Environmental Security: A South Asian Perspective

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1. Assessing the link between environment and security

Over the past decade considerable research has been conducted on the link between environment, impoverishment and security and in an effort to redefine the concept of security that has been traditionally linked to a state’s defense of sovereign interests by military means. The dramatic increase of interest in environmental change as a potentially key variable in affecting conflict has resulted in a number of controversial and often inconclusive empirical findings about environmental change as a source of insecurity. Hence an active debate has been generated between those who seek to incorporate the concept into existing institutions and practices, and those who are skeptical of such an approach.

Proponents linking environmental problems to non-traditional security concerns support the need for a holistic and multidisciplinary approach to global, regional and local environmental problems that threaten the economic well being of people, and therefore have the potential to spur conflict. The thesis broadly stated is that natural resource scarcities or ‘environmental scarcities’ as they are commonly referred to, are likely to lead to conflict and violence, that these have security implications and that these implications could translate into regional security problems. The following are arguments that are often used to support the relationship between environment and security:

1. Environmental degradation often undercuts economic potential and human well-being which in turn helps fuel political tensions and conflict. Various studies have analyzed causal links between environmental change and conflict, with a focus on developing countries, which are most likely to exhibit environmental conflict in the future. Examples of trans-boundary environmental problems that have the potential to trigger conflict include, configuration of groundwater aquifers that may be such that exploitation in one country may lead to depletion in another, one country may pollute river waters that run into another, excessive deforestation in a mountainous country could lead to flooding in

1 At its most fundamental level, the term security has meant the effort to protect a population and territory against organized force while advancing the state’s interests through competitive behaviour (Dabelko G.D, Dabelko D.D, 1995). Threats typically have been perceived as military challenges and have been traditionally countered with armed force. The concept of environmental security discussed here represents the result of efforts to broaden the definition of national security to include resource, environmental and demographic issues, thereby bringing environmental concerns to the high table of priority issues where security has traditionally had a seat.
downstream countries and the flooding may carry heavy loads of silt, industrial pollution in one country may effect the environment adversely in another, the bursting of a dam in an upstream country may lead to devastation in the downstream neighbors, and pressures on scarce resources could lead to large scale cross-border migration.

2. Framing environmental and population issues as security problems and raising international awareness of ‘environmental’ threats could spur collective action amongst countries and promote better compliance with international environmental agreements.

3. The environmental and security rhetoric would contribute to generating funds, public support and action oriented responses necessary to achieve sustainable development and population goals in developing countries.

4. In response to the research on environmentally induced conflict, military security thinkers have begun to consider environmental stress as an additional threat to state stability that must be considered and planned for. It is widely accepted that the military and intelligence agencies have unique capabilities to monitor, analyze, and predict scientific data and therefore to assist in mitigating environmental catastrophes, and protecting natural resources.

Throughout the environment and security debate, however, some analysts have often been critical of linking the two terms. This criticism can be categorized as those focused on the redefinition of the security concept and those focused on the relationship between environmental stress and violent conflict (Lonergan S, GECHS, 1999). Critics commonly point out the following aspects:

1. A threat-based approach to examining environmental problems may prove ineffective for interventions and corrective action, and may in fact deter the resolution of conflicts. Policy makers would therefore be served best by framing long-term, proactive environmental strategies that emphasize environmental preservation for enhancing peace and economic stability.

2. Environment and security concerns depend upon the geographic perspective and affiliation of countries. The developed countries are therefore more likely to be concerned about environment and security in terms of global environment changes and the potential for instability and conflict in strategically important regions of the world.
Developing countries on the other hand will tend to be concerned with the social and economic impacts of local and regional environmental problems. There may therefore be little or no overlap in the priorities of the developing and developed countries in setting goals and targets.

3. The argument for involving security institutions for protecting the environment is inverted by the fact that security institutions themselves have a tremendous potential to affect the environment in either a harmful or beneficial manner. Given the deleterious environmental impacts of military operations and war, and past record of incurring environmental damage, it is widely proclaimed that traditional security institutions should be excluded from playing a role in addressing environmental problems. In addition, the secretive nature of security structures may be inappropriate for the transparent and cooperative responses deemed most effective in addressing environmental problems.

4. Subsuming of environmental conflict under the rubric of regional security is also regarded by some analysts as largely a result of American strategic thinking, which in the post Cold War period is driven by the need for interventions in regions where perceived adverse developments pose a threat to the position of global supremacy.

In this paper we examine the concept of environmental security in the context of South Asia. Although there is no disagreement with the proposition that there are a number of ways in which acts of omission or commission concerning environmental change in one area or one country can have serious consequences in another area or country, whether a divergence of interests between countries in these matters would necessarily lead to military conflicts or wars is however highly debatable.

The transition from environmental conflict to environmental security is perhaps justified by the desire to widen the horizon and concerns of military establishments and sensitize them to newer forms of dissensions and tensions so that they are not limited by a narrow preoccupation with security in the conventional sense and are able to understand inter-country relations and politics in all their complexities. However while there exists a distinct possibility of countries going to war to gain access and control over a non-renewable resource such as oil, as in the case of the Gulf War in 1990, it seems quite improbable that the same analogy can be applied for water, and the rhetoric of ‘water wars’ seems quite implausible. This is largely because unlike oil, water is not an internationally tradable commodity, and water resources of one country can at best be used in the neighboring countries and are not amenable for transportation over large distances to
meet requirements for drinking water and irrigation (Ramaswamy R Iyer, 1998). Also pressure on water resources is more likely to spur cooperation, through treaties and joint projects for water resource development and utilization as has been illustrated by the Mahakali River Water Treaty signed by India and Nepal and the Ganges River Water Treaty signed by India and Bangladesh. It is remarkable to note that the Indus River Water Treaty entered into by India and Pakistan in 1960 has never once been repudiated despite the continuing tension between the two countries. Indeed not merely is there a possibility of avoidance or resolution of conflict arising from scarcity of natural resources, but there are distinct prospects of positive and proactive cooperation.

In a more balanced vein it may be said that as environmental problems become more severe, they are likely to precipitate social instability and civil strife. Scientists have warned of this possibility for several decades and there is adequate evidence that points to the disturbing conclusion that scarcity of resources is already contributing to violent conflicts in many parts of the developing world. These conflicts may foreshadow a surge of similar violence in the coming decades, particularly in countries where scarcity of water, forests, arable land, coupled with expanding populations already cause great hardships.

It must however be emphasized that societies most vulnerable to environmentally induced conflict are those simultaneously experiencing severe environmental scarcity and various forms of institutional, political and economic failures. The relationship between environmental stress and conflict is therefore characterized by multi-causality, recursiveness and feedback loops. Just as environmental stress can lead to conflict under unfavorable social, economic and political conditions, conflict can lead to environmental stress. Both characteristics are inherent in the two case studies in South Asia discussed in this paper and can be illustrated by the following diagram.

![Diagram showing the relationship between poverty, physical capital, human capital, social capital, environmental scarcity, agricultural productivity, economic productivity, social segmentation, political interventions, violent conflict, civil strife, and insurgency.](image-url)
2. Environmental concerns for South Asia

In the context of South Asia some of the key issues that this paper addresses are the nature of environmental stress that the region is most vulnerable to; the impacts of environmental stress; and the relationship of environmental change with social, economic and political stability.

2.1 The poverty and environment nexus

Poverty will continue to be one of the central challenges for the South Asian region in the decades to come. Despite an impressive economic growth rate of 5.3% during the last decade, the region is mired by persistent and even increasing levels of poverty. In the period 1987-1998 the population living on $1/day or less rose from 474 million to 522 million, thereby accounting for 44% of the world’s total of $1.2 billion at that income level. For the same period the population living on $2/day or less rose from 911 million to almost 1.1 billion or about 39% of the world’s total of 2.8 billion.

Table 1 Demographic indicators

<table>
<thead>
<tr>
<th>Country</th>
<th>Estimated Population 1995 (million)</th>
<th>Annual Population Growth Rate 1995-2015 (%)</th>
<th>Population without access to safe drinking water (%)</th>
<th>Population without access to sanitation (%)</th>
<th>Population with income of $1/day (%)</th>
<th>GDP/capita (PPP US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>118.2</td>
<td>1.61</td>
<td>5</td>
<td>57</td>
<td>29.1</td>
<td>1361</td>
</tr>
<tr>
<td>India</td>
<td>929.0</td>
<td>1.34</td>
<td>19</td>
<td>71</td>
<td>44.2</td>
<td>2077</td>
</tr>
<tr>
<td>Nepal</td>
<td>21.5</td>
<td>2.35</td>
<td>29</td>
<td>84</td>
<td>37.7</td>
<td>1157</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>17.9</td>
<td>1.05</td>
<td>43</td>
<td>37</td>
<td>6.6</td>
<td>2979</td>
</tr>
<tr>
<td>Bhutan</td>
<td>1.8</td>
<td>2.57</td>
<td>42</td>
<td>30</td>
<td></td>
<td>1536</td>
</tr>
<tr>
<td>Maldives</td>
<td>0.3</td>
<td>3.17</td>
<td>40</td>
<td>56</td>
<td></td>
<td>4083</td>
</tr>
<tr>
<td>Pakistan</td>
<td>136.3</td>
<td>2.53</td>
<td>21</td>
<td>44</td>
<td>31</td>
<td>1715</td>
</tr>
<tr>
<td>World</td>
<td>5627.125</td>
<td>1.23</td>
<td>_</td>
<td>_</td>
<td></td>
<td>6526</td>
</tr>
</tbody>
</table>

Source: UNDP.2000

On reviewing the existing work on poverty, it is evident that the causal factors for poverty include not only income but also social, cultural and political dimensions. While income is ultimately important, the critical underlying resources that produce income are the “assets” that the poor lack access to and control over in pursuing their livelihood. Assets can increase or decrease, but they are often more stable than income per se, and a more important determinant of
well-being. Assets in this context can be categorized as natural resources, social capital, human knowledge, physical infrastructure and financial resources and play an important role in the poverty-environment interactions in the context of the South Asian region.

The human development index (HDI) developed by the UNDP provides a measure of basic human development in one composite index and produces a ranking for 174 countries. The HDI value for countries with high, medium and low human development averages at 0.90, 0.59 and 0.38 respectively. Table 2 illustrates that despite the improvement in the levels of human development in recent years, the HDI for South Asia remains substantially low, thereby, indicating that significant efforts are required to meet the shortfall in human development.

Table 2 Human Development Index

<table>
<thead>
<tr>
<th>Human Development Ranking*</th>
<th>Human Poverty and Deprivation Index</th>
<th>Human Development Index 1975-98 (%)</th>
<th>Average Annual Rate of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>146</td>
<td>0.441</td>
<td>0.461</td>
</tr>
<tr>
<td>India</td>
<td>128</td>
<td>0.545</td>
<td>0.563</td>
</tr>
<tr>
<td>Nepal</td>
<td>144</td>
<td>0.449</td>
<td>0.474</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>84</td>
<td>0.727</td>
<td>0.733</td>
</tr>
<tr>
<td>Bhutan</td>
<td>142</td>
<td>_</td>
<td>0.483</td>
</tr>
<tr>
<td>Maldives</td>
<td>89</td>
<td>0.72</td>
<td>0.725</td>
</tr>
<tr>
<td>Pakistan</td>
<td>135</td>
<td>0.489</td>
<td>0.522</td>
</tr>
<tr>
<td>High Human Development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium Human Development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Human Development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>World</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: UNDP, 2000

*Total countries = 174

Similarly the human poverty and deprivation index measures deprivation in the dimensions used to measure basic human development, and includes health, education, economic provisions and social inclusion parameters. The HPI for the South Asian region ranges from 0.44 in Bangladesh to 0.72 in Sri Lanka, thereby indicating that 28%-66% of the population in the region suffers
from poverty and deprivation. It is therefore futile to deal with environmental problems without a broader perspective that encompasses the factors underlying poverty and inequality.

The United Nations Social Summit at Copenhagen in 1995 addressed the challenge of eradicating poverty and more recently at the Millennium Summit in September 2000 Member States resolved to reduce by half the proportion of poor with income levels of less than $1/day. The progress in this respect however remains too slow and the rate of poverty reduction in the period 1990-98 has been observed to be barely one-third of the requisite level to achieve this target.

2.2 The rural-urban divide

According to the Rural Poverty Report 2001 of the International Fund for Agricultural Development, 75% of the world’s 1.2 billion poor are rural, will remain so for several decades, and South Asia accounts for 44% of this population. Despite an increase in agricultural productivity in the period 1975-1990, which is the mainstay of the rural economy, the rural-urban gap has not declined globally. Table 3 illustrates the rural-urban differences in poverty for countries in South Asia. It is observed that even though rural welfare indicators have improved, the rural-urban gap in terms of access to safe drinking water, adequate sanitation and health services remain inequitable and inefficient. Where resources have to be divided between urban and rural spending, the outlay per capita is normally less in rural areas even though the initial levels of development and well-being are much lower in rural areas compared to urban areas. Therefore while urban oriented policies have made urban living more attractive they have also lead to higher congestion costs and have attracted migration from rural areas. Investments on the other hand, for reduction in the cost of cultivating staple crops in rural areas, for instance, could benefit both the poor farmers and urban food buyers who spend most of their income on staple foods. Studies have revealed that there is no corresponding urban output which if expanded or made cheaper benefits the rural poor on a comparable scale.

<table>
<thead>
<tr>
<th>Country</th>
<th>Poverty Head Count Index</th>
<th>Rural-Urban Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh 1983-84</td>
<td>1.32</td>
<td></td>
</tr>
<tr>
<td>Bangladesh 1995-96</td>
<td>2.78</td>
<td></td>
</tr>
<tr>
<td>India 1987-88</td>
<td>1.09</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Sanitation (%)</td>
<td>Safe drinking water (%)</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Urban</td>
<td>Rural</td>
<td>Urban</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>83</td>
<td>38</td>
</tr>
<tr>
<td>India</td>
<td>70</td>
<td>14</td>
</tr>
<tr>
<td>Nepal</td>
<td>28</td>
<td>14</td>
</tr>
<tr>
<td>Pakistan</td>
<td>93</td>
<td>39</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>68</td>
<td>62</td>
</tr>
</tbody>
</table>

IFAD, 2001

n.a data not available

With high population growth rates and widespread incidence of poverty coupled with rapid rates of industrialization and urbanization and inadequate mechanisms for environmental governance, characterizing much of the region, environmental stress in the form of land degradation, deforestation, water scarcity, water pollution and degradation of marine and coastal ecosystems emerge as the most significant environmental problems in South Asia. While the burgeoning population has created a pressure on the natural resource base and reduced the per capita availability of resources, the simultaneous degradation and deterioration of natural resources has constrained agricultural production and fishery, the means of livelihood for millions, thereby leading to large scale displacement, and cross-border migration with profound debilitating impacts on the economy and society.
The development of rural areas is therefore critical to the issue of environmental security in South Asia and in this regard some of the key challenges are:

1. Equitable and efficient allocation of natural resources such as water and land and higher shares, access and control of these assets by the rural people;
2. Widening market access for rural farm and non-farm products by enhancing skills, technological innovation, improved infrastructure and institutions;
3. Participatory and decentralized management approach and innovative financing mechanisms.

2.3 Shared environmental concerns

The focus on environmental problems in South Asia as in the case of other developing countries is more on local and regional systems such as cropland, forests, water and marine resources on which the bulk of the population depends for its livelihood.

Table 5 Environmental indicators

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>13.01</td>
<td>7.76</td>
<td>10940</td>
<td>0.8</td>
<td>0.18</td>
<td>73</td>
</tr>
<tr>
<td>India</td>
<td>297.31</td>
<td>21.86</td>
<td>1896</td>
<td>_</td>
<td>0.98</td>
<td>85</td>
</tr>
<tr>
<td>Nepal</td>
<td>14.3</td>
<td>33.72</td>
<td>7338</td>
<td>1.1</td>
<td>0.07</td>
<td>0</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>6.46</td>
<td>27.79</td>
<td>2341</td>
<td>1.1</td>
<td>0.32</td>
<td>_</td>
</tr>
<tr>
<td>Bhutan</td>
<td>4.7</td>
<td>58.64</td>
<td>49557</td>
<td>0.3</td>
<td>0.14</td>
<td>0</td>
</tr>
<tr>
<td>Maldives</td>
<td>0.03</td>
<td>_</td>
<td>_</td>
<td>_</td>
<td>0.73</td>
<td>_</td>
</tr>
<tr>
<td>Pakistan</td>
<td>77.08</td>
<td>2.27</td>
<td>1678</td>
<td>2.9</td>
<td>0.62</td>
<td>78</td>
</tr>
<tr>
<td>World</td>
<td>12848.91</td>
<td>26.78</td>
<td>7032</td>
<td>0.3</td>
<td>4.05</td>
<td>_</td>
</tr>
</tbody>
</table>

Source: UNDP.2000

In prioritizing the shared environmental concerns for the region the following emerge as the most prominent:
Land degradation

Land degradation and soil erosion in the region are largely a result of the land use practices, rapid rates of deforestation, poor irrigation and drainage practices, inadequate soil conservation, steep slopes and overgrazing. Water erosion is severe throughout the Himalayas and in India alone, about 13 million hectares is affected by water erosion. In the dry belt that extends across the Thar Desert in Pakistan and India, an estimated 59 million hectares of land is affected by wind erosion. In India, for instance, it is estimated that 45 million tons of agricultural production is lost due to soil erosion annually. Soil salinity and acidification also affect large areas under cultivation in Bangladesh and the northern region of India. Similarly, in Pakistan salinity is known to reduce crop yields by as much as 30%.

Mining in the region, which is largely unorganized and unscientific is also known to cause land degradation with significant trans-boundary impacts. In Bhutan for instance, dolomite mining has resulted in increasing incidents of landslides and soil erosion in the adjoining Indian state of West Bengal. The foothills in India, have taken the burden of landslide debris, with consequent pollution of the ground water aquifers in the region as a whole.

Deforestation and loss in biodiversity

Industrialization, agricultural expansion and a large dependence on forest products for meeting the energy needs have resulted in large-scale deforestation in most countries of the region (Table 5). In an effort to increase agricultural production farmers have encroached upon forests and other environmentally fragile areas. Deforestation has also resulted in the loss in biodiversity in both in the terrestrial and coastal ecosystems. Biodiversity losses have also resulted from trade in forest products, introduction of non-native species, improper use of agro-chemicals, and uncontrolled tourism. Loss in the coastal habitats includes a substantial loss in mangrove forests, largely as a result of shrimp ponds and paddy cultivation, with adverse impacts on commercial fisheries that rely on the mangroves as nurseries for fish breeding.

Water availability and quality

Resource scarcity as a result of population pressures is particularly acute in the region as is evident from the gradual decline in the water stress index that is defined as the total internal renewable water availability per capita. In India, for instance, the per capita water availability declined from 6,000 cubic meters per annum in 1947 to about 1898 cubic meters per annum in 1998 (Table 3) and is expected to decline further to 1600 cubic meters by the year 2017.
Groundwater depletion has emerged as a major concern in India, Bangladesh and Sri Lanka. It is estimated that as much as 70%-80% of the agricultural production in India depends on groundwater irrigation. The aquifers in the Mehsana and Coimbatore districts in the southern region have been permanently depleted as a result of insufficient re-charging. In other states including Rajasthan, Haryana, Punjab and Gujarat the extent of over exploitation of ground water ranges from 100%-260% as compared to the critical level of 85%. With agricultural production accounting for roughly 29% of India’s GDP, a large proportion of India’s GDP could actually be viewed to depend on groundwater. In addition, groundwater accounts for about 80% of the domestic water supply in the rural areas and almost 50% of the urban and industrial supply. Moreover in periods of drought groundwater provides the only reliable source of irrigation. Similarly, in Bangladesh, a fall in the water table in the northern and central parts of Bangladesh has resulted in severe water shortages.

Decline in water quality as a result of untreated sewage and industrial effluents is a growing concern in the South Asian region. The total sewage treatment capacity in India is a mere 10% of the present waste water generation, with less than three-fourths of the municipal waste being collected and the rest draining into the river systems. In India an estimated 10,286 million liters of sewage is discharged into the Damodar river everyday. Similarly, the total pollution load in the Yamuna river has been assessed at 1,286 million liters per day. In Delhi alone, 17 big drains are discharging about 1,068 liters of sewage daily into the Yamuna river. A survey of the major Indian rivers which form a part of the regional river systems shows that while most can support aquatic life, the water is completely unfit for drinking or even bathing. Similarly in Pakistan and Bangladesh, water pollution from raw sewage, industrial waste and agricultural run-off has assumed great significance. In Pakistan it is estimated that chemical pollution of the Ravi river results in huge losses in income from fishery. In Bangladesh, arsenic contamination of groundwater has been linked to the intensive use of fertilizers and is a potential hazard for about 1 million people. As is evident from the above discussion, the factors contributing to the deterioration in water quality are common to the countries of the region, and the rivers form a part of an interconnected river system, there exists a vast potential for cooperation to enable remedial and regulatory responses.

**Atmospheric pollution**

Given that the two most populous countries of the world, namely China and India, have substantial reserves of coal, large quantities of coal would continue to be used to meet the energy demand in these countries. The anthropogenic sources of sulfur dioxide (SO₂) emissions that result in acid rain, include coal based power generation, vehicular emissions and household...
energy use for cooking. The effects of coal burning tend to be spread over large areas, resulting in acid rain and fly ash deposits in areas near the coal burning plants as well as further away. Even though the sulfur content of the Indian coal is lower compared to that in China, the trans-boundary movement of air masses would carry the emissions in China to other parts of Asia as well. In addition to SO$_2$ emissions, in India alone, coal burning is estimated to generate 35-40 million tons of fly ash each year, of which only 2%-3% is utilized. Fly ash results in an increase in the suspended particulate matter content and hence a deterioration in the air quality.

The Regional Air Pollution Information and Simulation (RAINS)-model developed at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria, provides a consistent framework for the analysis of emission reduction strategies on a continental scale. TERI, has been involved in the Asian implementation of the model that considers emissions of sulfur dioxide (SO$_2$) as the major pollutant contributing to acidification of natural ecosystems. The RAINS-ASIA model takes into account patterns of trans-boundary movement of air masses in Asia to estimate the magnitude of acid rain that would affect various ecosystems in the countries of the region.

The level of sulfur deposition that an ecosystem can bear without long-term damage from acid rain is known as the critical load of that ecosystem. These critical loads differ from one region to another, based on the sensitivity of each ecosystem to sulfur deposition. Thus, one way of judging the potential environmental damage caused by excess sulfur deposition in different regions is to compare the expected levels with the critical loads. The predictions for the year 2020 for countries in Asia using the RAINS-Asia model presents a grim picture with sulfur deposits crossing the critical load in many parts. Except Pakistan, the western and central parts of India, western China, Myanmar and parts of Indonesia, most of the Asian continent is expected to be severely affected. The model projects an alarming possibility of excess sulfur deposition in India by 2020, reaching as high a level as 2-5 grams per square metre annually, over and above the critical loads.

The worsening crisis of an acid-rain catastrophe in Asia, surely calls for an urgent move towards a binding protocol between the nations exposed to this threat in the not too distant future. The action must be initiated now, as experience shows that all international agreements with binding commitments take long to bear fruit.
Climate change

Climate change is an especially important concern in Asia where climatic phenomena such as the monsoons, the El Nino Southern Oscillation (ENSO) and tropical cyclones have significant influence. In the South Asian region the temperature increase as a result of climate change is estimated at 0.1°Celsius- 0.3°Celsius in the year 2010 and 0.4°Celsius-2.0°Celsius in the year 2070, and a variation in the rainfall patterns is estimated in the range of 0%-10% in the year 2010 and 5%-50% in the year 2070 (Whetton P.1994). Increasing floods, typhoons, and droughts are ongoing concerns for many Asian nations whose human settlements and economy are already affected greatly by climatic variability.

Rise in sea level and increase in sea-surface temperature are the most probable major climate change related stresses on coastal ecosystems. Coral reefs are particularly sensitive to prolonged increases in seawater temperature and increased irradiance as this has been observed to cause coral bleaching. In the South Asian region, large populations live in low-lying coastal areas or adjacent to river deltas. Coastal dwellers and inhabitants of regions near deltas are especially vulnerable to sea-level rise and associated back water flooding which are among the most immediate consequences of an increase in average global temperatures.

Mangroves are the other vital coastal ecosystems that would be severely affected by climate change related increases in temperature and sea level rise (SLR). Intrusion of saline water and rise in temperatures are already taking a heavy toll on the mangrove ecosystems. In Bangladesh, for instance, there is a threat of loss in species in the Sundarbans, which is the largest continuous mangrove forest in the world. SLR is also likely to threaten the survival of a wide range of mammals, birds, amphibians, and reptiles living in the Sundarbans. A large part of the coastal area that is now protected by the Sundarbans will also be vulnerable to cyclonic storms and surges.

The sensitivity of major cereal and tree crops to changes in temperature, moisture, and carbon dioxide (CO2) concentration of the magnitudes projected for the region has been closely examined. Projected impacts on rice, wheat, and sorghum yields for instance suggest that any increases in production associated with CO2 fertilization will be more than offset by reduction in yield resulting from temperature and moisture changes. Although climate change impacts could result in significant changes in crop yields, production, storage, and distribution, the net effect of the region-wide changes is uncertain because of variations in the growing season, crop management, non-inclusion of possible diseases, pests and microorganisms in crop model simulations, and the vulnerability of agricultural areas to episodic environmental hazards,
including floods, droughts, and cyclones. Low-income rural populations that depend on traditional agricultural systems or on marginal lands will however be particularly vulnerable.

**Trans-boundary movement of hazardous wastes**

Trans-boundary movement of hazardous wastes is emerging as a critical issue that the countries of the region have not been able to address fully. Although seven of the nine countries in South Asia have signed the Basle Convention, the region lacks a common approach to the management of hazardous wastes. Appropriate institutional and regulatory mechanism, therefore need to be put in place for the surveillance and management of hazardous wastes.

**Natural disasters**

The South Asian region is vulnerable to a range of natural disasters with varying severity. This coupled with the lack of infrastructure and technological preparedness to predict and cope with natural disasters has led to a large-scale devastation on a periodic basis. In India and Bangladesh, for instance, floods and cyclones have caused widespread devastation on an annual basis, while the north-eastern Himalayan region represents the greatest seismic hazard in the Indian subcontinent. Human casualties as a result of natural disasters in the period 1960-81 is estimated at 633,000 in Bangladesh and 60,000 in India. Of this 386,200 in Bangladesh and 24,930 in India were casualties as a result of cyclones and 39,000 in Bangladesh, 14,700 in India, 2100 in Pakistan and 1500 in Nepal were casualties as a result of flooding (Bhatt C.P, 2000).

**3. Case studies in South Asia**

The following sections provide an overview of two case studies assessing the link between resource scarcity and conflict in South Asia. It is instructive to note the following observations based on the case studies:

1. Increase in population and per capita consumption levels create a greater demand on the resource base, thereby creating a demand induced resource scarcity. In each case population growth plays an important role contributing to environmental degradation that interact with other social, political and economic factors leading to conflict.

2. Unequal distribution of resources amongst the population of a region, resulting in migration from cropland rich areas to marginal areas at the risk of desertification and deforestation has induced conflict.

3. Internal conflicts may result in fragmentation whereby the state loses control over the peripheral territory and is unable to implement agreements on environmental protection, and collective security matters.
4. Environmental degradation in neighboring states may lead to adverse environmental impacts for the entire region, with significant spillover effects and repercussions on international security.

3.1 Water sharing disputes

Causal factors
The dispute arising from water sharing of the Ganges involves the struggle to gain control over the scarce water resource during the five dry season months extending from January to May. The Ganges flows through India and Bangladesh for a distance of about 2510 km, bifurcating into two channels before entering into Bangladesh. The Padma as the Ganges is called in Bangladesh flows through a distance of 112 km before joining the Brahmaputra in the heart of Bangladesh and the combined flow of the two rivers drains into the Bay of Bengal.

The dispute over the Ganges river water originated with the construction of the Farakka barrage that began in 1962 and was completed in 1972, 18 km upstream from the Bangladesh border. India’s main objective for the construction of the barrage was to preserve and maintain the Calcutta port by improving the navigability of the Bhagirathi-Hoogly river, which is the name of the Ganges in West Bengal in India. Through its feeder canal the barrage diverts a maximum of 40,000 cusecs of water to flush the Hooghly river of its sediments thereby keeping the Calcutta port operational and accessible to large ships all around the year. The dispute centers on the sharing of the river waters during the lean period when the flow is a maximum of 55,000 cusecs. Bangladesh has claimed a historical right to draw maximum water during the lean period in order to fulfil its drinking water, irrigation, industrial and ecological needs, thereby recharging the regional groundwater aquifers and reducing salinity in coastal areas of the Bay of Bengal.

The negotiations between India and Bangladesh to resolve the water-sharing dispute have been guided by two strategies. In the period 1982 to 1996, a series of high level official talks were held and negotiators used their skill and political backing to put forward a maximum claim on the lean season flow. The other strategy has involved an initiative to search for options to augment the flow as stipulated in the 1977 Treaty. The proposals for augmenting the water flow included the construction of storage dams along the tributaries of the Ganges in Nepal, thereby yielding a year round flow of about 176,400 cusecs. The flow from these reservoirs could be regulated to flow into the Farakka barrage provided there were no upstream claimants on the flow. The alternative proposed by India was the diversion of the Brahmaputra river to the Farakka barrage via a canal through Bangladesh thereby augmenting the water flow. The flow
control mechanisms at both the upstream and downstream sections were to remain with India, and the proposal was therefore rejected by Bangladesh.

Bangladesh on the other hand proposed to augment the flow through a tripartite arrangement with Nepal, drawing water from reservoirs on Kosi, Gandak and Karnali, the three major tributaries of the Ganges that flow through Nepal. This proposal however did not materialize, largely as a result of Nepal’s reluctance based on the first two barrages built on Kosi and Gandak that were perceived as an example of an unequal relationship between India and Nepal. Subsequently, however, India and Nepal signed a treaty in 1996 for the development of the Mahakali river. The agreement sets the basis for the creation of a 12 billion cum reservoir for the development of the 6480 MW Pancheshwar Multipurpose Project. It is unlikely though that the regulated flow from the Pancheshwar dam would be available for augmenting the dry season flow at Farakka.

The 1996 treaty between India and Bangladesh is the most recent agreement stipulating water availability for India and Bangladesh. However failing to take into account the annual hydrological variation the treaty resulted in a flow lower than in the previous years in the first lean period itself. As a result Bangladesh has now begun to focus attention on building the new Ganges barrage between the Gorai river and Ganges-Brahmaputra confluence, thereby raising the water level to feed the ground water aquifers, and diverting the flow into the Gorai river to flush-out salinity in the coastal areas of the Bay of Bengal. The estimated cost of the project is $1.5 billion, paving the way for the involvement of multilateral development agencies.

**Impacts**

With nearly one-third of the land area in Bangladesh depending on the Ganges river waters for its ecological balance, water scarcity as a result of the long standing dispute over water sharing has led to several adverse environmental impacts in the region. The agricultural sector is the most severely affected by reduced water availability during the dry season. Moreover the water withdrawal at Farakka has reportedly delayed the planting of crops, shortened the growing season and affected the productivity of the soil. As a result of the reduced flow in the Ganges during the dry season, saltwater intrusion from the Bay of Bengal has posed a serious problem affecting agriculture, domestic water supply, forestry and industry in the south-western region of Bangladesh. The salinity hazard has in turn lead to an increased reliance on ground water and the use of chemicals for water treatment. Increase in salinity has also affected soil nutrients and resulted in the large scale dying of the Sundari tree, the most valuable species of the
Sunderbans\(^2\), accounting for 60% of the forest’s timber production. Water withdrawal at Farakka and reduced flows during the dry season have also affected the fish species, fish habitat and feed chains, resulting in a decline in fishery which provides a means for livelihood and nutrition for a large segment of the population. In addition, the decreased dry season flow has contributed to excessive river-bed siltation with a consequent reduction in the carrying capacity of the river channels. This phenomenon has been instrumental in the increased occurrence of floods during the rainy season. Siltation has also resulted in river-bank erosion with consequent shifting of river course resulting in landlessness for farmers (Swain A. 1996).

**Policy recommendations**

In the dispute over Farakka, technological complexities have intermingled with state power and politics thereby eluding cooperation. Efforts for development of water resources have been unable to secure access to water in an equitable manner and led to disputes that are evident in three dimensions: between states, between groups and between the state and groups. The struggle for gaining control of water resources between states reflects the shift in focus from acquiring control over territories to acquiring control over natural resources for strategic interests. Even within nation states there exist examples of conflict between the upstream and downstream regions.

The responses to the Ganges river water sharing conflict reflect a state-centric approach that involves technological choices and politics. Technological and political solutions however do not automatically lead to an equitable and fair resolution because they relegate the people’s concerns to the periphery. In the context of the immense geographical and social diversity in the South Asian region, it is necessary to develop an integrated approach incorporating both state-led agreements as well as the micro dimension involving the concerns of millions of individuals who are affected by the macro strategies.

It must also be recognized that total control or elimination of occurrences such as floods is neither feasible nor desirable. It is therefore necessary to focus on developing mechanisms not only for flood control but also for flood adaptation, maximizing its benefits and minimizing losses. Adaptive measures include changes in agricultural practices, cultivation to suit the flood depth, development of early warning systems, flood plain zoning, and the support of indigenous techniques such as cutting embankments to release flood waters. Studies have indicated that

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\(^2\) Sunderbans is the largest natural mangrove forest in the world covering a total area of 5770 sq kms.
community networks have also been successful in providing support to affected communities (Swain A. 1999).

Therefore the challenge before South Asia is that of providing its people secure access to clean water for drinking, reliable irrigation, affordable energy, and respite from floods. To tackle these challenges the approach needs to be innovative and must strive to build institutional development at the regional, national and local levels to enable an effective response at minimal social and environmental costs.

3.2 Cross border migration

Causal factors
Migration from Bangladesh is largely a result of a high population density, poor natural resource base, vulnerability to natural disasters and an undiversified economy that depends primarily on rice and jute. Despite lower costs high yielding varieties of food grains have been introduced in less than 40% of the cultivated area. Population pressures have also reduced the available cropland per capita and have led to the reduction in the average size of agricultural landholdings to less than 1 hectare.

In addition, frequent flooding and the inadequate mechanisms for flood control have further exacerbated the loss of cropland. A recent study has estimated that about 19 million people in Bangladesh are displaced as a result of floods every year. Floods however are a necessary evil, since cultivation is dependent on the silt deposited on the flood plains during the rainy season. Also flooding replenishes the groundwater and helps maintain the fishery. Therefore flooding of the Gangetic basin constitutes a warning signal to communities that flood management by way of engineering skills, technological innovation and institutional development needs much strengthening to enable the population to live in harmony with nature.

Bangladesh must also contend with tidal waves that rise to as much as 20 feet and sweep across the southern coast, devastating the coastal areas. Global warming, resulting in sea level rise could make this phenomenon much worse and cause submergence of large areas along the coastline.

Impacts
Environmental degradation as well as population pressures on the scarce natural resources in Bangladesh have contributed to a large scale migration of Bangladeshis to the north-eastern states as well as to some of the large urban centers in India. Though the exact number of migrants from Bangladesh to India is difficult to assess, about 12-17 million Bangladeshis were
estimated to have migrated to India by the year 1993. The north-eastern states in India have attracted large scale migration largely due to the low population densities, and fertile agricultural land, even though the economic conditions may not be ideal in these states. These factors have contributed to providing cheap unskilled labour and agricultural land as a means of livelihood for the immigrants. In many instances the immigrants have benefited at the cost of the development of the original inhabitants thereby leading to adverse social, economic, environmental and political impacts. The migrants have also been regarded as a security threat by the intelligence agencies in India for their susceptibility to getting involved in information gathering activities for extremist groups both on the India- Bangladesh border and on the frontier with Pakistan.

The resultant native –group conflict is illustrated, by the on-going civil strife in Assam which is rooted in a student led agitation in 1979 against the illegal Bangladeshi migrants, paralyzing the economy and administration in the state in the ensuing years. The agitation focussed on deportation of the immigrants and resulted in the worst communal riots since the Independence struggle in 1947. The confrontation between the native Assamese population and the Bangladeshi migrants has made Assam susceptible to armed conflicts involving the military and paramilitary forces.

The volatile situation in Assam as well as the approaching saturation point in West Bengal has led to large-scale migration to the large urban centers like Delhi, Mumbai and Hyderabad. The migrants have become a part of the local political struggle in many areas, with a potential for violent conflict. To some political parties in India, the migrants have been a tool to enlarge the political base either by winning their support or by mobilizing the native Hindu population against the Muslim immigrants.

Within Bangladesh, in the Chittagong Hill Tracts, south of the north-eastern Indian state of Tripura, an ethnic conflict rages between the Bengali speaking Muslim population and the native Buddhist and Christian tribal population of the thinly populated but densely forested area. The ensuing clashes have transformed into insurgency operations involving the Bangladeshi military forces.

Policy recommendations
As is evident from the above discussion, environmental degradation and resource depletion are the two main factors that contribute to population movement and subsequent conflict. Other key factors include rapidly growing populations and inequitable distribution of income and resources. The poor have been the worst affected as a result of environmental problems. This implies that
policy recommendations focus on sustainable resource utilization, consider the factors that underlie the population growth rates, and address the inequitable distribution of income and access to resources within and between countries. Greater effort is also required for improving environmental awareness at all levels, involving local communities in environmental programs and increasing support for NGOs to assist the government agencies in environmental protection (Lonergan S, Swain A, 1999). Based on the several studies that point to global environmental interdependence, resource rich countries need to recognize that environmental vulnerability of weaker countries will lead to spillover effects thereby proving detrimental to the well being of the region and global community as a whole.

4. Conclusions

1. **Resource availability for eradicating poverty:** Most of the poor in South Asia live in rural areas. The urban-rural gap remains large, inequitable and inefficient, with deleterious impacts on the environment. With most donor agencies and developing countries reorienting their policies towards poverty reduction, one would expect enhanced investment and foreign aid in the poor regions, yet this is not the case. In the period 1987-98, the net aid disbursed in real terms fell from 0.33% to 0.24% of sharply rising OECD Gross Domestic Product, as against an agreed level of 0.7%. South Asia contains 44% of the world’s poor but received only 12% of the net aid disbursed in 1998, less than 1% of the region’s GNP and a strikingly low per capita aid of $3.8/person. Thus there is a paradox: an ambitious target for poverty alleviation and sustainable development with fewer resources to achieve it.

2. **Governance and local empowerment:** Refocusing the strategy for environmental protection requires the strengthening of institutions and empowerment of people. The success of joint forest management in India, hill community forestry in Nepal and irrigation user groups in India, Pakistan and Sri Lanka add to the evidence that social capital and participatory processes are as crucial to environmental protection as financial resources and development programs. Community-based natural resource management initiatives coupled with policy reforms can prove an effective mechanism for improving access to and improving productivity of natural resources.

3. **Technological innovation:** The value of human, land, water and other assets depend on technologies that improve the productivity of those assets thereby generating adequate return and income. Globalization can bring significant benefits of technological
advancement, and market access through improved connectivity and information. However, it must be emphasized here that unless local communities themselves are involved in the selection and use of these technologies they are unlikely to benefit from their implementation and the technological interventions will prove weak and unsustainable in the longer term.

4. *Global partnerships for sustainable development*: Macro-partnerships can provide the overarching global framework for development strategies, thereby enhancing effectiveness of investments and aid through improved donor coordination for the development of the region as a whole. In this respect the Comprehensive Development Framework (CDF) proposed by the World Bank provides a holistic approach to development and seeks a better balance in policy making by highlighting the interdependence of social, human, environmental, economic, institutional and financial elements. Similarly, the United Nations Development Assistance Framework (UNDAF) brings greater coherence, collaboration and effectiveness to UN development efforts. Though the CDF and UNDAF are currently in the experimental phase both mechanisms embody the bottom-up approach.

5. *Corporate responsibility*: Harnessing the power of corporations and encouraging their cooperation is one of the key areas for building environmental security. Both individually and as cartels and coalitions corporations have the size, influence and financial resources to wield control internationally. Multinational corporations can play an influential role in advancing environmental protection by shaping technological advances and commercialization of products and technologies, participating in negotiations on global environmental issues thereby contributing to consensus building, supporting programs for public education and awareness and creating international institutions to advance sustainable development principles.

6. *Regional mechanisms for environmental protection*: The trans-boundary nature of global environmental problems suggests that cooperation and not competition, between states, represents the best strategy for addressing these concerns effectively. Therefore responding to environmental problems through prompt collective action could be an important means to generate trust and goodwill among disputing states. Even though there exist several regional mechanisms for environmental protection there exists a deficiency of policies that address the nature of trans-boundary environmental problems and their impacts. In this respect a network of regional institutions could prove effective
in complementing the existing institutional mechanisms by contributing to the creation of an understanding of the key issues, exchange of information amongst key institutions, and training and capacity building of relevant stakeholders.

Finally it can be said that there is reason to believe that once a proper perception is created on common environmental problems facing South Asia, to which common and politically neutral solutions are possible, then cooperation between countries of South Asia would perhaps follow. As a small example it can be mentioned that in 1992 just before the Rio Summit all the Environment Ministers of the SAARC requested a 2-day briefing session on climate change with TERI. This briefing was organized at TERI, New Delhi. Similarly, before COP-I in Berlin in 1995, at the request of the Pakistani and Sri Lankan ministers in particular a similar briefing was arranged with TERI for the delegations from the SAARC countries. This example is given only to highlight the fact that cooperation is possible on common environmental problems that do not impinge on national sensitivities.
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