginal, compared to the potential for better progress. A humane society can do better.

Nobel Laureate Thomas Schelling (1997, p. 14) concluded his paper on the cost of combating global warming with the following: "The need for greenhouse gas abatement cannot logically be separated from the developing world's need for immediate economic improvement. The trade-off should be faced. It probably won't be."

However, this is a viewpoint largely from production aspect rather than consumption aspect, and cannot hold good when viewed from an integrated view of developed and developing country roles nor from respective perceptions of long-term self-interests.

The focus has to be larger than global warming to cover environment, economy, and society in order to address the congruences and conflicts. Greater participation of stakeholders, including community-based organizations and non-governmental organizations, will offer cost-effective and pragmatic mechanism of policy design and implementation. An informed polity and active civic participation will devise better institutional environment and institutional arrangements in the interests of all on a sustainable basis, based on attention to ensuring resilience of the socio-economic and environmental systems, and avail mechanisms of adaptive learning.

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Glossary

Accession The act whereby a state accepts the offer or the opportunity to become a party to a treaty already negotiated and signed by other states. It has the same legal effect as ratification.

Adaptation Adjustments in natural or human systems in response to climatic changes.

Adaptive capacity The ability to adjust to climate change to cope with potential damages or take advantage of new opportunities.

Adoption The formal act by which the form and content of a proposed treaty text are established. As a general rule, the adoption of the text of a treaty takes place through the expression of the consent of the states participating in the treaty-making process.

Aerosols Extremely small particles of fine liquid or dust as gaseous suspensions in the atmosphere. Aerosols are classified as smoke, fumes, mist, and dust. Burning coal, for example, releases sulfur dioxide which in the atmosphere is transformed into sulfate aerosols.

Afforestation Establishing new forests and trees on unforested land. Afforestation of large areas of land can grow trees which will absorb and store carbon from the atmosphere could slow carbon dioxide buildup.

Agency maximand The internal goal-oriented objective (such as a department budget that provides greater resources for the staff working within the department) not necessarily related to the objectives of the existence and objective and substantial performance of the organizational entity.

Agreements The 1969 Vienna Convention on the Law of Treaties employs the term "international agreement" in its broadest sense. It employs the term "international agreements" for legal instruments, which do not meet its definition of "treaty".

Amicus curiae "Friend of the Court"; a person or entity allowed to present arguments of relevance on an issues or issues before a competent legal authority.

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Anthropocentric The viewpoint that humans are the central feature of planet earth, and that environment and ecology should be valued in terms their utility or lack of it for the humans.

Anthropogenic Caused or created by human beings.

Backstop technology A substitute technology, which becomes economically feasible when the price of a non-renewable natural resource has risen to a level (resulting from continued extraction).

Biodiversity The combination of different kinds of plant and animal species that live in a region. Biodiversity includes (a) genetic variability, and (b) the number of species. Biodiversity applies at three major levels: ecosystems, species, and genes. Biodiversity: "the genetic, taxonomic, and ecological variability among living organisms; this includes the variety and variability within species, between species, and of biotic components of ecosystems" (UNEP, 1992). According to the definition of the 1992 Convention on Biological Diversity (CBD), this is "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part".

Biophilia The innate tendency to support other forms of life and to affiliate with natural living systems; inherent human need to affiliate deeply and closely with the natural environment, especially its living organisms; this was seen as a part of human mental and emotional apparatus (many interesting details can be seen in Wilson, 1992).

Bioprospecting The use of biological materials in a pioneering way for commercial development of new crops or drugs and pharmaceuticals.

Biosphere The segments of the Earth and its atmospheric surroundings that can support life, in principle: the region on land, in the oceans, and in the atmosphere inhabited by living organisms.

Biota The collection of all living things, including plants and animals.

Biosphere The segments of the Earth and its atmospheric surroundings that can support life, in principle, the region on land, in the oceans, and in the atmosphere inhabited by living organisms.

Bycatch Animals and plants which are caught incidental to attempts to catch a "target species"; the collection of biotic species not necessarily intended with reference to the catch of a specific Species.

Climate variability Climate variability refers to variations in the mean state of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).

Convention The term "convention" can have both a generic and a specific meaning. Article 38 (1) (a) of the Statute of the International Court of Justice refers to "international conventions, whether general or particular" as a source of law, apart from international customary rules and general principles of international law and – as a secondary source – judicial decisions and the teachings of the most highly qualified publicists. This generic use of the term "convention" embraces all international agreements and is synonymous with the generic term "treaty".

Carbon budget The amount of carbon released into the atmosphere by net sources, whether natural factors, like dying plants, or human activities, like burning fossil fuel, minus the amount of carbon absorbed by the ocean, growing green plants and other carbon "sinks".

Carbon Equivalent (CE) A metric measure used to the emissions of the different greenhouse gases based on their global warming potential (GWP).

Carbon sequestration The uptake and storage of carbon trees and plants, for example, absorb carbon dioxide, the oxygen and store the carbon. Fossil fuels were at biomass and continue to store the carbon until burned carbon sinks. Carbon reservoirs and conditions store more carbon (carbon sequestration) than they release. Carbon sinks can serve to partially offset greenhouse gas emissions. Forests and oceans are common carbon sinks.

Chlorofluorocarbons (CFCs) A set of synthetic compounds belonging to the family of greenhouse gases used in air conditioning, as industrial solvents and in other commercial applications. CFCs destroy ozone in the stratosphere (see ozone), and are being eliminated under an international agreement negotiated in Montreal in 1987.

Climate The prevalent long term weather conditions in a particular area. Climatic elements include precipitation, temperature, humidity, sunshine and wind velocity and phenomena such as fog, frost, and hail storms. Climate deals not only with the atmosphere but also its variations.

Climate feedback A secondary process resulting from primary climate change which may increase (positive feedback) or diminish (negative feedback) the magnitude of climate change.

Convention The term "convention" can have both a generic and a specific meaning. Article 38 (1) (a) of the Statute of the International Court of Justice refers to "international conventions, whether general or particular" as one of the source of law.

Ecological footprint The average amounts of productive land and shallow sea appropriated by each person in bits and pieces from around the world for food, water, shelter, energy, commerce and waste absorption.

Ecology System of organisms and their interaction with the physical, chemical and biological characteristics associated with the system.

Ecosystem Dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (Article 2 of the CBD) a system of interdependent forms of life and their physical environment; this could be described at local regional or other demarcations of levels. This is the set of all life forms and their physical environment, including the entire set of interacting entities between them. Ecosystems are products of the interactions of all living and nonliving factors of the environment and the biosphere. The functioning of an ecosystem results in several interactions, and these lead to what is known as "balance of nature" at any given time.

Ecosystem services The flow of materials, energy and utilizable information from the biosphere that support human existence; these include the regulation of the atmosphere and climate; the retention of hydrological cycles and their stability; the purification and retention of fresh water; the formation and enrichment of soils; nutrient recycling; the recycling of wastes and chemicals; the pollination of crops; production of food, fiber, biomass and several others and their byproducts; and provision of intangible aesthetic and cultural benefits.

Endemic A species native to a specific location, occurring naturally in a specific region or a characterization of biogeophysical features; a species or a race native to a particular location.

Environment The physical, chemical, and biological surroundings of an organism or species.

Externality Uncompensated effect of economic, physical or other activity. An externality arises when production or consumption or other activities of an entity provides: (a) utility to the latter without paying for costs imposed on other entities, or (b) receives no compensation commensurate with the benefits provided to others.

Feedback mechanisms A mechanism that connects one aspect of a system to another. The connection can be amplifying (positive feedback) or moderating (negative feedback).

Flagship species An animal species that is applied as a reference to protect other species and ecosystems.

Free-rider The possibility of using goods/services without having to pay for the usage.

General equilibrium (economy) All markets in an economy are simultaneously in equilibrium, with balanced demand and supply, and prices do not vary.

Geosphere System comprising the soils, sediments, and rock layers of the Earth's crust, both continental and beneath the oceans; the mineral abiotic portion of the Earth.

Global commons The planet Earth's resources that are not under the jurisdiction or control of one or more specific countries; these include much of the oceans, space,

arctic and antarctic regions and all other resources at the global level that are not owned or regulated directly.

Incentive-compatible The responsiveness of an entity to the provision of incentives, usually with reference to one or more stated objectives of the system or its functions.

Jus cogens Preemptory norms of international law.

Like product Same or equivalent product, which should be treated equally or equivalently under the non-discrimination principles of "national treatment" and "most-favored-nation" treatment under WTO rules.

Market failure This is usually a reference to the feature that in competitive market situations, the market price of an item differs from its social cost (defined as the private cost plus environmental or other external costs or benefits). When the markets are imperfect or non-competitive the feature is automatically assumed to prevail.

Montreal protocol An international treaty signed in 1987 that limits production of chlorofluorocarbons. The discovery of an ozone hole over Antarctica prompted action to control the use of gases which have a destructive effect on the ozone layer. From this concern emerged the Montreal Protocol on substances that deplete the ozone layer. This is a 1987 Protocol on Ozone Depleting Substances, to the 1985 Vienna Convention on the Protection of the Ozone Layer, and came in to force in 1989.

Mitigation An intervention aimed at reducing the severity of climate change by controlling emissions of greenhouse gases and/or enhancing carbon sinks.

Most-favored-nation treatment (MFN) Treating all trading partners equally (GATT/ WTO rules).

National treatment Avoiding discrimination between "like products" that are made domestically and those that are imported (GATT/WTO rules).

Open access resource A material resource with no property right held by any individual or entity.

Ozone An unstable gas in which three molecules of oxygen occur together (O_3). Ozone is a greenhouse gas. In the atmosphere ozone occurs at two different altitudes. Low altitude tropospheric ozone is a form of air pollution (part of smog) produced by the emissions from cars and trucks. High in the atmosphere a thin layer of stratospheric ozone is naturally created by sunlight. This ozone layer shields the earth from dangerous (cancer-causing) ultraviolet radiation from the sun.

Ozone hole The Antarctic ozone hole was first detected in 1985 and is measured by a vertical column of ozone in the atmosphere in Dobson units. It was realized that this hole was being created by man-made substances such as CFC's.

Ozone layer The ozone in the stratosphere is very diffuse, occupying a region many kilometers in thickness, but is conventionally described as a layer to aid understanding.

Pareto improvement A reallocation of resources which leads to improving welfare of some without worsening welfare of others (named after Vilfredo Pareto (1848–1923)).

Pareto optimum This is claimed to have been attained by an economy when resources and output cannot be reallocated in a Pareto improvement sense.

Phenology The branch of science dealing with the relationship between climate and periodic biological phenomena related to or affected by climatic factors, like bird migration or plant flowering.

Pigouvian taxes These due to the author Arthur C. Pigou of 1930s, refer to taxes or equivalent penalties and charges assessed as required to correct for externalities caused by economic agents or producers-polluters.

Polluter Pays Principle (PPP) This was first officialized by the OECD in 1975, and represents an allocation of property rights on the environmental assets to consumers making producer-polluters pay the difference between the social costs and private costs of provision goods and services.

Precautionary Principle (PP) "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (Principle 15 of the 1992 Rio Declaration).

Protocol This term is used for agreements less formal than those entitled "treaty" or "convention".

Public goods The goods that exhibit both consumption indivisibilities and non-excludability, combine the features, respectively: once the resource is provided, even those who do not pay for it cannot be excluded from the benefits they confer; and, one person's consumption of the good does not diminish the amount available for others.

Ratification Ratification defines the international act whereby a state indicates its consent to be bound to a treaty if the parties intended to show their consent by such an act.

Res communis Assets of global common interest but not amenable to state sovereign control.

Resilience The ability of a system to restore itself in response to internal/external disturbances, without changing its own original state.

Res nullius Open access property; resources that are not in the possession of an entity of legal existence with any rights of exclusion of the usage of these resource by any party.

Sequester To remove or segregate. Activities, such as planting trees, remove carbon dioxide from the atmosphere, and thus sequester carbon dioxide.

Sink A reservoir of any medium which assimilates or absorbs pollutants, and thus it uptakes a pollutant from a part of the atmospheric cycle. Soil and trees tend to act as natural sinks. For example, the oceans absorb about 50% of the carbon dioxide released into the atmosphere. Oceans and forests function as carbon dioxide sinks.

Standard Specifications approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for products or related processes and production methods, with which compliance is not mandatory. It may also include or deal exclusively with terminology, symbols, packaging, marking or labeling requirements as they apply to a product, process or production method.

Stare decisis The principle that a judicial body should follow its own previous decisions and those of similar or greater authority.

Stress This is the result of an environmental change that reduces the survival fitness of an organism. This is usually governed by a nonlinear relationship between the influences and fitness.

Sustainability The phenomenon of being able to continue to maintain a resource or process without limitations of extinction or inaccessibility over time and space.

Threshold limits The limits of factors beyond which growth and equilibrium/stability of populations, or other survival features of life forms and organisms, are likely to be adversely affected. These limits constitute critical levels for species survival.

Transaction costs The total (financial and economic) costs of undertaking a transaction, usually excluding direct production or other price-based costs. Typically, these costs include costs of obtaining and processing relevant information, monitoring and assessment of appropriate parameters in connection with the design and implementation of a policy or program, and other costs of pursuing a specific action.

Treaty The 1969 Vienna Convention (Article 2(1) (a)) defines a treaty as "an international agreement concluded between States in written form and governed by international law, whether embodied in a single or more related instruments. In order to speak of a "treaty" in the generic sense, an instrument has to meet various criteria: (a) it has to be a binding instrument, which means that the contracting parties intended to create legal rights and duties; (b) the instrument must be concluded by states or international organizations with treaty-making power; and (c) it has to be governed by international law.

Index