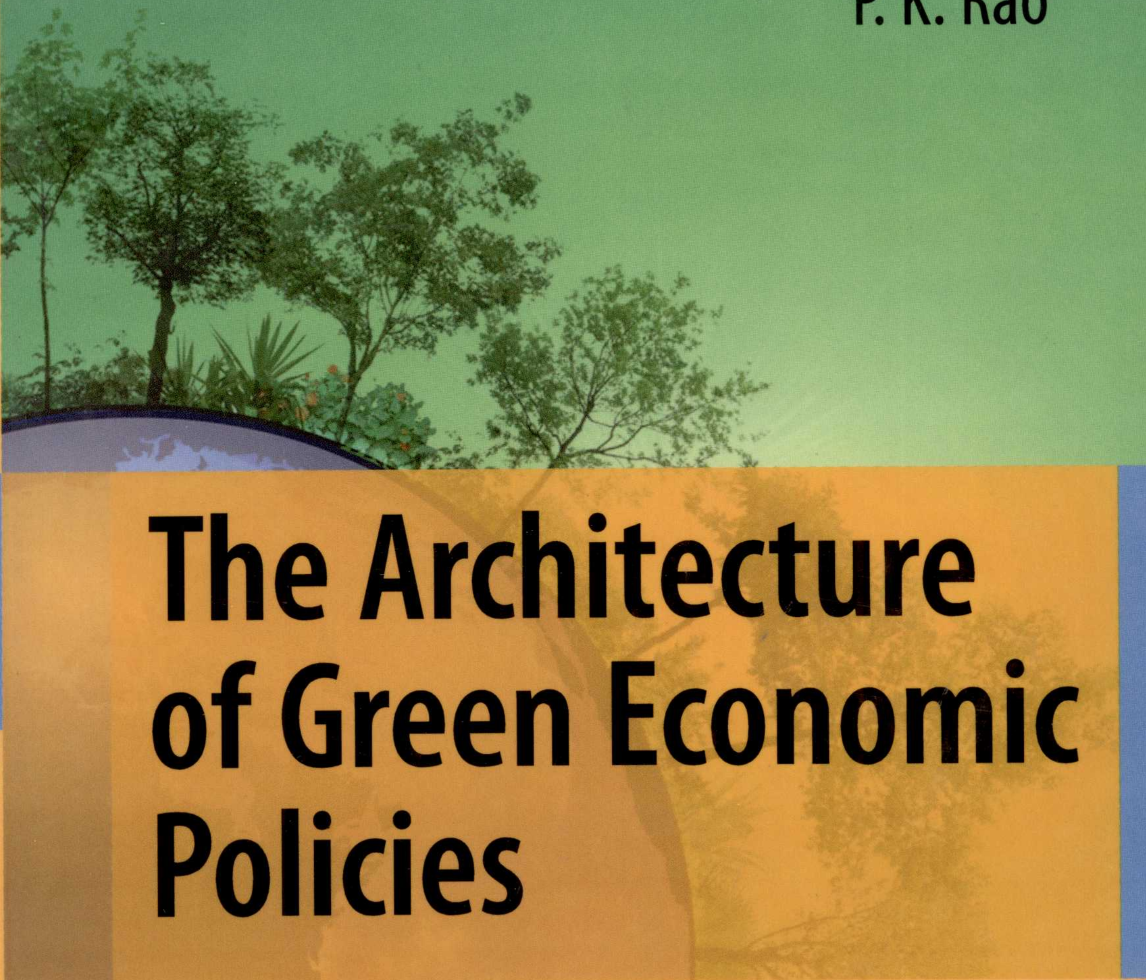
P. K. Rao



The Architecture of Green Economic Policies

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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

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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