Article

Paradigms of global climate change and sustainable development: Issues and related policies

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Abstract

Combating climate change is intimately linked with peace and resource equity. Therefore, critical link establishment between climate change and sustainable development is extremely relevant in global scenario. Following the 1992 Earth Summit in Rio, the international sustainable development agenda was taken up by the UN Commission on Sustainable Development (CSD); the climate change agenda was carried forward by the UN Framework Convention on Climate Change (UNFCCC). International and local climate change mitigation policies need to be assessed based on sustainability criteria. The increasing concern over climate change drives towards the search of solutions enabling to combat climate change into broader context of sustainable development. The core element of sustainable development is the integration of economic, social and environmental concerns in policy-making. Therefore, article also analyzes post-Kyoto climate change mitigation regimes and their impact on sustainable development. Wide range of post- Kyoto climate change mitigation architectures has different impact on different groups of countries. Nevertheless, there are several reasons for optimism that sustainable consumption patterns might develop. One is the diversity of current consumption patterns and the growing minority concerned with ethical consumption. Another is the growing understanding of innovation processes, developed to address technological change, but applicable to social innovation. A third reason is the growing reflexivity of communities and institutions.

Keywords sustainable development; global climate change; policies; indigenous technologies; civil conflict.

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1 Introduction

Global environmental change in current Anthropocene era has been the outcome of globalization, urbanization and population expansion. Land-use change, management practices, pollution and human demography shifts are all drivers of environmental/climate change either directly or indirectly (Zhang et al., 2006; Zhang and Zhang, 2007; Rosenzweig et al., 2008; Zhang, 2007, 2008; Sharma et al., 2011; Zhang and Chen, 2011; Zhang

et al., 2011; Ballestores and Qiu, 2012; Enti-Brown S et al., 2012; Sayadi et al., 2012; Wu and Zhang, 2012). The carbon dioxide content of the atmosphere, largely a consequence of the burning of fossil fuels such as coal, wood, and oil and gas, has increased nearly 30 percent since the start of the industrial revolution, a trend which follows the upward growth in global population (Mcbeath, 2003). Melting of glaciers, shrinking of sea ice extent in the Arctic Ocean including the Bering Sea, and thawing of permafrost in Alaska, Canada, and Siberia are obvious impacts which has been observed from time to time (Weller and Anderson, 1998; Mcbeath, 2003).

The popularity of former U.S. Vice President Al Gore's Oscar-winning documentary, An Inconvenient Truth (2006), is merely the most obvious current in the climate of opinion on climate. If the views of the Intergovernmental Panel on Climate Change (IPCC) are an accurate measure of world scientific thought, then the majority of scientists believe that anthropogenic global warming has either already begun or will become manifest in the very near future, with average global temperatures predicted to rise by 1.5-4.5°C by the middle of next century (IPCC, 1990; Ridgley, 1996). Despite an incomplete understanding of the processes at work, there is considerable agreement that this warming will be the result of increased releases and atmospheric accumulation, since the industrial revolution, of carbon dioxide (CO_2), nitrous oxide (N_20), methane (CH_4) and chlorofluorocarbons (CFCs) the primary greenhouse gases (GHGs). Anticipation in some quarters of a host of negative consequences of such warming has led to ever louder calls to initiate strong policy actions to curtail GHG emissions (Wirth and Lashof, 1990).

Changes related to regional warming have been documented primarily in terrestrial biological systems, the cryosphere and hydrologic systems; significant changes related to warming have also been studied in coastal processes, marine and freshwater biological systems, and agriculture and forestry (Rosenzweig et al., 2008). Responses in physical systems include shrinking glaciers in every continent melting permafrost shifts in the spring peak of river discharge associated with earlier snowmelt lake and river warming with effects on thermal stratification, chemistry and freshwater organisms, and increases in coastal erosion. Further, in biological systems, changes include shifts in spring events (for example, leaf unfolding, blooming date, migration and time of reproduction), species distributions and community structure (Rosenzweig et al., 2008).

As far as human health is concerned the World Health Organisation estimates that the warming and precipitation trends due to anthropogenic climate change of the past 30 years already claimed over 150,000 lives annually (Patz et al., 2005). Many prevalent human diseases are linked to climate fluctuations, from cardiovascular mortality and respiratory illnesses due to heat-waves, to altered transmission of infectious diseases and malnutrition from crop failures. Shope (1991**)** proposed the hypothesis that global climate change might result in a worldwide increase of zoonotic infectious diseases. Patz et al. (1996, 2005) further contributed in this direction. The IPCC (See Confalonieri et al., 2007) has mentioned a plethora of adverse effects of climate change to stress its impact on human health. In synergism with climate change, other important factors that trigger the emergence/re-emergence of infectious diseases include population growth, migration, urbanization, international trade, poor socioeconomic conditions, famine, war, loss of biodiversity, deforestation, and land use change (Zell et al., 2008). All together, these factors have an impact on human and animal health even though the contribution of each factor is difficult to quantitate (Reiter, 2001; Zell et al., 2008). Directly or indirectly, these factors either increase exposure of humans to pathogens or pose the societal problem to assure high levels of hygiene (Taubes, 1997; Zell et al., 2008). Hence, several important viruses emerged independently of climate change, for example SARS virus, Nipah virus, Hendra virus, and the highly pathogenic avian influenza H5N1 virus (Zell et al., 2008). Dependence of a pathogen on an arthropod vector may further increase the complexity by characteristics of the vector biology. The articles in the special issue of the *American Journal of Preventive Medicine* reflect a growing engagement of health professionals in addressing the challenge of climate change (Ebi and Semenza, 2008; Gage et al., 2008; Patz et al., 2008; Keim,

2008; Luber and McGeehin, 2008; Maibach et al., 2008; St. Louis and Hess, 2008; Semenza et al., 2008; Hess et al., 2008; Kinney, 2008; Younger et al., 2008).

The most adverse impacts are predicted in the developing world because of geographic exposure, reliance on climate sensitive sectors, low incomes, and weak adaptive capacity. Socio-economic impacts, though generally not well understood, are likely to be profound and will impact humans through a variety of direct and indirect pathways (Stern, 2006; IPCC, 2007; Cline, 2007). Further, the role of globalization in addressing the problems of poverty and inequality is not clear (Wade, 2004). One school of thought (Dollar and Kraay, 2002; Wolfensohn, 2001; World Bank, 2002) opined that the current wave of globalization, which started around 1980, has actually promoted economic equality and reduced poverty, whereas, according to other globalization has dramatically increased inequality between and within nations' (Mazur, 2000). Moreover, the indirect risks are often hard to predict but could have the worst impacts.

Aforesaid alarming concerns provoked the politics of its origin among developed, poor, and developing countries.

2 Politics of Global Climate Change (GCC)

Before going into the details of politics pertaining to GCC, I will discuss the twin concept i.e. conquest of nature and social by human beings in current Anthropocene. The twin conquests-however imperfect, incomplete, and ultimately illusory-of the natural and the social have ushered in an anti-Hobbesian world (Lie, 2007).

(1) *Conquest of Nature*. Scientific and technological advances have largely tamed the natural and the wild in the West as well as elsewhere. Rather than being divine, supernatural, or simply natural forces beyond human control-lodged traditionally in the cognitive realms of myth, folklore, and religion-nature is seen as being intelligible, predictable, and ultimately controllable (Thomas, 1983; Dear, 2006). Even if God-like control is unattainable-and the very idea of the conquest of nature is hubris-a deeply optimistic strain in the scientific mindset envisions nature as increasingly colonized and controlled by human conceptual inventions and technological interventions.

(2) *The Conquest of the Social Dimension*. The same modern West that has struggled to colonize nature has simultaneously sought to order the human world. Through the social sciences (with their traditional aspiration to match the epistemological gravity of the natural sciences) and their associated policy instruments, the social, political, and economic domains have become both understandable and potentially controllable. At least in the twentieth century, Keynesian and post-Keynesian instruments of economic, social, and welfare policy seem to have mitigated the prospects for sudden and massive social dislocation on the order of the Great Depression of the 1930s. While such instruments have by no means eliminated social risk, and in some cases have actually amplified the vicissitudes of individual life, they have at least established a level of ambient socioeconomic predictability and regularity that circumscribes the possibility of large scale dislocation for gross swaths of the population.

Since the time immemorial early in 1651, Thomas Hobbes's Leviathan famously described the state of nature for human beings as ''solitary, poor, nasty, brutish, and short.'' Without a strong government, people were bound to live under ''continual fear and danger of violent death'' (Hobbes 1651/1994, p. 76). Three centuries later, the state of the world, at least in the affluent West, evinces relative stability and predictability. Rather than fearing violent death, whether from famines, diseases, or wars, most citizens in the West expect a life of plenty and lead relatively healthy and peaceful lives. However, as late as 1900, the average life expectancy in the USA was 47 years; by 2004, it had increased to 77 (Brym and Lie, 2006). In short, human life in the contemporary West is no longer ''nasty, brutish, and short'' but rather ''nice, safe, and long.'' We

live in a counter- Hobbesian universe.

The dominant opinion in the West is that GCC is a fact of life and that we-in actuality, the elected representatives and the associated machinery of governance-should do something about it. Given that weather-induced disasters are at once normal in the sense of statistical frequency and unpredictable, heat waves, cold spells, hurricanes, tornadoes, and other awesome displays of unruly nature will happen here, there, and everywhere. Because we find nature more or less intelligible and controllable in principle, we have come to believe that we should be able to anticipate and prevent ‘‘predictable’’ disasters. Popular outrage will be greater in direct relation to past failures to tame predictable changes and disasters. An initial failure may be forgiven, but the public is unlikely to accept a second or third failure. Simultaneously, each disaster will be ‘‘experienced’’ by a larger number of people through the global mass media and will strike greater terror in the population precisely because of the counter-Hobbesian character of our lives.

The combination of the politics of care with instant access to news from the other side of the world, the expectation that we can ‘‘do something’’ covers a greater group of people, even outside of the locality and the country. Thus, conventional wisdom in the West today is that injustice, rather than suffering, is at the heart of GCC induced disasters and, indeed, of all forms of disaster. A compelling reason for this view is the recognition that risk and exposure to risk constitutes a major mode of inequality or asymmetry in social life (Beck, 1986). While the metaphysical and meta-human character of an eighteenth century earthquake did not lead observers to remark on the preponderance of the poor and the marginalized among the dead and the maimed, few could completely escape the sociological conclusion that the relatively poor and the socially marginalized were disproportionately represented among the list of dead and injured people in a contemporary earthquake like Kobe’s. Again, the extensive commentary on Hurricane Katrina frequently cited the ‘‘unfair’’ nature of the damage in terms of the poor and the minority as the primary victims (Lie, 2006). What renders the current situation especially problematic is that the modern state is everywhere facing limits to its welfare capacity. Even when infrastructural renewal is mandated, it becomes ever more difficult to pay for grand projects or even petty repairs. Often, the limits on welfare capacity are at least as much political as fiscal: the march of popular democracy ironically makes it more difficult to take preventive measures against predictable (and unpredictable) changes and disasters. Whereas technocratic elite may make cool calculations of aggregate benefits and costs, an unruly electorate and its putative representatives are often swayed by selfish or short-term incentives, such as lower taxes for voters and campaign contributions for politicians. Political authorities in highly democratic polities consequently may have diminished capacity for infrastructural development to prepare for or react to GCC induced disasters. Therefore, climate-induced disasters in particular and natural disasters in general may very well contribute to the legitimation crisis of the state (Habermas, 1973).

In developing countries explosive population growth may lead to economic crisis, natural resource depletion, increased ecological footprint and other factors which an integrated way result in perturbing the peace. Hegre and Raleigh (2007) discussed thoroughly the effect of population concentration in disaggregated armed conflict studies. However, Buhaug and Rød (2006) found that population density was neither a statistically significant predictor of conflicts over government nor of conflicts over territory in a study of Sub-Saharan Africa using a similar design as this study.

With an increasing focus on environmental consequences of climate change, speculations about how GCC may eventually influence patterns of war and peace have arisen (Brauch, 2002; Homer-Dixon and Blitt, 1998; Klare, 2001; Pervis and Busby, 2004; Rahman, 1999; Renner, 1996; Schwartz and Randall, 2003; Raleigh and Urdal, 2007). Climate change is expected to bring about major change in freshwater availability, the productive capacity of soils, and in patterns of human settlement (Raleigh and Urdal, 2007). Fearon and Laitin (2003) and Collier and Hoeffler (2004) argued that poverty increases the likelihood of war since poor states

have a much weaker financial and bureaucratic basis, providing opportunity for insurgency. They further mentioned that ethnic, religious and cultural diversity contribute little in the direction of armed conflict. However, other school of thought (Hegre et al., 2001) insisted that ethnic as well as religious diversity also play a pivotal role in destruction of peace. In order to address the issue that up to what extent climate change poses a traditional security threat, Raleigh and Urdal (2007) build on propositions from the environmental security literature, identifying potential links between natural resource scarcity and violent conflict. They combined these propositions with environmental change scenarios from the Intergovernmental Panel on Climate Change (IPCC, 1990), and developed testable hypotheses about the expected relationships. These hypotheses were tested in a statistical model with a global coverage.

Further, internationally, GCC is likely to figure as a focal point in international tensions and conflicts. This is true in at least three ways. The first is the politics of blame. In an effort to combat GCC and its obvious cause, carbon emission, the powerful countries are likely to shift the blame outside of the country. Particularly, in recent past they imposed it on developing countries like India. Here the most likely victims of the blame game are the less developed countries. Most importantly, the West will overlook its own history of carbon-emitting behaviour and lay the blame of accelerating GCC on China, India, and other rapidly developing economies.

Secondly, there will be enhanced competition for natural resources. GCC-induced changes are likely to highlight the insecurity of natural resources that the affluent West has come to take for granted. For example, the struggle over water may become more intense than the struggle over oil. In the light of predicted water scarcity due to impact of GCC, water researchers, managers and policy makers are now predicting about the next world war for water itself. The Australian drought of 2006 may be a forerunner. Territorial nationalism and traditional land disputes will persist and even take on greater political import because of enhanced competition for natural resources. Additionally, the anticipated fear and terror associated with GCC may provoke terrorist organizations to target ‘‘nature’’, thereby bringing about a more Hobbesian world. The targets may very well revolve around natural resources. Disrupting the water supply-in times of extended drought-or electricity generation-imagine a lack of air conditioning in U.S. Sunbelt cities in the summer-would have profound impact on everyday life in the West. In terms of the sciences, we will most likely see an increased politicization of and intervention in, scientific activities. In the manner of patient activism in medical research, outsider intellectuals and activists will seek to intervene in scientific discussions. Nineteenth century social-science disciplines-with their privileging of the pure and neglect of the applied—and their reluctance to engage in interdisciplinary research (especially across the categorical chasm between the natural and the social) will seem increasingly obsolete and irrelevant.

From the aforesaid discussion, it is clear that GCC may well turn out to be the proverbial tip of an iceberg that contains a multitude of natural and social threats to the way we live now. Real icebergs may be melting, but metaphorical ones are multiplying around the world.

3 Critical Linkage between GCC and Sustainable Development

Following the 1992 Earth Summit in Rio, the international sustainable development agenda was taken up by the UN Commission on Sustainable Development (CSD); the climate change agenda was carried forward by the UN Framework Convention on Climate Change (UNFCCC). The cultures of UNCSD and UNFCCC are remarkably different. The CSD mostly deals in broad principles, seeking to address the tensions among the three major thrusts of the sustainable development discourse: towards economic, environmental and social sustainability. It devotes a considerable amount of its time to stakeholder dialogue, where businesses, NGOs, trades unions and others present their positions.

The term sustainability belongs originally to the field of ecology, referring to an ecosystem's potential for subsisting over time, with almost no alteration. When the idea of development was added, the concept would no longer be looked at from the point of view of the environment, but from that of society (Reboratti, 1999) and the capital economy. The concept of Sustainable Development is also articulated as a discourse of ethics, which specifies human conduct with regard to good and evil (Acselrad, 1999). Our Common Future concludes that, ''human survival and well-being could depend on success in elevating sustainable development to a global ethics'' (WCED, 1987). The Earth Charter (2001) states that, ''we urgently need a shared vision of basic values to provide an ethical foundation for the emerging world community. Therefore, together in hope we affirm the following interdependent principles for a sustainable way of life as a common standard by which the conduct of all individuals, organizations, businesses, governments, and transnational institutions is to be guided and assessed.''

Although there is no single agreed-upon definition of Sustainable Development, virtually all definitions conceive of the principal in terms of a tension between the goals of economic development and environmental protection, with a preference for the goals of economic growth (Geisinger, 1999). The language of the principal itself, as defined by the Brundtland Commission is instructive: ''Development involves a progressive transformation of economy and society''.

On the whole, climate change analysis and policy has been dominated by economic thinking, narrowly focused on cost-effective responses to climate change (Cohen et al., 1998). The debate is mainly confined to two of the three realms of sustainable development: economic and environmental. The social sustainability agenda is largely sidelined.

The UNCSD and the UNFCCC approaches are complementary; both are important. But the two discourse communities do not learn enough from each other, despite the fact that many people participate in both. More dialogue is needed:

- To address the concerns of many parties to the UNFCCC about development, equity and sustainability (DES).
- To develop synergies between climate policies and the broader sustainable development agenda.
- To explore whether the two communities could learn from each other's experience, to develop more effective and feasible policies.

In the industrialised countries, the fastest growing causes of environmental damage and resource use are directly linked to households, lifestyles and consumption. Between 1971 and 1995 in industrialised countries, CO_2 emissions from the industrial sector fell by 9%, while emissions from building use grew by 22% and emissions from transport grew 65% (Price et al., 1998). Industry, including power generation, in many OECD member countries was successful in reducing its emissions of SO_x and heavy metals, its generation of waste and its water consumption, but energy use and material throughput in the economy overall grew, with municipal waste generation and water consumption keeping pace with GDP (OECD, 1998; Rai, 2008a, b; Rai, 2009).

Surveys of public attitudes show a widespread view that action is needed to address environmental concerns. Attitudes vary on roles of government and other actors, and on the relative contribution of technology and lifestyle changes. Those who view lifestyle change as necessary and desirable also expect changes in technology (Kasemir et al., 2000). However, among respondents who say that lifestyle changes are unnecessary or infeasible, one of the common rationales is that technology will supply the necessary reductions in environmental load (Kempton et al., 1995; Stoll-Kleemann et al., 2001).

Furthermore, many scenario builders have explored the potential for a sustainable future, often contrasting scenarios involving rapid technological change with those involving major shifts in values and lifestyles

(Banister and Stead, 1999; Green and Vergragt, 2002; Nakicenovic and Swart, 2000). They draw on extensive quantitative research to support their estimates of the technological potential, but assumptions about lifestyle changes are usually unsupported guesses. Nevertheless, the scenario exercises usually conclude that a combination of technological and lifestyle changes will be required.

The best quantification of the technological potential, and of the need for change, has been carried out for GHG mitigation. Findings from this research base are sometimes extrapolated to other environmental and resource concerns. In particular, CO_2 stabilisation scenarios published by the IPCC (Wigley et al., 1997) provide the quantitative foundation of calls for industrialised countries to strive for a "Factor 10" reduction in resource intensity over the next 30–50 years. Resource use would be cut by a factor of five, while the economy doubles in size. This aim has found considerable support in some government and business circles, including discussions at the UNCSD and the Organisation for Economic Co-operation and Development (OECD). Publications such as *Factor Four* (von Weizsäcker et al., 1997) and *Natural Capitalism* (Hawken et al., 1999) have also encouraged a hope that technology might deliver resource savings without lifestyle changes. However, a review of historical rates of change in resource productivity, in a variety of countries, sectors, and economic and political circumstances, suggests that technology could deliver at most only about half of the Factor 10 target (Michaelis, 1998). Even this would require a radical shift in government policies and public priorities, which would also force changes in lifestyles.

Everyday life is profoundly intertwined with technology (Røpke, 2001); both technology and behaviour are embedded in culture and social systems and they cannot change independently, either from each other or from other aspects of those systems. In practice, technological change usually goes hand-in-hand with changes in behaviour. The larger the technological change, the greater the attendant shift in consumption patterns and markets (Freeman, 1990; OECD, 1998).

While the argument for lifestyle changes for GHG stabilisation seems clear, local air and water pollution can probably be addressed through cleaner technology. On the other hand, lifestyle changes may be required in response to other intractable environmental problems. These include the disappearance and disruption of natural habitats, the related loss of biodiversity, and increasing competition for fresh water.

Three areas of consumption are responsible for the majority of GHG emissions, water consumption and land use in industrialised countries. These are food, housing and personal travel. One study in the US found that these three aspects of lifestyle accounted for 85% of water use, 80% of GHG emissions and 87% of land use (Brower and Leon, 1999). In European studies, Spangenberg and Lorek (2002) and Vringer and Blok (1995) similarly found that food, travel and housing dominate material and energy use.

Several indicators have been developed to evaluate the total impact of a given lifestyle, in particular, within discussions about fair shares of the world's resources and carrying capacity. One of the most popular is the "ecological footprint", which offers an indication of the land required to maintain a given lifestyle on a sustainable basis, including either the provision of renewable energy or the hypothetical planting of trees to absorb CO_2 emissions from fossil fuel use (Wackernagel and Rees, 1996). For individual lifestyles or specific goods and services, footprint calculations may be based on lifecycle (engineering) analysis of products and services consumed, or on input–output (economic) analysis, to calculate indirect impacts. Regional and national footprints are calculated on the basis of aggregate energy and material flow statistics and estimates.

Some studies find that the global footprint per capita exceeds the "biocapacity" (maximum availability of productive land world-wide) of 1.9 ha per capita by about 20% (Wackernagel et al., 2002). The average per capita footprint in OECD member countries is 5.8 ha compared with 1.5 ha for non-OECD countries (Wackernagel et al., 2002). Such estimates affirm the view that citizens in industrialised countries are consuming more than their share of the world's resources.

Some of the largest differences between north and south are in the most environmentally damaging types of consumption. Car ownership is 25 times higher in the north than in the south (UNDP, 1998). Residential electricity use is 11 times higher (IEA, 1997). Meat consumption is only 3 times higher (FAOSTAT, 2002)—but so is TV ownership (UNESCO, 1998). Increasing access to TV globally means that there is now near universal awareness of a portrayed lifestyle ideal. Young people around the world aspire to the Western model of an upper middle class lifestyle (Wilk, 1998).

The average consumption data cited here hide huge variations between and within countries. Myers (1999) draws attention to the growing consumption of the middle classes in developing countries, and poverty in industrialised countries is also a major problem. But while increasing consumption in the south will begin to rival that of the north in coming decades, the wealthier citizens of industrialised countries continue to set the global trend for lifestyles and consumption.

4 Post Kyoto Mitigation Approaches: Issues of Sustainability

The increasing concern over GCC drives towards the search of solutions enabling to combat climate change into broader context of sustainable development. The core element of sustainable development is the integration of economic, social and environmental concerns in policy-making. Applying this mode of thinking-seeing GCC through a sustainable development prism-is the only way in tackling the climate change and sharing efforts among countries. The question of binding commitments for GHG emission reductions is a difficult topic complicated by sometimes opposing issues of equity, efficiency, and development. A plethora of post-Kyoto climate change mitigation architectures have been put forward (Soltau, 2006).

The possible post-Kyoto climate change mitigation architectures can be grouped into eight types of commitments countries could adopt in the future (Olmstead, 2005)

(1) Binding absolute emission reduction targets.
(2) Flexible emission targets (non binding, positively binding, dual targets, price caps).
(3) Enhanced coordinated technology RD&D efforts.
(4) Coordinated policies and measures (technology standards, taxes, menu of policies).
(5) Mandatory financial contributions to funds, technology transfer.
(6) Greening of investment flows (e.g. export credit agencies).
(7) Sustainable development policies and measures.
(8) Enhanced participation in an extended clean development mechanism.

In existing scenario, future international climate regimes will be evaluated based on their impact on sustainable development. The environmental, economic, social and political criteria will be applied to rate and to rank future climate change mitigation architectures. The rating will be based on score system. As the different post-Kyoto climate change mitigation architectures have different impact on different groups of countries, the countries will be grouped into several groups: (EU and other Annex-I countries, USA, Advanced Developing Countries and Least Developed Countries) and post-Kyoto architectures will be evaluated based on scoring according economical, environmental, social and political criteria. The scoring will be applied for each group of countries. The best architectures or having highest positive impact on sustainable development would be ranked according highest scores obtained for all criteria and for all groups of countries.

Each climate change mitigation architecture employs one or more international policy mechanisms to achieve goal of reduced GHG emissions, but under most proposals, individual participating countries would have wide latitude in choosing domestic policies to meet their particular national emissions reduction commitment. Therefore the main post-Kyoto architectures can be described in the following way (Olmstead, 2005):

-Targets and timetables: Specific emissions targets are imposed on each participating country over a certain period. These proposals almost always include flexibility mechanisms, such as emissions trading.

-Harmonized domestic policies and measures: The focus is on specific national level policy actions, without defining emissions targets. A coordinated carbon tax collected by each national government would be an example of this.

-Resource transfer from developed countries to developing: Mandatory technology and financial flows are mobilized from industrialized to developing countries.

-Sustainable development policies in developing countries.

- Implementation of sustainable development policies in developing countries. The extended clean development mechanisms can be used as a good tool to implement sustainable development policies in developing countries.

Alternatively, countries could take on flexible emission targets, including the following options (German Federal Environmental Agency, 2005):

- Non-binding emission targets, meaning that not reaching them has no consequences. Here emission trading could not be applied.

-‘‘Positively binding’’ emission targets, meaning that additional emission rights can be sold, if the target is reached, but no additional emission rights have to be bought, if no rights have been sold and the target is still not met.

-‘‘Dual’’ targets, meaning that two targets are defined, a ‘‘selling target’’, below which emission rights can be sold, and a ‘‘buying target’’, above which emission rights have to be bought.

-‘‘Price cap’’, meaning that an unlimited number of additional emission rights is provided at a given maximum price.

-Dynamic targets, meaning that targets are expressed as dynamic variables as a function of the GDP (‘‘intensity targets’’) or variables of physical production (e.g. emissions per tonne of steel produced).

Another type of climate change mitigation architecture would be to enhance and coordinate technology research, development and deployment efforts. Such activities would influence the development of new technology that will be needed to reduce emissions in the long-term. As another alternative, countries could agree on coordinated policies and measures such as technology standards or taxes on the emission of greenhouse gases. In the negotiations toward Kyoto, harmonized policies and measures were rejected by many countries, because they were seen as prescriptive and leaving less flexibility to the countries compared to emission reduction targets.

Similarly, resource transfer from developed to developing countries can also be credible climate change mitigation architecture. One option of this type of architecture would be mandatory contributions to funds and technology transfer. Such funds would finance emissions reduction projects or adaptation activities. A second option for commitments for developed countries that aim at limiting emissions in developing countries would be the ‘‘greening of investment flows’’. These are those flows of resources that are currently transferred from developed to developing countries through development banks and export credit agencies.

The last climate change mitigation architecture is based on the commitment of developing countries to adopt sustainable development policies and measures. In this approach, development objectives are formulated first. In a second step, it is considered how climate policies can support these development goals. This approach is very attractive to developing countries as it focuses on their main concern of sustainable development. Another option in this type of architecture for developing countries could be to participate in an enhanced CDM, which would allow sectoral government programmes to be eligible CDM projects.

Further, very important issue in post-Kyoto climate change mitigation architectures is participation of

developing countries. The future climate architectures include five basic degrees of developing country participation (Muller, 2003):

-None: No policy requirements and no emission reductions are imposed on developing countries, although they may receive low-carbon technology or financial aid from industrialized countries. The first commitment period of the Kyoto Protocol is an example.

-Voluntary: Developing countries can choose whether to undertake commitments or not, with the expectation that some might do so.

-Differentiated: Developing countries have requirements, but they are different from those of industrialized nations over the entire time frame of the proposal.

-Conditional: Countries take on graduated requirements as they meet certain conditions, such as a level of per capita gross domestic product (GDP) or emissions.

-Full: The proposal does not have different requirements for countries classified as developing or industrialized.

When referring to ‘‘continuing Kyoto’’ or ‘‘increasing participation’’, often the key features of the Kyoto Protocol are meant, which include (World Resource Institute, 2002):

-Maintaining two groups of countries, Annex-I and Non- Annex-I, assuming that gradually countries move into Annex-I.

-Binding absolute emissions reduction targets for Annex I countries for a basket of greenhouse gases.

-Flexibility through Kyoto mechanisms, such as emissions trading (ET), joint implementation (JI) and the clean development mechanism (CDM).

The main climate change mitigation policies including local and international consist of energy and carbon taxes, removal of subsidies on fossil fuels, emission trading schemes, subsidies to low carbon energy options including renewable energy sources and energy efficiency measures, regulations and standards, voluntary agreements and information and awareness. Based on results of WEC ‘‘Energy and Climate Change Study’’ the evaluation of climate change mitigation measures implemented Baltic States according to 3 dimensions of sustainable energy development (acceptability, availability and accessibility) will be performed. The evaluation is carried out on scoring for each criteria of each policy measure on a scale of 1 to 5, with 1 representing the lowest assessment and 5 the highest:

5-The impact of climate change mitigation instrument on acceptability, availability and accessibility is very positive.

4-The impact of climate change mitigation instrument on acceptability, availability and accessibility is good.

3-The impact of climate change mitigation instrument on acceptability, availability and accessibility is poor.

2-The impact of climate change mitigation instrument on acceptability, availability and accessibility is week.

1-The impact of climate change mitigation instrument on acceptability, availability and accessibility is negative.

The main approaches of post-Kyoto commitment schemes widely discussed in scientific literature and political documents are based on targets and timetables except the commitment of human development with low emissions. The following schemes will be further evaluated based on sustainability criteria described above:

-Continuing Kyoto by accepting biding absolute emission reduction targets.

-Multi-stage approach assuming that countries gradually move through several stages in between

Annex-I and non-Annex I countries with respect to increasing stringency.

-Contraction and convergence approach means that all countries would agree on a global target of stable concentrations of CO_2 in the atmosphere and they would also agree on a path of yearly global emissions that lead to that concentration level and the global emission limit will be shared among all countries so that per capita emissions converge by a specific date.

-Multi-sector convergence approach applies the principle of converging per capita emissions to emissions of individual sectors and not on the national level.

-Brazilian proposal is based on the method to share emission reductions amongst countries according to the impact of their historical emissions on the surface temperature change and to share responsibilities proportionally to their historical contributions.

-Triptych approach is a method to share emission allowances among group of countries based on sectoral considerations including the power sector, energy intensive industries and the domestic sectors.

-Commitment to human development with low emissions approach draws a line between basic and luxury goods of human beings basic needs and associated emissions.

5 Conclusions and Recommendations

In the light of all these discussion we can suggest under mentioned points to be addressed appropriately:

(1) The core tenet of sustainable energy development is the integration of economic, social and environmental concerns in energy policy making. Applying this mode of thinking-seeing climate change through a sustainable energy development lens could help in tackling the climate change mitigation in harmonized way with other policies targeting sustainable energy development targets, achieve synergies in these policies and ensure that proposed climate change mitigation regimes would have positive impact on sustainable energy development.

(2) The policy makers need to select the best climate change mitigation tool based on several criteria of sustainable energy development encompassing economic, social and environmental one. When policy-makers are asked to choose the instruments for climate change mitigation they have to find a solution that gives the best outcome in terms of sustainability. Multiple criteria decision analysis allows to select the best policy tool and ensure the synergy in policies aiming climate change mitigation and sustainable development and to develop the harmonized policies framework.

(3) At present most assessments of climate change measures are partial and incomplete. A more holistic assessment-against economic, social and environmental dimensions of sustainable development called 3 A's (acceptability, availability and accessibility) developed by World Energy Council (WEC)-would not only ensure that the measures were likely to be more effective in a wider sense in promoting sustainable development, but would also help make them more viable in a narrower sense-that is, more acceptable to those affected and therefore easier to introduce and get supported-and thus more likely to achieve their goals.

(4) The analysis of possible post-Kyoto climate change mitigation architectures was performed based on three criteria of sustainable energy development. Several criteria are perceived important by all major countries or country groups. These uncontroversial criteria should always be satisfied when designing a future international climate regime and there include economic, environmental, social and environmental criteria.

(5) Based on our analysis of international post-Kyoto climate change mitigation regimes according to 3 A's the most suitable future regime would be flexible emission reduction targets via continuing Kyoto approach. This approach provides the highest advantages relative to the critical criteria of sustainable energy development: acceptability, accessibility and availability for all groups of countries.

(6) Improved observation networks are urgently needed to enhance data sets and to document sensitivity of

physical and biological systems to warming in tropical and subtropical regions, where many developing countries are located. Demarcation of alteration in phenology during different time interval at different networks may be an innovation in this direction.

A government strategy for sustainable consumption based on leadership and facilitation, rather than control and management, might have a number of features:

• A commitment to public and multi-stakeholder dialogue about values related to consumption, about the nature of the good life, and about visions for a sustainable way of living.

• A strategy to change consumption that engages a wide range of different actors in society, including business, the media, the education establishment and religious organisations.

• Support for experimentation and learning by local communities, schools and other groups and organisations, to find new ways of promoting sustainable ways of living.

• Finding new ways of evaluating progress, supplementing the current concern to develop quantitative indicators with more qualitative approaches, engaging the public and others in ongoing dialogue.

Finally, I recommend the role of traditional and indigenous technologies in coping with climate change. In agrometeorology and management of meteorology related natural resources, many traditional methods and indigenous technologies are still in use or being revived for managing low external inputs sustainable agriculture (LEISA) under conditions of climate variability.

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