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SOCIAL SUSTAINABILITY, INDICATORS AND CLIMATE CHANGE[1]

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4.1 Introduction

Human lives and economic progress are both dependent on natural systems - as sinks for carbon dioxide and sources of oxygen, and as the ultimate natural base of the economic activity. Climatic disasters such as floods, droughts, and cyclones threaten and destroy human lives and assets. Humans have learnt through the ages to convert natural resources into wealth and to cope with natural disasters more or less successfully depending on the prevailing circumstances (i.e. access to resources, technologies, density of population etc.). With the numbers of humans increasing, the pressure on natural resources increased over time. The world population will soon reach six billion; and the developing world bears the brunt of this increase. With the assault on the nature perpetrated largely by the now developed countries while increasing their wealth, and more recently by the developing countries seeking to improve their economic conditions, the climatic balance has been seriously destabilized. Thus, the IPCC TAR must systematically address the links between climate change and issues involving development, equity and sustainability (*Munasinghe 1999*).

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In the days bygone, there were natural disasters causing huge destruction, in cases leading to the wiping out of civilizations such as those of Babylon, Mesopotamia, Greece, and Takshashila. However, those disasters did not perhaps occur as a consequence of disastrous human assault on the nature, certainly not on a world-wide scale. But the looming adverse climatic phenomenon that human society faces at the advent of the third millennium is a direct result of human assault on the nature and is of world scale. Obviously vulnerability widely varies from one geographical area to another depending on location, the level of economic development and social capabilities of the people concerned.

Although there still are uncertainties about the extent and mix of climate change, recent literature suggests that the human system will be subject to manifold problems including food-insecurity, wide-spread loss of employment and production due to abandonment of low-lying areas, high risks of health hazards, and large-scale eco-migration as a consequence of climate change *(Bruce et al., 1996).* Although the vulnerability of the human system is a function of adaptability and there are complexities and certain spatial differences in societal vulnerability to climate change, it is necessary to understand whether the social sustainability can be maintained in a warmer future world. This paper will discuss the pertinent issues concerning implications of climate change for social sustainability and identify the indicators that may be used in monitoring the anticipated impacts of climate change.

4.2 Climate Change and Social Vulnerability

The Second Assessment Report of the Inter-governmental Panel on Climate Change (IPCC) clearly demonstrates that both the ecosystem and the human system will be adversely affected by climate change *(Watson et al., 1996).* The changes in natural systems at unprecedented rates induced by global warming would cause land degradation and desertification; loss of pastoral and range lands; overall decline in tropical forest areas; debacle in fresh water storage and delivery infrastructure due to alteration in the timing and amplitude of runoff from snow melt; degradation of wetlands due to alteration of their hydraulic regimes; reduction of the area and the volume of the cryosphere; and inundation of low-lying coastal areas due to sea level rise. All such physical effects will destabilize the natural and the human systems as well as the existing symbiosis between humans and the nature. As a result, the production and social systems could be seriously disrupted.

The processes of desertification and salinization would reduce available cultivable lands in many countries across the globe. As a result, the ongoing process of loss of cultivable land due to other increased uses (habitat, roads, urban development) of land caused by increasing population and urbanization will worsen. Many of the coastal productive areas will have to be abandoned. Increased frequency of natural disasters such as floods and cyclonic storm surges would also cause reduction in agricultural production. Although, agriculture in some northern areas would perhaps benefit from general warming and CO_2 fertilization would have beneficial effect on certain (C_3 and C_4 type) crops, the overall global agricultural production might dwindle, depending upon geographic location of impacts. The principal damage will result from heat stress, decreased soil moisture, and an increased incidence of pests and diseases. Since population and, hence, demand for agricultural products, especially for that of food items, would significantly increase, food security in many parts of the world would face increased challenges under changed climatic conditions *(Reilly et al., 1996; Reilly, 1995;*

Rosenzweig et al., 1995). Besides agriculture, other economic activities, such as agro-industries and trade, would also be affected to varying degrees, directly or indirectly. Moreover, the sector specific economic activities are often interconnected and the impacts transmitted by transactions within and between economic sectors *(Moreno et al., 1996).* Most of the poor people of the globe live in predominantly agrarian societies. They depend on agriculture as owner-operators or agricultural laborers; many are also engaged in agro-industries and petty trading. Climate change would not only cause vulnerability to their agriculture and other economic activities, but will also threaten their employment and health. *Reilly et al. (1994)* estimated global welfare losses of between $0.1 and $61.2 billion in a scenario without adaptation (CO_2 concentration being 555 ppm.), while under moderate adaptation scenario changes in welfare would be between +$7.0 and -$37.6 billion.

Loss or degradation of rangelands would adversely affect livestock production. Competition for land for producing food for human consumption would cause decline in areas for the production of livestock feed. Desertification and salinity intrusion would exacerbate the problem even further. Therefore, people depending upon livestock production would face adversities.

It is highly uncertain whether the fisheries will benefit or lose on a global scale. The expected benefits due to longer growing seasons, lower natural winter mortality, and faster growth rates at higher latitudes may be offset by negative factors including alterations in reproductive patterns, migration routes, and ecosystem relationships. In areas where large number of people catch fish from common waters such as wetlands, decline in wetland areas would be detrimental to sustainable fisheries *(Ali, 1999).*

Human health is responsive to Earth's natural systems. Any adverse change in the climate system will, therefore, affect human health *(McMichael et al., 1996).* Direct effects include deaths from heat waves and extreme weather events, while indirect effects include a range of vector-borne diseases. It is anticipated that an increased frequency or severity of heat waves would cause an increase in human mortality and illness. General circulation modeling reveals that under $2XCO_2$ scenario the number of heat-related deaths would increase several-fold in North America, North Africa and East Asia. Increased frequency of other extreme weather events such as floods, hurricanes, and storm surges would also result in increased deaths, physical injury, infectious diseases, and psychological disorders, especially in disaster-prone countries. Table1 presents a list of socio-economic activities in a typical disadvantaged country where vulnerability may be reduced through possible adaptation.

It is expected that the life-cycle dynamics of the vector-borne parasites will be favored by the anticipated climate change. Non-vector-borne infectious diseases such as cholera, salmonellosis, and other food- and water-related infections would also increase, particularly in tropical and subtropical regions. The adverse effects of such diseases superimposed on large-scale malnutrition and hunger in poorer segments of different societies, particularly in the developing world, would spell disaster for a large number of people around the globe. Another potential important category of health impact would result from the deterioration in social and economic circumstances that might arise from adverse impacts of climate change on patterns of employment, wealth distribution, population mobility, and limited resettlement prospects.

In general, the sensitivity of the hydrological system is high towards changes in climate system, especially in the drier zones. Changes in the precipitation regime cause floods and droughts, while changes in the temperature regime determine moisture availability, degree of aridity and infiltration. Both abundance and inadequacy of water would severely affect freshwater ecosystems directly. It is most likely that primary

production will be affected; survival, reproduction and growth of freshwater organisms will also be affected. With a rise in the occurrence of extreme events, availability of freshwater may be constrained, especially in the tropical countries; and the people there may experience water-related vulnerability.

Global warming would necessitate more energy for space cooling in warmer zones in the south and, perhaps, less energy for space heating in colder areas. Since energy production and supply in most of the southern countries are less than adequate, the imbalance would be much pronounced under warmer conditions.

Since the cost of rehabilitation of and adaptation to damages caused by disasters may be recovered, people may have to pay more to have access to infrastructure, utilities and services. For instance, cost of protecting road networks in a low-lying area may be recovered by increasing road tax and/or increased cost of transportation in that area. People living in such areas may have to pay more for the same services as a consequence of climate change. Hence, the cost of living is likely to increase in more vulnerable areas, which would in turn decrease the capacity of the affected people to adapt.

Since the poor and the disadvantaged segments of society have limited means to cope and adapt, their relative vulnerability will be higher compared to rich or non-poor segments of society. If the cost of adaptation is added to the charges levied for all kinds of social services, then the poorer people will be even more vulnerable. Clearly, climate change will accentuate inequality in a society.

The issue of inequity not only relates to a society, it is also an inter-country phenomenon. The world is divided between few rich nations and a large number of poor nations and, within the poor nations, disparity is high with the majority being on the wrong side. Moreover, both inter- and intra-country disparities are on the increase. The poorer countries and the poorer people are more vulnerable to natural disasters (*Banuri et al., 1996*).

One consequence of vulnerability induced by climate change is the need for the affected people to try and migrate to safer places. The UNHCR identified four root causes of refugee flows *(UNHCR, 1993).* These are: political instability, economic tensions, ethnic conflict, and environmental degradation. *Lonergan (1998)* argued that environmental degradation and resource depletion may play a contributing role towards inducing population movement, often filtered through contexts of poverty and inequity. According to *Jacobson (1988),* environmental refugees have become the single largest class of displaced persons in the world. Since the impact of climate change would cause the most severe forms of environmental degradation, it may be forecast with a relatively high degree of confidence that a large population across the globe would seek to migrate elsewhere. If a sizeable proportion of the vulnerable population finds it difficult to sustain their living under climate change scenarios, they may seek to relocate themselves (eco-migration) either within the country, or within the regional countries, or anywhere else. *Myers (1993),* based on IPCC indications, projected potential environmental refugees in a greenhouse-affected world, in 2050, at 150 million persons.

Although the World Commission on Environment and Development *(WCED, 1987)* suggested environmentally-induced population displacement to be a recent phenomenon, human beings have tried out-migratory responses to unsuitable environmental conditions since prehistoric ages. However, the concern that climate change impacts will produce waves of refugees is recent *(El-Hinnawi, 1985; Jacobson, 1988 and Myers, 1995).* The growing literature on climate change impacts and vulnerability shows that there will be three types of climate change-induced migration or eco-migration: in-country, intra-regional, and global.

Many of the vulnerable people of the world live at subsistence or below subsistence levels. If human development index (HDI) of these people, regardless of their origin and nationality, was to compiled, they would make up the bottom of the HDI league table. Since their resilience (economic, social, health) is very low, their capacity to adapt to the anticipated adverse situations under a warmer world is extremely thin. For them, migration is the best intuitive choice. The difficulty in being able to migrate, given the rules and regulations governing migration in cases even within country, but especially across countries, would determine how far they would succeed. As *Suhrke (1994)* labeled this group the "maximalists", as they try to out-migrate by overcoming difficulties facing them, for maximizing their opportunities, to less vulnerable areas within the same country, or in the neighboring countries, or anywhere in the world where opportunities for living seem to be somewhat higher.

People living in a vulnerable zone would face difficulties, given intense competition for limited natural resources and employment and income earning opportunities. Application of appropriate technologies may facilitate enhancement of production and improve employment opportunities, that would not be enough to offset the anticipated losses and overall degradation of the natural resource base. To satisfy the demand of all the concerned people, there would be additional stresses on the resource base and, therefore, a new vicious circle of socioeconomic vulnerability— increased resource exploitation for higher profit—higher degradation of resource base—further resource exploitation causing further resource degradation—productivity and output decline—socioeconomic vulnerability might emerge leading to unsustainable ecosystems. Such a bleak scenario is more likely to be observed in poorer countries.

With increasing physical and socio-economic vulnerability, the people living in an otherwise amicable society may become less sensitive to the needs of others. Competition for resources, employment and services will increase and there will be greater social inequality. As a result, there may be increased social tensions. Such tensions may not remain confined to particular countries - there may be regional, even international ramifications. Such events might generate extreme uncertainties resulting in more and more people wanting to out-migrate.

Also, if the social disparity is accentuated by adverse effects of climate change, the affected people, unable to find employment, might take recourse to crimes and other anti-social activities, destabilizing the society.

4.3 Social Vulnerability, Sustainability and Indicators

Social sustainability is a complex issue. It may be defined as an orderly progress of society, which can be disturbed (made vulnerable) by continued political, economic, and market differentiation. Climate change by accentuating these disparities, by affecting different groups differently, may exacerbate social disruptions and undermine social sustainability. One needs to evaluate various aspects of social sustainability in order to measure its overall present status and future prospects. The purpose of this paper is limited to connections between climate change and social sustainability. What is attempted here, therefore, is to identify the implications of climate change on the social fabric and suggest indicators which will reflect changes in relation to the base conditions.

Human systems, given their economic and social circumstances, may be able to absorb a great deal of adversities, damages, and losses. In the 1990s, many events have taken place across the globe, causing colossal losses of human lives, assets,

infrastructure etc. A severe cyclone caused deaths of 138,000 people in the coastal areas of Bangladesh in 1991, while another similar cyclone about the same time along the coastline of South Carolina and Georgia States in USA caused damages worth about US$8 billion. In Japan a severe earthquake destroyed significant parts of Kobe city. Widespread occurrence of both droughts and floods caused famines in Ethiopia, Sudan and Angola. In all cases people showed tremendous resilience to cope with the hardship and the affected societies managed to survive. There have been internal and external assistance to facilitate resurgence of social resilience in the affected areas. Even in a small area, that experienced natural or manmade havoc, kinship and sympathy of others helped the victims to come out of despair and to dream for a better future. In each case people have suffered, but they have also overcome adversities. The threshold for complete unsustainability of a society under stress is difficult to define. In fact, the more fortunate people within a country or from other countries may continue to come forward to help restore/safeguard the sustainability of an affected society in any part of the globe. That is, human conscience may work in favor of providing necessary resources by those who can afford to do so to enhance the capacity and endurance of the affected people to cope with adversities. But the prospect of such humanitarian assistance cannot be a parameter in the planning exercise. It can at best be considered as the last straw providing succor to people unable to cope with the impact of a disaster despite all their efforts to do everything possible to mitigate and adapt.

Under conditions of climate change, social sustainability is a reflection of the society's ability to reduce social vulnerability caused by the induced changes. The indicators of sustainability would, therefore, refer to how well a particular society could perform the task of reducing vulnerability. If a society is well prepared in terms of human, physical (infrastructural), and financial capacities; well positioned in terms of general awareness and institutional capabilities; and possesses a high resilience (moral, kinship and otherwise), then it should be able to effectively lower its vulnerability. Table 2 presents the indicators of climate change, socio-economic impact indicators and their relationships.

The answer to the question *how good is the knowledge base of the concerned people regarding societal vulnerability?* would provide a basic indicator. It would not always be possible to quantify various aspects of the problem; but a good knowledge base, quantitative where possible and qualitative in other respects, would allow both the local people and the planners to devise necessary actions well in advance.

Number of lives at risk would provide a quantified measure of physical vulnerability. An absolute number or a proportion of people likely to be relocated due to certain physical effects would give a good indication. Similarly, the number of people who do not have access to minimum requirement of food/dietary intake would give a direct indicator about food vulnerability of a society. Any deviation from the present trend would indicate the level of adverse impact caused by climate change.

The number of people likely to lose employment and/or income due to climate change induced impacts provides another social indicator. It might, however, be difficult to separate the warming-induced losers from the rest. One straight forward indicator might be the total number of work-days lost due to extreme weather events. Number of school-days lost per academic year could be used as a similar indicator.

The indicators that are expressed by monetary terms are informative, but those might be misleading for the purpose of interpreting social vulnerability. The costs of almost anything in the developed countries are higher compared to that in the developing countries. How much being spent to take care of something or to provide insurance to the same would have a northern-bias. Similarly, how much could have ensured protection

against certain problems would have southern-bias. Unless the issue of equity is built into such estimations, it would tend to misguide its users. For planning purposes, however, such indicators could be useful as starting points.

To understand loss of social cohesion one may use indicators that express the state of social peace. For example, one may estimate the increased number of anti-social activities recorded by the law enforcing agencies in the most vulnerable areas. Estimations of international, intra-regional and local migration are already considered as indicators of livability within a society. In many countries, however, such events are forced by sheer economic stress and marked by perception of higher levels of opportunities in the countries/areas of destination. Table-3 provides a checklist of elements of vulnerability in a typical disadvantaged country.

4.4 Moving Towards Social Sustainability

People suffering from inequity, unemployment and poverty are particularly at risk under climate change. Improving sustainability of a particular society under threats of climate change would mean minimizing/eliminating vulnerability and its impacts. Vulnerability reduction may be approached from two different prongs: (i) adopting preventive policies and actions such as mitigation, and (ii) enhancing resilience of a vulnerable society through effective adaptation. The importance of both the modalities have been globally recognized; and they have been included in the Kyoto Protocol.

MITIGATION

Mitigation would essentially reduce the GHG load onto the atmosphere, thereby reducing the magnitude of changes in the climate systems. The central activities under mitigation include increasing fossil fuel efficiency, reducing leakage wherever possible, increasing efficiencies of household and commercial appliances, increasing use of non-fossil fuel alternatives, and renewable energy sources etc. Reducing fugitive and unnecessary emissions from different economic sectors, reducing methane emission from wet rice cultivation wherever possible, and increasing CO_2 sequestration potential through alternative land use planning are also regarded as technically viable mitigation options. From social point of view, changes in human consumptive behavior regarding lesser use of carbon intensive material, increased recycling of carbonaceous materials, opting for non-rice grains as main food items etc. are also considered to be technically viable mitigation options. Obviously, such adjustments would require considerable changes in people's ways of living.

ADAPTATION

Adaptation, especially anticipatory adaptation would increase the resilience of the vulnerable societies and empower them to safeguard against social unsustainability. Certain policies to that end may be considered: (i) a set of policies aimed at promoting socio-economic development and social justice, and (ii) the other set aimed at reducing physical aspects of vulnerability. The basic elements of the two categories of such a policy regime are indicated below.

Policies aimed at Socio-economic Development and Social Justice

An overriding focus of the policy regime, in this context, has to be the empowerment of the people for participating in economic, social and political processes in an effective manner, for which ethics and morality must underpin the behavior of the people, particularly of those who are in decision-making, program implementation, and leadership positions. Furthermore, social equity, which is a pre-requisite for sustainability[4], must be a guiding principle underlying the whole process. The practical areas to focus on, keeping these principles and guidelines in sharp focus, would include:

- improving human skills through education and training
- promoting democratic values, institutions, and practices
- improving employment
- improving access to resources and social services, particularly of the poor and the disadvantaged
- increasing income generation opportunities
- reducing poverty
- reducing population growth
- improving health care
- environmental capacity building at individual and institutional levels through environmental education and training concerning various aspects and impacts of climate change, choices available, and how to decide on the course of action given the various non-climate goals.

Policies aimed at Reducing Physical Aspects of Vulnerability

- protecting flood-vulnerable areas with embankments
- providing irrigation in drought-prone areas
- producing seeds that may resist extreme weather events
- altering crop calendar
- preparing to cope with emergencies and disasters
- managing land-use practices
- creating social infrastructure (cyclone or flood centers) to minimize losses.

In reducing vulnerability, only one or the other of mitigation and adaptation policies and programs cannot be sufficient. Rather, both the modalities depending upon the institutional, financial and other capacities of the particular vulnerable society must be undertaken. A vulnerable society should blend the two and find the most cost-effective and, at the same time, socially acceptable options towards achieving long-term social sustainability. But underdeveloped societies, particularly the most vulnerable ones, may not be in a position to devise appropriate strategies and employ human and other

[4] Indeed, growth produces winners and losers, given the existing systemic inequity in relation to access to opportunities and resources. The on-going free market reforms in countries around the world with globalization being its international ramification have been accentuating inequity among nations and within nations. The process is bound to generate tensions and disruptions over the longer term, making for unsustainable natural and human systems, nationally and internationally. Promotion of equity therefore is key to sustainability.

resources to implement those all be themselves. International cooperation becomes a critical factor for them in the context of their efforts for improving social sustainability.

Table 1. Possibilities of awareness induced adaptations with respect to socio-economic activities in a typical disadvantaged country

Socio-economic activity	Awareness induced adaptation possibility					
	Bear losses	Share losses	Modify threat	Prevent effects	Change use	Change location
Crop Agriculture / farming	+	*	*	+	+	Q
Livestock rearing (managing grassland, rangelands etc.)	+	+	*	Q	+	Q
Fisheries management						
Open water (capture) fishery						
Sweet water	+	+	Q	-	Q	+
Brackish water	Q	Q	Q	-	-	+
Marine	Q	Q	Q	-	-	-
Culture fishery						
Sweet water	+	+	*	+	+	Q
Brackish water	+	+	+	+	Q	+
Forest management	+	+	*	Unc	+	-
Energy production and management	+	+	*	Unc	Unc	Unc
Water resource management	+	*	*	*	Unc	-
Industrial activities	+	*	Q	Unc	Q	+
Transport & communication	+	+	*	+	Q	+
Physical infrastructure development	+	+	*	+	Unc	+
Health and sanitation management	Q	Unc	+	Q	-	-
Settlement	+	*	*	+	Q	+
Trade	+	+	Q	Q	Q	+
Tourism and recreation	Q	*	+	Q	Q	+

Notes: + means adaptation is possible; * means adaptation highly possible; Q means adaptation possibility is questionable; Unc means uncertain possibility and – means limited to no adaptation.

Source: Ahmed et al., 1998.

Table 2. Indicators of climate change and socio-economic impacts

Sl. No.	Climate change indicators	Physical effects	Socio-economic impact indicators
1	Rise in global average temperature	Desertification and moisture stress (droughts)	Loss of agricultural production, income; increased hunger and malnutrition Higher demand for irrigation water Increased cost of agricultural production; lower access of the poor to food More energy requirement for space cooling in southern countries
2	Changes in cryosphere	Increased melting of ice sheet, icecaps in the mountains	Increased flood-related havoc Loss of lives and assets
3	Sea level rise	Submergence of coastal areas	Loss of agricultural land, production and income Relocation and/or destruction of homesteads and fixed assets Complete destruction and abandonment of infrastructure Higher costs for protecting the coastal zones
		Increased salinity intrusion	Reduced food production Increased hunger and malnutrition
4	Increased precipitation	Increased runoff	Enhanced floods Loss of infrastructure (roads, settlements and educational centers) Alteration in crop calendar leading to crop losses

Note: This is not an exhaustive list of impacts; there can be many others. There may be extreme weather events, causing flash-floods due to high intensity rainfall, higher frequency of formation of cyclonic storm surges, prolonged droughts leading to crop losses etc. The impacts on human health could not be shown in this relational matrix.

Table 3. Past socio-economic trends and vulnerability in a typical disadvantaged country

Past socio-economic trends	Direction of socio-economic vulnerability
Increasing population	+
Increasing number of landless	+
Increasing number of underemployed	+
Increasing incidence of malaria	+
Persistence of water borne diseases	+
Increasing permanent migrations	+
Increasing seasonal migrations	+
Increasing settlement on coastal lowlands	+
Increasing settlement on unstable riverine sand-bars	+
Increasing settlement in other marginal locations	+
Decreasing absolute poverty	-
Increasing education opportunities	-
Increasing health care services	-
Increasing mid and upper classes	-
Increasing urbanization	+/-
Increasing economic diversification	+/-

Note: Modified from Ericksen *et al.*, 1994. + means positive relationship, - means negative relationship and +/- means uncertain relationship.

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