SUSTAINABLE DEVELOPMENT

ENVIRONMENTAL SECURITY, DISARMAMENT AND DEVELOPMENT INTERFACE IN SOUTH ASIA

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Economic Resources and Environmental Concerns in South Asia: A Changing Interface

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INTRODUCTION

The South Asian region—Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka—possesses an extraordinary diversity of land forms and climatic regimes ranging from the highest mountains, hottest plains, wettest and driest places and dissected valleys to coral islands. All these give further substance to the concept of cooperation and mutuality. They have some very vital commonalities, viz. (i) shared struggle for development, (ii) the constant search for sustainable resources, (iii) strive towards finding a mass and cost effective technology, and (iv) traditional methods of planning and of management interventions.

With the total population of 1.19 billion in South Asia, one of the major concerns has been the deepening nature of poverty and its impact on the process of environmental degradation. It is roughly estimated that in whole of South Asia, there are at least 450-500 million living in absolute and abject poverty. The problem of poverty is further aggravated by various other social deprivations, discriminations and skewed distribution of income and employment from which the poor suffer. Though there are various common elements that characterize the nature of poverty in South Asia, one such remarkable feature has been the constant demographic pressure on land and water leading to conflict over resources both within and outside the nation. These conflicts have acute bilateral overtones. The Kauveri water dispute between the Indian states of Karnataka and Tamil Nadu and the Ganga water dispute between India and Bangladesh are two different critical examples that have alarmingly cropped up. This has inevitably injected a serious question of sustainability in the development debate in South Asia.

Except Bhutan, all the SouthAsian countries have recorded a large-scale deforestation with the annual rate of deforestation reaching as high as 4 per cent in Nepal. Some of its adverse impacts have already started taking its tolls in areas like agriculture, range land, climate change, human settlements, biodiversity, human health, hydrological resources, mountain ecology, cultural heritage, etc. In fact there has been conscious effort (with some concrete results) by some of the well known scientists and environmentalists to study the Greenhouse Effect on the region under the auspices of the South Asian Association of Regional Cooperation (SAARC).

The concept of regional cooperation in South Asia has already attained its eleventh year, but nothing concrete has taken place in the direction of regional approach to natural resource and environment management. Some of the key issues such as sharing of water resources, harnessing of hydropower potentials, joint approach to combat the natural disasters, conservation of bio-tech and marine resources continue to evade the attention of these nations, though all of them have remained directly affected by all these issues.

The structural adjustment policies which are currently accompanying the open economy industrialization strategy of almost all the South Asian countries, are likely to put further strains on the natural resources, poor and downtrodden and environment at large unless a concerted plan of action for its management and conservation is put into immediate effect. The impact of Trade Related Intellectual Property Rights (TRIPS) on the exploitation and conservation of genetic resources within its vast biodiversity, also needs to be addressed at a regional level. In fact the lack of regional debate on these critical issues has further confounded the traditional attitude of the regional partners to be within the cocoon syndrome.

In the vital area of adopting strategies for environmental protection in the region, it is essential to envisage and concretize some sort of coordination and cooperation in the areas of environmental law and policy, government interventions, social mobilization and scientific and technological interventions. This chapter addresses itself to some of these issues with an avowed objective of highlighting the major concerns rather than making any rigorous analysis of the issues.

NATURAL RESOURCES

South Asia as a region has diverse pattern of natural resources. In some cases they are abundantly endowed with. In terms of mineral resources,

though India is significantly endowed with, other countries also have impressive reserves of specific resources; Bangladesh has huge deposits of coal (1820 million metric tons) and natural gas (1050 billion cubic metre) and Pakistan has a bulk of coal, natural gas and crude oil reserves. There has been a fair sprinkling of other natural resources like forest, natural rubber, bauxite, marble in Nepal, Bhutan and Sri Lanka. The region as a whole continues to have about 16 per cent of the total area covered by forest resources (Tables 1, 2 and 3).

Table 1 Fossil Fuel Reserves in the SAARC Region (1990)

Country	*Coal & Lignite (Mmt)*	*Crude Oil (Mbls)*	*Natural Gas (Bcm^3)*
Bangladesh	1820	40	1050
Bhutan	—	—	—
India	59000	5549	687
Nepal	—	—	0
Pakistan	145	139	462
Sri Lanka	—	—	—
Total (SAARC)	61089	7210	2487
SAARC % of World	5.7	0.71	2.1

Source: World Energy Council Report 1992.

Table 2 Ocean Thermal Resources of the Region

Country	*Delta T (c) between 0-100 m*	*Distance from Resource to Shore (km)*
India	18-22	65
Maldives	22	1-10
Sri Lanka	20-21	30

Source: United Nations, *A Guide to Ocean Thermal Energy Conversion for Developing Countries* {ST/ESA/134} New York, 1984, Table 1.

One of the major advantages of the SouthAsian nations is that they command many scarce biological resources. Their tropical forests are the banks of fabulous genetic heritage and their biodiversity in tropical forests of high mountain areas will be one of their strong sources of strength in future bargaining with the advanced world which needs these genetic resources in their industrial processes, such as biotechnology (Table 3).

The region possesses, vast stores of clean and renewable energy. Nepal alone has the potential for 83,000 MW of hydropower. The estimated hydropower potentials of the countries of the region are:

Bangladesh (52000 MW), Bhutan (21000 MW), India (75400 MW), Pakistan (20777 MW) and Sri Lanka (2000 MW). However, a very small proportion of this great potential has been exploited so far. (Tables 4 and 5.)

Table 3 Forest Types in South Asia

Country	*Forest Type*	*Area (in million hectares)*
Bangladesh	(a) Evergreen	1.52
1986-87)	(b) Moist deciduous	0.27
	(c) Mangrove	0.67
Bhutan	NA	NA
India	Tropical moist deciduous forests	23.68
	Tropical dry deciduus forests	18.66
	Tropical set evergreen forests	5.12
	Sub-tropical and alpine forests	16.74
	Mangrove forests	0.4
Maldives	NA	NA
Nepal	NA	NA
Pakistan	NA	NA
Sri Lanka	Low country wet zone	1.45 %
	Montane zone	1.54 %
	Intermediate zone	Neg
	Dry zone	21.97 %

Source: SAARC (1992, b) p. 53.

Since wind, solar power or biogas cannot meet all the needs, clearly hydropower is the best choice amongst other options both in terms of cost effectiveness and environmental safety. Moving in this direction opens up all sorts of other benefits. Amongst the best sources of hydropower are multi-purpose hydel projects. These yield irrigation, flood-control and navigation benefits in addition to producing electricity. To take a concrete example the detailed feasibility of the Karnali-Chisapani project in Nepal indicates that it could produce 10,600 MW of power, irrigate 3,300,000 hectares of land (90 per cent of benefited land area will be located in India) yield enormous flood control benefits, and well timed regulation of the flow of water from the reservoir could make parts of the Ganges navigable. It would certainly arrest a major part of the sediment flowing into the Ganges. Each of these features yields major benefits for the ecology and the economy. Such a vast increase of irrigated tracts if well managed and efficiently drained would help to feed the additional billion or so that are likely to be born in the subcontinent in the next century.

Table 4 Hydroelectric Potentials in South Asia

Country	*Hydroelectric Potential (in MW)*	*Total Installed Capacity (in MW)*
Bangladesh	52000	230
Bhutan	21000	355
India	75400	20800
Nepal	83000	254
Pakistan	20777	2892
Sri Lanka	2000	1137

Sources: (i) Government of India, *Economic Survey*, Ministry of Finance, 1995-96.
(ii) Central Bank of Sri Lanka, *Annual Report*, 1995.
(iii) His Majesty's Government, *Economic Survey*, Ministry of Finance, 1994-95.
(iv) Royal Government of Bhutan, *Seventh Five Year Plan 1992-97*, Planning Commission.
(v) SAARC, 1992(b).

Table 5 Installed Generating Capacities in Power Utilities (1989-90) (MW)

	B'desh	*India*	*Nepal*	*Pakistan*	*Sri Lanka*
Thermal	2370	58100	29	4167	272
Nuclear	—	2200	—	137	—
Hydro	230	20800	254	2892	1137
Total	2600	81100	283	7205	1409

Sources: Same as Table 4.

Flood control would add to the security of the crops and if the Ganges can become even partially navigable, the cheapest means of transport would be available in a region which is likely to face the worst pressures on its transport system. Investment in hydroelectric development can also preserve and protect the watersheds of those river systems thereby compelling the upland environmental protection.

There is in this sub-region, already established technological capability in certain solar and other renewable resources of energy generation, particularly in India. In the past, these sources of energy were left untouched as they were prohibitively expensive. Small scale solar system including the so-called passive systems to tap direct heat-wind biogas, special wood and mini-hydro units, are all in the area of present feasibility, with promise of extensive utility. These sources could reach the most inaccessible and remote locality, as well as the more productive rural area, for purpose of processing and preservation of agricultural and other crops. However, there is need for a coordinated research and its dissemination in many of these areas.

ENVIRONMENTAL CONCERNS

One can broadly identify three types of environmental problems in the South Asia region, namely:

(1) land degradation and destruction of natural resources, including deforestation, soil erosion, soil fertility loss, waterlogging, salinization and toxification of soils, loss of biological diversity, damage to and destruction of coral reefs, mangroves, fisheries and other coastal and marine resources, and excessive extraction and associated problems relating to underground reservoirs of fresh water;

(2) pollution, including pollution of ambient air in cities and household air in villages; pollution of lakes, rivers, underground reservoirs and marine water with detrimental effects on mangroves and coral reefs; toxic waste dumping and environmental hazards emanating from industrial activities;

(3) unsustainable environments in villages/human settlements caused by inadequate or inappropriate shelter, lack of water supplies, poor sanitation, shortage of cooking fuel, poor nutrition, excessive use of agro-chemicals and habitation of environmentally fragile and hazard-prone areas.

In addition, there are predictions concerning the adverse impact of greenhouse gases and the rise in sea level on the subcontinent. These include more frequent storms, flooding, coastal erosion, scarcity in fresh water supply, changes in agricultural yields, loss of biodiversity, and possibly, loss of entire low lying islands.

The causes of environmental degradation in the region may be attributed to both underdevelopment and development. In general, the region's huge population, which has doubled in the course of past three decades and could double again in the next four decades at the current rate of growth, the consequent pressure on resources, particularly with regard to food and agriculture and the inefficient urban industrial growth could be held principally responsible.

DEMOGRAPHIC PRESSURES

The South Asian region has around one-fifth of the world population while it constitutes hardly 3.31 per cent of the world total geographical area. In most of the countries in the region the population growth has far outplaced the growth in agricultural sector. These countries seem to have been caught in a low growth-poverty reproduction syndrome. The

region has witnessed an extensive erosion of its natural resource base over the last fifty years. Since more than 82 per cent of the poor live in the rural areas, the population pressure has a predominant impact on the poverty situation.

Though the projected growth rate of population for the period 1989-2000 is likely to be a little weaker, the overall demographic pressure would pose a major development problem (Table 6). This will be particularly so for countries like Nepal and Maldives which have severe physical limits to cultivation and human settlements. In Maldives only 10 per cent of the total land area is cultivable which makes it dependent on food import for almost 90 per cent of its food requirements. Similarly for a country like Nepal which already has a density of 590 per sq. km of arable land (one of the highest in the world), the only option left would be to increasingly cultivate marginal lands and forests. This may further add to the existing environmental problems of river silting and flooding.

Table 6 Population Size and Rates of Growth in the South Asia 1980-2010

	Population in '000			*Average Annual Growth Rate (%)*		
	1980	1990	2000	1980-1990	1990-2000	2000-2010
South Asia	948770	1191360	1468952	2.28	2.09	1.79
Bangladesh	88221	113684	144265	2.54	2.38	2.07
Bhutan	1242	1539	1942	2.14	2.33	2.38
India	688856	846191	58267	2.06	1.86	1.55
Maldives	158	213	286	2.99	2.95	2.63
Nepal	14858	19571	24858	2.76	2.39	2.22
Pakistan	85299	118122	154794	3.76	2.70	2.45
Sri Lanka	14819	17217	19438	1.50	1.21	1.05

Source: United Nations, *World Population Prospects*, the 1992 Revision, UN publications, Sales No. E.93.XIII.7.

The population in the South Asian region as a whole is projected to grow at an average annual rate of 2.1 per cent during the current decade. Only India (1.9 per cent) and Sri Lanka (1.2 per cent) are expected to achieve growth rates under 2 per cent. In absolute terms also, the population of South Asia which increased by 243 million during the 1980s is projected to increase by 278 million during the 1990s and by 289 million between 2000 and 2010. The increasing urbanization is reflected in the glaring fact that more and more people are moving to the urban

areas thereby putting a heavy pressure on both employment and civic utilities (Table 7).

Table 7 Population Density and Urban Population

	Mid-1990 Population Density (persons/sq. km)	*Urban Population as Per Cent of Total*
Bangladesh	730	14
Bhutan	13	5
India	267	28
Maldives	715	25
Nepal	119	10
Pakistan	142	32
Sri Lanka	260	21

Sources: Country Studies, SAARC 1992(b) and World Bank Reports.

PRESSURE ON LAND AND AGRICULTURE

Agriculture sector has been the backbone of the South Asian economies which contribute as high as 45 per cent in Bhutan's gross domestic product. Expectedly this is the sector which would have to mostly bear the brunt of population pressure. However, could this sector any longer withstand the pressure? In Sri Lanka land use pattern has undergone drastic changes as increasingly mangroves and wetlands are cleared for aquaculture; this has reduced natural productivity of these highly sensitive ecosystems. On top of this, shifting cultivation (15.38 per cent of the total land area) continues to be pervasive as a traditional agriculture practice with hazardous environmental consequences. The *terai* region popularly known as the granary of Nepal is soon going to be an explosive issue both because of an unprecedented population pressure arising out of migrations from the hills and from across the border and rampant deforestation leading to soil erosion and flood havoc. Table 8 gives us a notion about the distribution of land into major areas like crops, forest and grass.

The requirement to expand both cash and food crop production is encouraging the abandonment of the traditional cropping system in favour of energy-intensive, very often mono-cultural cropping patterns that are dependent on irrigation expansion that ultimately lead to increased waterlogging and salinity. Agricultural chemical residues pollute ground and surface waters, and soil fertility and

natural pest resistance decline. Soil erosion and the consequent nutrient losses degrade the resource base further. This process is exacerbated by limited accessibility of richer farmers only to resources and technologies such as those under the green revolution. In many cases as richer farmers prosper, small farmers are pauperized and driven to landlessness and eventually to already overcrowded urban areas or marginal lands that should never be cultivated, except possibly with long rotation periods.

Table 8 Land Use in SAARC Countries (mha)

Country	*Crop*	*Forest*	*Grass*	*Other*
Bangladesh	9.56	2.46	0.51	2.63
Bhutan	0.65	2.57	11.75 (inc. other)	1.6
India	180	67.70	12	94
Nepal	3.5	5.5	1.8	4.4
Pakistan	32	4.58	18.5	27
Sri Lanka	1.7	2.53	0.4	1.6

Source: Economic Survey and *Plan Documents* of these countries.

Equally damaging phenomenon in South Asia has been the excessive use of chemical fertilizers to enhance the level of productivity in agriculture. This has been supplemented by intensive irrigation techniques leading to a steady fall in the level of water-table. Though Sri Lanka and Bangladesh have a much higher yield per hectare, it is India which has almost recorded 1.5 fold jump in the yield during the period 1979-1992. In Bangladesh, improper and imbalanced use of fertilizers by the farmers has depleted the soil organic matter content as nitrogen alone contributed about 75 per cent of the total nutrient use (phosphorus 12, calcium 8 and potassium 5 per cent). In India alone over 80,000 tonnes of plant protection chemicals were used in the mid-1980s as against 2000 tonnes in the mid-1950s. All these have further adversely affected the land degradation process. Though in comparison to other countries in Asia-Pacific region the use of chemical pesticides in Nepal is one of the lowest, the pesticide sales by the Agriculture Input Corporation have increased manifold. This is also reflected in the steady rise in the volume of imported agriculture related chemicals as shown in Table 9. Table 10 briefly highlights major land degradation problems in South Asia.

Table 9 Imported Agricultural-related Chemicals including Pesticides

(in million rupees)

Commodity	*1983*	*1989*
Insecticides	8.435	42.167
Fungicides	0.435	0.060
Herbicides	1.728	0.167
Disinfectants	7.745	0.074
Anti sprouting	0.070	1.156
Total	18.125	43.624

Sources: Leela Dahal, "A Study on Pesticide, Pollution in Nepal, National Conservation Strategy", Implementation Project, 1994, p.25.

Table 10 Major Land Degradation Problems in South Asia

Country	*Problems*
Bangladesh	Soil erosion, salinity, acidity of soil, river bank erosion, water-logging, decreasing soil fertility
Bhutan	Soil erosion, river bank erosion
India	Soil erosion particularly sheet and gulley erosion, waterlogging, soil salinity, alkalinity, decreasing soil fertility, spread of weeds, chemical degradation due to pesticides and fertilizers not assessed, land subsidence, mine spoils debris dumps and loss of land due to mining
Maldives	Salinity due to salt water intrusion, coastal erosion
Nepal	Soil erosion, deterioration of soil quality, waterlogging along canal systems, quarrying has let to denudation of hill slopes, excessive erosion and debris accumulation in rivers.
Pakistan	Soil salinity, waterlogging, soil erosion
Sri Lanka	Soil salinity, waterlogging, pesticide accumulation in the soil, ground water and surface water bodies, land degradation due to extraction of raw materials for the ceramic and cement industry, industrial pollutants discharged onto agricultural land, gemming, sand mining, brick and tile clay extraction.

Source: (i) SAARC Secretariat, *Regional Study on the Causes and Consequences of Natural Disasters and the Protection and Preservation of the Environment*, Kathmandu, 1992(b) p. 36.

CONFLICT OVER RESOURCES

In South Asia very often the water resource management problem arises mainly because of water's uneven geographical distribution. These problems can be broadly classified into professional or public issues, the former based on science and the latter on politics. Most of the public issues stem from a combination of three situations (Sharma and Nag, 1994).

(i) Growing awareness of global and regional disparities in water resource availability steadily enhancing expectations and bringing about a change in the water demand,

(ii) The maintenance of the existing level of water resource utilization becoming difficult on the same resource base or pricing structure,

(iii) Resource utilization, abuse or disregard by one group or nation, threatening to cause damage to the other.

The use and management of water resources are very often marred by the politics which in turn can be attributed to the differing demands for this resource in the basin countries depending on variables such as population growth, level of economic development and accessibility to other domestic water sources. When the resource is of an inter-provincial like Kauveri between Tamil Nadu and Karnataka in India or international nature like Ganga between India and Bangladesh it exerts a different impact altogether. Nationalist tendencies along with strong involvement of social organizations are observed to exert resource regionalization on any water resource dispute.

Particularly in South Asia, international rivers constitute a significant proportion of the region's supply of water. Hence much attention is given to them to supplement the national supplies and meet the needs of economic unit, the physical effects generated in one are passed on to its neighbour, giving rise to external influences.

The dilemmas of equitable sharing have long been apparent in regard to the use of rivers common between two or more nations. This is particularly so in case of use of the river Ganges at Farakka between India and Bangladesh and the other Himalayan rivers between India and Nepal. Criteria of prior use, historic rights and relative needs have been advanced as equitable standards, involving numerous controversies between or amongst the states or nations. This is mainly because of the increased demands for water and a reduction in its supply due to natural and man-made causes and a decline in its total volume. This potential scarcity coupled with the new technological developments in agriculture and industry have given rise to the question of equitable sharing and the emergence of fresh water management politics.

DEPLETION OF FOREST RESOURCES

The South Asian region is characterized by a range of forest types depending upon altitudes, climatic zones and annual precipitations. These vegetations vary from tropical wet evergreen forest of Sri Lanka to tropical moist deciduous of Bangladesh and Bhutan to dry alpine

forests of India and Nepal. Forests play a very vital role in the: (i) protection of mountain slopes and catchment areas, (ii) protection against wind, erosion and ravine formation, (iii) protection of wildlife, aesthetic value and recreation, (iv) maintenance of a pool of genetic resources and carbon dioxide balance in the atmosphere, and (v) protection and regulation of water supplies.

However, the rich forest resources of South Asia have witnessed a steady depletion particularly in the last three decades (Table 11). The

Table 11 Forest Area and Deforestation Rates in the Region

Country	*Forest Area (mn ha)*	*Avg. Ann. % of Land Area*	*Rate of Deforestation (%)*
Bangladesh	2.5	17	1.5
Bhutan	2.6	64	0.1
India	68	23	0.3
Nepal	5.5	37	4.0
Pakistan	4.6	5	0.4
Sri Lanka	2.5	39	3.5

Sources: SAARC Secretariat, *Regional Study on Greenhouse Effect and its Impact on the Region*, Kathmandu, 1992(a) p. 39; UNDP, *Human Development Report 1994*, pp. 176-77.

incessant deforestation that took place could be largely attributed to the following factors:

(i) The staggering gap between the quantity of firewood that is consumed in the country annually and that which can be produced on a sustainable basis has further deepened. For example, according to an estimate by the Forest Survey of India about 235 million cu m of firewood were consumed in the country while the sustainable level of production forest was hardly 40 million cu m. In Pakistan nearly 50 per cent and in Nepal almost 95 per cent of the heating and cooking requirements are met by fuelwood every year.

(ii) The cattle and buffalo population in the region increased from 317.09 million in 1980 to 342.9 million in 1992 which doubly enhanced the number of animals that grazed in forests. This has further confounded the gap between availability and requirement of green fodder.

(iii) The exceedingly high demand for timber (for furniture, housing, boat manufacturing and railway sleepers industries) as against a limited supply capacity of the forest resources has resulted into both unauthorized and official felling far outplacing the silvicul-

turally permissible limit. In a country like Bhutan too forest products constitute as high as 16 per cent of its exports.

(iv) The encroachments of forest lands for cultivation, shifting cultivation and diversion of forest land to non-forest uses have been quite rampant in almost all the South Asian countries. In Pakistan forests have been cleared for irrigation projects, farm lands, new townships and roads. In India alone around 0.33 million hectares of land was diverted during 1981-94 to non-forest use such as agriculture, river valley projects, transmission lines and roads.

(v) Mangroves are salt-tolerant, woody, seed bearing plants which generally grow in the inter-tidal areas of sheltered shores, estuaries, fringing reefs and salt marshes. In recent years, mangrove forests have been cleared to make way for ponds for the cultivation of fish and prawns. Mangrove forests have also been destroyed for fodder, timber and firewood, as well as for cultivation and land reclamation.

(vi) Sometimes development intervention itself has often had unintended and grave consequences on the environment. One of the strongest advocates of conservation of forests is USAID. Yet in Nepal a highly successful programme of malaria eradication carried out by USAID triggered off the most major destruction of tropical forests of the Terai. For long a low growth rate of population kept the pressures manageable and malaria was the natural guardian of forest during that period. The eradication of malaria suddenly made it safe to resettle anywhere in the Terai, including the jungles and no alternative mode of protecting the forests replaced malaria the highly efficient guardian. As a result vast tracts of prime eight km deep forest land came under the plough, the rivers flowing into the Ganges changed courses, causing tremendous devastation and the fragile Bhavar range suffered erosion at an alarming rate (Rana, 1995).

Some Adverse Impacts

The depletion of forest resources has a wide ranging impact on ecological balance. The adverse impacts vary from extinction of rare flora and fauna to changes in the climatic conditions and from desertification to flood.

(i) Because of habitat destruction, a number of plants and animals are in the endangered list. In India two species of mammals (Indian

Cheetah and the Indian Rhinoceros) and two species of birds (pink headed duck and mountain quail) and an amphibian Salamander have now been declared as extinct. Similarly in Bhutan a large number of animals have been put in the category of threatened species. It includes, Asiatic elephant, snow leopard, musk deer, pygmy hog and Scalter's Monal pheasant and black necked crane.

(ii) Landslides, one of the direct outcomes of the depletion of forests, are among the major natural disasters in the Himalayan regions of Pakistan, India , Nepal and Bhutan. A survey recently discovered that 78 major landslides occurred annually in the central and western development regions of Nepal between 1970 and 1980. Cloud bursts and flash floods accompanied by heavy rainfall are the main causes of landslides in India. Scientific observations in north Sikkim and Garhwal regions clearly reveal that there are an average of two landslides per sq km. A rough estimate of monetary loss for the country as a whole is of the order of Rs 150 crores per annum. The devastating landslide of 1888 in Nainital, 1950 and 1968 in Darjeeling, 1978 in Nilgiris and 1987 in Sikkim and of 1988 in Matiana in Himachal Pradesh killed thousands of people and destroyed a large chunk of agricultural and forest land. In Pakistan massive landslides take place every year along the highways built in mountain terrains such as the Murree Hills, Pir Panjal and the Hindukush.

(iii) A study showed that Bangladesh is experiencing micro-level desertification over an area of 777,000 ha as a result of prolonged natural and artificial causes like excessive felling of village woodlots, variations in levels and patterns of precipitation, reduction of perennial water resources, increased saline intrusion from the sea, reduction of soil moisture content and lowering of groundwater table. The northwest districts of Greater Rajshahi, Pabna, Bogra, Dinajpur and Rangpur have been the most affected regions.

(iv) The disturbance in the mountain ecology has started attracting a lot of attention. The phenomenon of *jokulhlaup* (glacier leap or burst in icelandic) also known as glacial lake outburst floods (GLOF) is being widely discussed among the mountain ecologists because of its frequent and alarming occurrence. A study done by Kathmandu based ICIMOD confirmed its occurrence in the Himalayan belts of South Asia as well.

On August 4, 1985 a glacial lake drained suddenly and sent a 10 to 15 metre high surge of water and debris down the Bhote Koshi and Dudh Koshi rivers in Nepal for more than 90 km. An estimated 1 million m^3 of water was released creating an initial peak discharge of 2000 m^3/sec, two to three times the magnitude of minimum floods due to heavy monsoon rains. This spectacular natural event destroyed Namche small hydel project, eliminated bridges and swept villages. In 1981 a much larger *jokulhlaup* devastated the Kathmandu-Kodari Highway that links Kathmandu with Tibet. It is largely believed that such occurrences would have taken place in the Indian Himalayas, too, particularly in the Eastern region. This has to be seen against the backdrop that 15000 odd Himalayan glaciers cover about 17 per cent of the mountain area as compared to about 2.2 per cent in the Swiss Alps.

Landslides caused by flash floods often temporarily dam rivers with narrow gorge. The accumulated boulders and rocks transported by these turbulent rivers throttle the narrow river passage. This builds up a reservoir of trapped water which ultimately forces the debris out and bursts releasing an even more intense flood that leads to yet larger landslides and mass wasting.

(v) Of critical importance is the fact that forest watersheds are the main source of water needed for energy, irrigation and domestic use.

(vi) Soil erosion strikes at the first resource base of development. It assumes enormous proportion in some cases and prevails in varying forms in all countries. In case of Nepal its most important export has been the enormous tonnage of soil that washes down annually to other countries. Disastrous flood—it has been estimated that by the year 2000, there will be about 1,000 million people living under the shadow and by the waters of the Himalayas along its subcontinental range.

(vii) The forest fire which has become a recurrent phenomenon is also largely attributed to deforestation and subsequent wrong regeneration of forests. The forests of Garhwal and Kumaon were of the mixed deciduous type. Beginning with the colonial British administration and intensifying later in the 1950s and the 60s, this region was saturated with pine trees, on the ground that this species has a short maturation period, enabling a higher rate of timber extraction. It also allowed for several industrial applications based on pinewood resin.

Other ecological factors have been ignored. Earlier mixed forests gave local populations a wide range of fuel, fodder, food and medicines.

Leaves, branches, twigs and bark pieces had a rapid turnover period. Left to themselves, such droppings, deadwood and remnants are tinder material. Pine fruit and needles have found much less community use and their annual accumulation actually renders a huge part of the UP hills every hot summer a giant tinder box waiting to be kindled.

Impact of the Greenhouse Effect

The SAARC Secretariat in Kathmandu has for the first time come out with a preliminary study on the Greenhouse Effect and its impact on the region. The study shows that for SAARC countries the energy sector is the primary contributor of carbon emissions. The fuel source however, varies between countries depending on the energy base of each economy. For example in India, coal is the major contributor to emissions, in Sri Lanka and Nepal it is biomass (in Sri Lanka burning of fuelwood 75 per cent, agricultural waste 22.5 per cent and bagasse 2.5 per cent) particularly fuelwood, in Bangladesh it is natural gas, while in Pakistan it is oil and gas. Further it is found that in Sri Lanka the household sector is the largest contributor of carbon emissions. In Bangladesh it is the industry which is accountable for the largest carbon emissions (Tables 12 and 13).

Table 12 Summary Statement of Largest Carbon Emissions by Sector and Fuel for the SAARC Region

Country	*Sector*	*Fuel*
Bangladesh	Industry	Natural gas
Bhutan	Domestic	Fuelwood
India	Industry	Coal
Maldives	Domestic	Oil
Nepal	Domestic	Fuelwood
Pakistan	Industry	Oil and Gas
Sri Lanka	Domestic	Fuelwood

Source: SAARC Secretariat, *Regional Study on Greenhouse Effect and its Impact on the Region*, Kathmandu, 1992(a), p. 46.

The SAARC study concludes that:

(i) the largest impact will be on Bangladesh where there will be a 1.5 metre rise in the sea level by the middle of the next century. This rise is expected to inundate about 15.8 per cent of the total area of Bangladesh. As a result 13.74 per cent of the net cropped area and 28.29 per cent of forest area of the country will be lost. About 9 per cent of the country's population will not have any option but to migrate to the urban areas. The inundation of cropland is expected to cause a loss of nearly Taka 29.71 billion worth of agricultural crops.

Table 13 Estimated Carbon Dioxide Emissions from the use of Fossils Fuels in South Asia

(million tonnes/year)

Country	*Actual*	*1986 S1**	*2000 S2***
Bangladesh	3	6	5
India	119	226	200
Maldives	0	0	0
Nepal	0	0	0
Pakistan	13	31	27
Sri Lanka	1	3	2
Total (SAARC)	136	266	236
Total (Asia Pacific Region)	911	1652	1418
SAARC Emissions of % of A-P Region	15	17	17

*S1: Business as Usual **S2: Emphasis on energy conservation.
Source: UN ESCAP 1991. *Energy Policy Implications of the Climatic Effects of Fossil Fuel Use in the Asia Pacific Region* (ST/ESCAP/1007), UN, Bangkok.

(ii) in Sri Lanka, if the present trends in rainfall and temperature variations continue, there is likely to be a change in the present boundaries of the agro-ecological zones with definite effects on agriculture.

(iii) large inter-annual variations in rainfall intensities, makes it difficult to discern a clear picture of the impact of warming on the spatial distribution of rainfall in India. Based on a scenario of increasing temperatures, it is predicted that there will be serious effects on the productivity of many crops. The east coast of India, with a larger frequency of storms and lower continental slopes, is more vulnerable than the west coast to damages from storm surges and cyclonic activity.

(iv) in Pakistan there is likely to be a potential decrease by 0.45 tonnes per hectare for wheat and 0.7 tonne per hectare for rice for every 1 degree Celsius rise in temperature or 10 per cent decrease in precipitation. It is also expected that a global warming scenario will increase the country's susceptibility to pests and insects, and may lead to a further dependence on insecticides and pesticides.

(v) increased ice melting in the Himalaya together with changes in rainfall patterns could inundate vast areas of the flood plains of the

Ganga-Brahmaputra-Barak basins which will multiply the miseries and sufferings of millions of people.

Impact on Mountain Ecology

The unplanned and haphazard mining in the Himalayan regions has destroyed the natural setting, made the slopes barren and unproductive and destroyed leaf mould—a valuable organic fertilizer. In the Doon Himalayas, the extent of limestone dust particles from the quarries has been estimated at 360 micrograms per cubic metre as against the safety level of 100. The dust that explodes from the mining operations in the Himalayan terrain pollutes air and causes damage to the organic life.

Himalayas as the name implies are the "abode of snow." The total ice cover in the terrain is around 16,000 sq. km, i.e. 17 per cent of the total area. There are about 15,000 glaciers and a very large number of them exist at present above the snowline. Most of them are located in the Great Himalayan Ranges. These glaciers vary in their shape, size and structure. These glaciers are the banks of water for the Indo-Gangetic Plain. The Gangetic glaciers in Central Himalayas—a source of the river Ganges—have an ice surface of 200 sq. km and its total volume is approximately 20 cu km of ice. The Brahmaputra which ranks among the mighty rivers of the country, rises in the Great Glaciers in the Kailash Range of the Himalayas.

The deforestation in the Himalayas has greatly affected the climate, the amount of snow and also the volume of ice is fast decreasing. It is taking a serious turn of ecological disaster. It is necessary to make an exhaustive study of the Himalayan glaciers, their parameters, rate of erosion, amount of debris and the total volume of ice.

The Himalayan rivers such as Indus, Ganges and Brahmaputra drain a number of countries in South Asia and provide a large quantity of water to be used for irrigation and domestic purposes. The enormous erosion caused by these rivers producing a vast quantity of debris and silt has already assumed a complex shape. The silt and sediments are shrinking the basins of the rivers and this causes floods in the rivers. The frequency of floods causes a great loss to top soil besides loss of life and property.

The grasslands in the Himalayan belt are fast disappearing on account of constructional development works, emerging of new colonies, new roads, new projects and unplanned land use. As the grass

cover is shrinking it is bound to cause a crisis in the ecosystem. In order to provide a protective soil cover and to meet the increasing demand of herbage there is a dire need of planting improved and better varieties of grass and implementing their proper and efficient management. Silvipastrol or Silvi-horti-pastoral systems in the Himalayas are more useful and profitable as compared to grass development alone. Effective protection of grazing lands would increase the herbage cover and herbage yield. Fertilization and introduction of grass legume mix in the mid hills and cockfoot, Timothy, perennial rye grass and cantucky grass in the sub-Alpine and Alpine grasslands can regenerate the degraded grass cover.

Crisis in the Mountains

The Himalayas constitute the highest mountain system of the world. They extend over a distance of above 2,500 km breadth varying from 150 km to 400 km and cover an area of about 5,00,000 sq. km. They are tectonic mountains formed due to upheaval of Tethyian sediments. They are still rising at the rate of 1 cm per year and according to an estimate it took several million years for the Himalayas to attain their present status and structure.

The Himalayan belt is highly unstable, comprising metamorphosed sediments and is so sensitive that a slight vibration caused by any agency can disturb them. The seismic history of Himalayas makes it clear that more than 95 per cent of the Indian earthquakes have been experienced in this belt. These earthquakes have taken a huge toll of both human lives and property.

The damage to the Himalayan environment can be broadly attributed to (i) rubbish and pollution above the Base Camp—fixed ropes, oxygen, bottles, faeces, general detritus, (ii) rubbish at and below the Base Camp—tins, plastic, faeces, (iii) pollution of water supplies, and (iv) deforestation.

Far more important is the degradation of the lower slopes due to wood cutting for building and for fuel, the latter mainly for the use of locals and porters but also for facilities for tourists.

Overcrowding on the popular 8000-m peaks mainly worries those who knew the Himalayas when there were restrictions on access. Nowadays, there can be more than one hundred people strung out on the ordinary route of Everest. Many of these people are not mountai-

neers in a true sense as they hire others to make decisions for them, to pass judgement as to whether it is right to continue or to retreat, to pick out a route, to select a safe camp site, and more often than not to do camp chores. This is the modern breed of high mountain tourists who have bought their way onto that mountain.

Monsoon modeller AD Vernekar and his colleagues at the University of Maryland have worked out how the snow cover in Europe and Asia, especially in the Tibetan plateau, affects the Indian monsoon. Using what he calls a COLA (Centre for Ocean-Land-Atmosphere Interactions) global circulation model, the scientists found the monsoon to be strong all over India, when the snow cover in the two continents was light, and weak when the snow cover was heavy. Scientists have known for long that the temperature gradient between the equator (0 degree), which is usually warmer, and the 35 degree North parallel, which is cooler, reverses when the monsoon builds up. Through June, July and August, the temperature at the 35 degree North parallel, which coincides with the 4,000 metre high Tibetan plateau, is higher than that at the equator. It is this difference in temperature that is believed to induce the monsoon winds. Scientists found that a heavy snow cover results in a weak but prolonged monsoon because the absence of dense clouds causes more solar radiation to reach the earth's surface and maintains the reversed North-South temperature gradient for a longer period (Khanna, 1993).

NATURAL DISASTERS

In South Asia, most of the countries having fragile developing economies are more vulnerable to natural disasters. However, we continue to live without any adequate natural disasters planning and systematic management. There appear to be three causes which dominate natural disaster processes: (i) human vulnerability resulting from poverty and inequality, (ii) accelerated population growth, especially among the poor, and (iii) environmental degradation and poor land-use management systems.

The five SAARC nations—India, Pakistan, Nepal, Bhutan and Bangladesh, having the Himalayan range as their boundary have a long history of seismic tremors. One can see the frequency of occurrence and subsequent devastation increasing every decade (Table 14).

Table 14 Lives Lost in Some Major Earthquakes in South Asia

Place	*Loss of Lives*
Kangra (India, 1905)	20,000
Assam (India, 1950)	26,000
Darbhanga and Madhubani (India, 1988)	500
Latur (India, 1993)	10,000
Queta (Pakistan, 1935)	60,000
Beshan (Pakistan, 1973)	5,000
Kathmandu Valley (1934)	3,400
Tashigang Dzong (Bhutan, 1988)	NA

Flood Havoc

The accelerated erosion of mountain slopes has removed the top soil and the productive capacity of the terrain has greatly been affected. It is estimated that about 1.5 million hectares of good forest land is lost every year because of the environmental assault. The eroded soil can neither hold water nor nutrients. The absence of vegetal cover is also responsible for promoting the quick run off of water and a very little seeps into the ground to re-appear in the form of springs. The level of underground water has been going down slowly and gradually and there has been a substantial decrease in the volume of sub-surface water.

The siltation and sedimentation caused by soil erosion results in the shallowing of the river valleys and in turn causes floods. The floods make soils barren, unproductive and defective. On an average, floods annually, affect an area of about 8 million hectares of the Gangetic plain, including about 3.5 million hectares of cropped land. The estimate made by scientists comes to Rs 5,000 crore as a loss caused by the floods during the last 5 years.

A Report by the Centre for Science and Environment (1991) mentions that:

- India is the most flood affected country in the world after Bangladesh.
- It accounted for one-fifth of the global death count due to floods from the 1960s to 1980s. Over 30 million people were displaced annually.
- Annual flood damages increased nearly 40 times from an average of Rs 60 crore a year during 1950s to an incredible Rs 2307 crore a year during the 1980s. The flood affected area shot up from an average of 6.4 million hectares a year in the 1950s to 9 million hectares in the 1980s

Bangladesh has the worst record of cyclones and tidal surges. They occur so frequently and in such magnitude that they are directly responsible in multiplying the problems of poverty. According to meteorologists, the peculiar geographical location of Bangladesh and the inverted funnel-shaped bay is particularly prone to cyclones. And due to the high density of the coastal population, even a minor storm can wreak major havoc. Its tumultuous past is recorded below. The southern Bay of Bengal is notorious for spewing out cyclones, inevitably, Bangladesh has had to bear the brunt of their fury (Khan, 1994).

- 1854: The region's earliest recorded cyclone devastates the entire Barisal coast.
- 1876: The Bakerganj cyclone strikes Bangladesh coastal areas, claiming 200,000 lives.
- 1919: Originating in the Pacific, a great cyclone travels 6,000 km in 20 days to Bangladesh.
- 1970: In the worst cyclone so far, 5 coastal districts were completely devastated: 2 million people die and 5 million are affected.
- 1985: A cyclone-driven tidal wave claims 10,000 lives in the island of Urir Char.
- 1991: Last of the big ones, the cyclone claimed 138,000 lives. Total damage estimated at $2.5 billion.
- 1994: Claimed 233 lives and destroyed properties worth $131 million.

Later a study on the impact of the 1991 cyclone carried out by BCAS (1991) showed that (i) both the pH and salinity of soils were more in the affected areas, (ii) 25-30 per cent of mango and jack fruit trees were found uprooted, (iii) sharp increase in reliance on deep tube wells for drinking water due to the visible pollution of pond water, (iv) farmers lost their stock of seed and food, livestock and equipment and could not work for the next crop, and (v) the prey-predator relationship has been badly disturbed.

BIG DAM CONTROVERSIES

One of the most controversial projects in India has been the Tehri Dam project. A clutter of independent reviews including by the Ministry of Environment and Forests (MoE&F) has indicted the dam on every possible ground—costs, safety, seismicity and design. The MoE&F warned that in the case of an earthquake induced dam failure, the reservoir will empty out

in 22 minutes; and in 63 minutes, a 260 metre-high column of water will inundate Rishikesh; in 80 minutes a 232 m high water column will inundate Hardwar. This is definitely an alarming warning. The government claims that the project has been reviewed thrice since 1992, and maintains that every objection has been adequately met and there is no need for a review. (Bahuguna, 1995).

Investigation on Tehri high dam, which was first to be located at Dobra 12 km upstream to Tehri was completed by mid-sixties, but later the engineers thought it would be profitable to build a high dam at the present site below the confluence of Bhagirathi and Bhilanga. The installed capacity of the dam was to be 600 MW (1972), providing irrigation to 2.7 lakh ha. and cost Rs 192.9 crore in 1977; but later the project was revised. It was to generate 2400 MW electricity and its cost in 1989 was Rs 3,000 crore, which now is estimated to be Rs 6,500 crore. However on the grounds of resource constraint only the stage-I with 1000 MW has been taken up with a cost of Rs 3334.50 crore till March 1994. The benefits from irrigation are said to be same but in order to prove the utility of project later 300 cusec (162 million gallons) of water per day was to be given to the metropolitan city of Delhi and 200 cusec (100 m gallons) to some other towns of western U.P. Since the Planning Commission first sanctioned Tehri dam in 1972, peoples' movement against it started and work could not be started till 1978.

As soon as the river was diverted into the diversion tunnel and site clearance for the dam started, peoples' movement led by noted Gandhian and environment activist Sunderlal Bahuguna became active in December 1989. The agitators took hold of the site and stopped the machines at work. A MoE&F's Environmental Appraisal Committee for river valley projects was examining the project and in 1990 it came out with a unanimous report:

> "taking into consideration the geological and social impacts accompanying the project, the cost and benefits expected; and after a careful examination of the information and data available, the Committee has come to the unanimous conclusion that the Tehri project, as proposed should not be taken up as it does not merit environmental clearance."

In the construction of dams, a supremely important factor is a trade-off—the balancing of costs against the associated risks. All risks calculations are based on the law of probabilities. The High Level Committee appointed in 1990 had used a 50th percentile estimate of peak ground acceleration during earthquakes. This implies that during half of the total number of earthquakes, the dam would be in great jeopardy. (*Down to Earth*, July 15, 1995)

Sharma (1987) gives the list of nine such events including Gohna in Alaknanda in 1953, Tista in 1969 and Chenab in 1970. In August 1968, a huge rock slide occurred in the Burhigandaki river at Lamusi, damming the river for 29 hours. The Alaknanda blockade of 1970 and Bhagirathi blockade of 1978 are recent. Alaknanda deposited huge amount of silt in Ganga canal even beyond Hardwar and Dabrani (Bhagirathi) blockade raised the river bed by 6 metres at Tehri 100 km downstream. Kulekhani tragedy in Nepal is the latest which damaged the power station and killed thousands.

The Sardar Sarovar Project of India has also been fraught with endless controversies. The Narmada Bachao Andolan led by a well known environmental activist Medha Patkar has brought forth many environmentally untenable facets of this project before the public debate. In fact, the World Bank's "Project Completion Report" for the controversial Sardar Sarovar dam on the Narmada has cast a shadow over the project's future. India's unimpressive track record in operations and maintenance, says the report, is responsible for the uncertainty.

India has borrowed US $151.5 million from the WB to build the dam. The Bank's plans to lend more money were cancelled in 1993, following the Indian government's failure to meet the new conditions for additional loans. These conditions are as basic as identifying the displaced and resettling them. The authors of the report admit that the WB "did not follow its own environmental guidelines", such as environmental impact studies, while going ahead with the project. They point out that if there are extended delays in the construction of the dam, there could be a 25 per cent reduction in power and a 30 per cent reduction in irrigational benefits.

The Rs 2,000 crore Assam's Barak Valley multi-purpose project has emerged as another serious contentious issue between India and Bangladesh as the latter apprehends that it will reduce the Sylhet region of Bangladesh to a sandy waste. The Jamat-e-Islamia and the Brihatta Sylhet Gana Dabi Parishad are backing anti-dam green activity. The project aims at controlling the recurrence of high flood in the Barak valley and generating 1500 MW of hydel power in a phased manner. There is some consternation within the North-East region too. The Manipur state Government is barraging the project, claiming that it might cause the submergence of 31 Hmar tribal villages in its Churchandpur district affecting 1316 families. Tippaimukh, the dam site is on the Assam-Manipur border. (*Down to Earth*, February 25, 1995)

The Arun Valley is a remote area of the Himalayas in Nepal inhabited by the 450,000 people from ten different groups. The Arun III

project with an initial capacity of a little over 200 MW and tagged at US $764 million is by far the largest single development project in Nepal. According to a Nepali planning expert Arun provides the cheapest firm energy, i.e. at the rate of 5.94 cents per kW/hr. If one takes into account only the cost of the project to the national economy, the production cost of both firm and average energy will be less than 2 US cents per kW/hr. (Mahat, 1995). Construction of the 117 km road through eastern Nepal, opening one of the last large areas of unaffected indigenous forests, from altitudes of a few hundred metres above sea level to the forest boundary at about 4000 metres, will in the long term produce severe ecological damage, and will severely encroach upon the Barun reserve, which continues to be Nepal's one of the most important national conservation treasures (Hagen, 1995).

A number of NGOs united to form a group called Alliance for Energy in February 1993. How quickly and convincingly it could mobilize the people against this gigantic high dam project could be seen from the fact that the World Bank , one of the major financiers of the project sent team after team to review the project. The Projects Inspection Panel established in November 1994 on the insistence of four Nepalese NGOs maintained that Nepal's proposed Arun III dam involves "apparent violation of policy that requires further investigation."

Ernst Gunther Broder of this inspection panel earlier said that information discloses that environmental and social impacts and resettlement issues need to be considered adequately before the project starts. An exhaustive study of alternatives to tackle the dam's negative impacts should also be conducted without delay. And by July 1995, the World Bank withdrew from this project saying "large complex projects require institutions like World Bank to weigh the benefits against the risks and then decide on their feasibility." The WB President Mr James Wolfensohn added, "irrespective of whether that was the right or wrong decision at the time, I concluded that under today's circumstances and the information at my disposal, the risks to Nepal were to great to justify proceeding with the project"(Dutt, 1995).

THE WITHDRAWAL SYNDROME: ENRON PROJECT IN INDIA AND DS PLANT IN PAKISTAN

Two very significant events that have brought into limelight the likely environmental hazards created by setting up of plants by foreign based

companies have rattled the environmentalists in South Asia. In both cases, the proposed plants have severe environmental implications which led to serious public debate. This debate finally gave way to a strong pressure on these firms leading to either cancellation of the project or forcing them to withdraw from the project or introducing a substantial modification in the environmental safety clauses of the project.

The Konkan belt where the US multinational giant, the Enron Development Corporation, is setting up a 2015 megawatt gas-fired combined cycle power project has been traditionally known for its horticulture, particularly its mango plantations. Mangoes and other fruits worth crores of rupees are exported from the region. The Dabhol Power Company (DPC), formed by Enron with General Electric and Bechtel Enterprises, has acquired 595 hectares of land for its power plant. Naturally the residents of this belt fear that the pollutants emanating from the industries springing up in the area will eventually have an adverse effect on their fruit crops.

In the period between June 1993 when the Company submitted its rapid environmental appraisal to the Union Ministry of Environment and Forests (MoE&F) and November 1994 when it was finally given the go-ahead, the company has faced numerous questions about its environmental soundness. The DPC boasts of opting to use liquified natural gas (LNG) to fuel its power plant because it is environmentally benign, emits virtually no sulphur dioxide, and unlike coal, does not lead to the by-products of fly ash and slurry, which pose enormous problems for disposal.One of the major objections raised to the DPC is its potential to contribute to pollution during the first phase (695 MW) when it will use distillate oil. The level of sulphur dioxide released by this fuel is higher than that released by Indian coal, which is low in sulphur content. The DPC, however, counters this objection by pointing that it has conducted extensive tests on existing levels of sulphur dioxide and nitrogen oxide in the air around the plant site and concluded that even with distillate fuel the emissions of both gases will be well below the Indian Government standard of 80 micrograms per cubic metre for both. While the levels of nitrogen oxide will go up from the existing 21$\mu g/m^3$ to 21.9$\mu g/m^3$, the levels of sulphur dioxide will rise from the existing 21 $\mu g/m^3$ to 22.1 $\mu g/m^3$. LNG will increase the nitrogen oxide levels by another 2.0 $\mu g/m^3$ but will not affect the sulphur dioxide levels. These projections can be tested only when the plant actually gets underway. The potential

damage to local fishing resulting from the discharge of hot water into the sea is another serious objection. (Sharma, 1995)

When a Pakistani NGO, Sustainable Development Policy Institute (SDPI), received news from Greenpeace International about the imminent transfer of Copenhagen based Dansk Sojakagen's (DS) old chlor-alkali factory in March 1994, it along with Greenpeace and several Pakistani and Danish NGOs immediately launched a campaign to halt the shipment. The international environmental organization warned that the mercury cell technology was the "oldest and dirtiest" of the 3 major technologies for chlor-alkali production. It had already been discredited worldwide on account of numerous health hazards associated with mercury poisoning, such as nervous disorders, nightmares and insanity. (Chiranji, 1995)

In western Europe, the havoc wreaked by mercury contamination had led to a decision by all Paris Commission countries (including Denmark) to phase out the mercury cell technology. Chlorine, was also under severe attack the world over for possible ill effects such as cancer, birth defects and liver damage. The Copenhagen Environmental Protection Agency (CEPA) categorized the equipment as chemical waste in March 1994, in the hope that under the Basel Convention—which prohibits the export of hazardous waste from the Organisation for Economic Cooperation and Development (OECD) countries to non-OECD countries—it would not be allowed to leave Denmark.

Danish workers who had been employed at the DS plant and nearby residents also wrote to the Danish government about the monumental problems that they had faced for 20 years. In a dramatic gesture of solidarity, local Danish activists began a 24-hour candlelight vigil on November 9 in Copenhagen as the mercury-contaminated equipment for the plant was loaded into containers for shipment to Pakistan. The shipment was to reach Pakistan by the first week of December 1994. Danish dock workers and Pakistani trade unions also voiced their condemnation of the transfer by refusing to be associated with the loading and unloading of the shipment. In the face of escalating protests, the Senate Committee on Environment agreed to re-examine its earlier decision to allow the hazardous plant into Pakistan. Finally the Ravi Alkalis announced their intention not to press ahead (Charanji, 1995).

GENETIC RESOURCES AND THE PATENTS

A widely debated issue has been as to what extent the patenting of genetic resources would be detrimental for the regional economies. These are primarily agricultural economies and therefore heavily dependent on genetic resources for upgrading and maintaining agricultural stocks. Privatization of genes under the new regimes of TRIPS, leading to license fees for their use would not only result in the absurd spectacle such as to pay for the use of their own property, but also increase the already strained research budgets in these countries. Scientific research would suffer, leading to diminishing technological capacity, thereby both exacerbating the technology gap and increasing dependence.

A noted activist writes, "although patents and PBRs have a 'research exemption' clause which allows protected material to be used for basic research, the results of such research cannot be applied commercially. Developing a technology means commercial application of research results. This would not be possible without the payment of heavy licence fees for using patented genetic material. This would for example, mean that Indian scientists would be restrained in their ability to use the plant germplasm to breed improved varieties for their farmers. It would also mean that India would be hindered by patents to develop an indigenous biotechnology industry using its germplasm. If the compounds in the Indian Neem are patented by a foreign company like WR Grace, Indian industry would have to pay royalty to be able to establish its own Neem based biopesticide units" (Sahai, 1995).

Ecologists and biologists are concerned about another dangerous offshoot of gene patents. That is genetic erosion. The pro-patent lobby argues that patenting is not the only process to induce genetic erosion, that intensive cultivation, particularly the Green Revolution has already contributed to that. On the other hand, the anti-group argues that just because other systems have already caused damage, does not mean the way is opened to compound the problem still further.

No sooner the infamous Trade Related Intellectual Property Rights (TRIPS) became effective under the new World Trade Organization, the countries in South Asia have started confronting very serious issues which have squarely challenged their rights over such resources which they thought so far were their exclusive domain. The examples of Neem (*Azardirachta indica*) and Haldi (*Curcuma longa*—turmeric) are most

exciting that have alarming long-term implications. In fact there could be large areas where the patents have been registered by the big corporations without even giving an inkling to the developing countries.

A recent study done by the Centre for Science and Environment revealed that out of the 36 Neem patents filed so far 72 per cent are held by corporations (as high as 22 by the US corporations of which 12 deal with manufacturing processes especially those interventions which help increase storage, stability) (Table 15). More serious aspects are that (i) most of these patents were filed during the last 10 years when the TRIPS debate really enlivened with consistent opposition from many developing countries, (ii) WR Grace and Co of US dominates the patented rights with 11 patents in its name alone, (iii) 30 out of the 36 patents deal with neem related substance being used as pest-control agents, and (iv) no Indian agency or individual has yet obtained a patent for developing a manufacturing process that would increase the marketability of neem related products (Agarwal, 1996).

Table 15 Patents on Neem-related Products Filed since 1985
(Classified according to country)

Country	*1985*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*Total*
Japan	1	—	—	—	—	—	—	1
Germany	—	1	—	1	—	1	—	3
USA	1	3	3	2	1	11	5	26
India	—	—	—	—	1	1	1	3
Not known	—	—	2	1	—	—	—	3
Total	2	4	5	4	2	13	6	36

Source: Down to Earth, March 15, 1996.

Though the 'possible commercial use of neem was first obtained from the traditional knowledge of the people of India' with the scientific research on neem dating back to 1920s, interestingly the first Indian patent was obtained by the National Institute of Immunology as late as 1993.

In case of *haldi* which has been for centuries used in India as food additive, wound healer and anti-inflammatory agent, three of the four patent holders are a German (use of preparation of turmeric plant), an Indonesian (combination of compounds isolated for turmeric as anti-inflammatory agents) and an American (colouring process and turmeric composition for foods and beverages). The fourth holder is an

Indian of American origin. The broad nature of the patents on turmeric may affect the plans of Indians to commercially utilize the various properties of this plant which is widely grown and used in India. The Council for Scientific and Industrial Research (CSIR) has in fact decided to challenge these patents as these inventions are not only obvious but also lack novelty (Suresh, 1996).

In fact the increasing privatization and patents will lead to an even greater narrowing of the genetic base. Plant varieties carrying a few economically important traits like high yields or resistance to a particular disease, have been and will continue to be marketed aggressively by the patent or PBR holders. This leads to only few varieties being grown for a crop, displacing older varieties.

The extraordinary ecological diversity of the region—ranging from the cold deserts of the Karakoram and Ladakh to the hot sandy desert of the Thar, from the high mountain temperate forests of Himalayas to the lush tropical forests and vast mangroves of India, Bangladesh and Sri Lanka and from the sharply dissected mountain lands of Nepal and Bhutan to the unending, flood-prone plains of Pakistan, India and Bangladesh—gave rise to an equally extraordinary cultural diversity. In large parts of the region, however, colonialism and subsequent centralized interventions completely disrupted and transformed the local economic, ecological and cultural systems and left the region in a state of all-round impoverishment.

The biodiversity treaty in Rio (although unsigned by the USA) signed by 153 nations reaffirmed the sovereign rights of states over their own biological resources. This is an area where the state-of-the-art technology and knowledge regarding the true value of biological resources is limited. One major area that SAARC could develop would be institutes that pool the expertise knowledge and if possible resources of biodiversity in the region. This would take advantage of the high technical manpower that the region produces. Each country could then access the knowledge and technology banks to make the best, sustainable use of its biological resources or to protect them where they are threatened with extinction. Creating such a sophisticated source of biotechnical knowledge and expertise and a source of genetic resources or a genetic pool would clearly need heavy financing. However, the idea if well worked out could attract external donors to support such an institution.

STRATEGIES FOR ENVIRONMENTAL PROTECTION IN THE REGION

Environmental Policies

The set of policies prescribed to overcome environmental problems should mainly address themselves to:

(i) improving the access of the poor to natural resources and alleviating mass poverty,
(ii) limiting population growth to the carrying capacities of ecosystems,
(iii) developing programmes that preserve or maintain vital ecosystem functions,
(iv) ensuring provision for the needs of future generations in terms of resources and environmental quality as well as technologies for meeting those needs,
(v) preserving the diversity of genes, species, communities, habitats, and ecosystems,
(vi) using renewable natural resources on the basis of sustained yields, to minimize the impact of the exploitation of natural resources,
(vii) using clean technologies in industrial processes
(viii) improving the efficiency of energy, water, and safeguarding against planned obsolescence.
(ix) strict monitoring and coordination in the entry and modalities of the operation of the foreign companies in their industrial participation in the region.

These actions would require that the mechanisms of their implementation, including strategies, instruments and institutions, take into account the precise nature of the environmental problems encountered in each country. Such problems would differ from one country to another, as would the capacity of each country to carry out the actions required to solve the problems. Besides solving problems of an international or global dimension, their origin and impact will require international cooperation. National governments will need to have international, financial and technical support particularly for tackling those problems which have regional repercussions owing to the developing countries' limited financial and technical capabilities for solving such problems.

One has to consider two increasing concerns. Firstly, short-term measures adopted for environmental reasons may have adverse impacts on trade and impede the economic growth of developing countries. Secondly, as a result of unfavourable world economic growth these countries may feel obliged to maintain export patterns leading to an over-exploitation of natural resources.

Policy Implications

Learning from their past experiences many of the South Asian countries have over the years devised various means to minimize the process of environmental degradation and their impact. Some of them have developed strong institutional systems to thwart the damaging impact of certain kind of natural disasters, whereas some of these countries have found in collective social actions a positive way of dealing with the environmental degradation. We also find an array of non-governmental organizations working and networking across the region for the common purpose of implementing and safeguarding the national and international environmental laws and regulations. The scientific research in the arena of natural resource conservation along with the commitment to balance the ecological parameters have together led to a situation where some meaningful scientific interventions and applications could be generated in the last decade or so. Some of the proactive and reactive environmental capabilities that have been built in various parts of South Asia should stir the minds of those who have so far considered the degradation process as their exclusive problem.

The sites for building dams are limited and once all the dams are built, there is no scope for future development. Thus dams will remain as monuments of human greed and stupidity. Save Himalaya Movement led by Sunderlal Bahuguna has suggested a practical solution to resolve the conflict. Instead of temporary and risky engineering structures, permanent dams should be created in Himalayas through dense tree cover. Non intervention in the hill catchments of the rivers will increase the water holding capacity of the slopes and ultimately regulate the flow of the rivers.

The furor raised over what came to be known as the "Great 1992 Flood" in Sri Lanka yielded results. The government formed the Greater Colombo Flood Control and Environmental Improvement Project (GCF&EIP). It was launched in October 1993 by the Sri Lanka Land

Reclamation and Development Corporation (SLLR&DC). objectives of the project were to operate and maintain the 45! to be rehabilitated; acquire and conserve 4,000 ha of marshla... retention areas; resettle and upgrade the low-income communities living on canal banks and improve the environment in project areas.

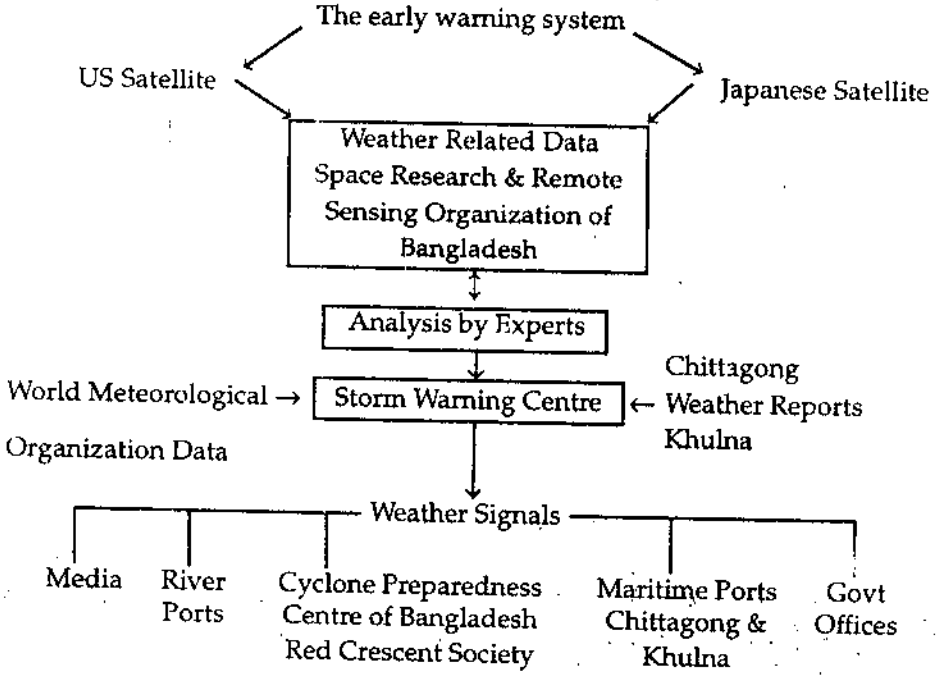
On the other hand, the Sri Lankan environmentalists are worried that their country's recently adopted Environmental Impact Assessment (EIA) process—10 years in the making—is headed in the wrong direction. It was in 1988 that the National Environmental Act was amended to make EIAs mandatory for all substantial development projects. The Ministry of Environment and Parliamentary Affairs gazetted the regulations on June 24, 1993. The regulations prescribe a stage-by-stage procedure for EIAs. This includes an initial environmental examination (IEE), an action plan to mitigate environmental impacts and, if necessary, a supplemental environmental report. Each stage is more exacting than the preceding one. However, things aren't as demanding as they seem. One criticism is that some "thresholds" are too high, offering developers enough loopholes to avoid carrying out EIAs. For instance, EIAs are required only for: hotels or holiday resorts with more than 99 rooms or covering 40 ha; aquaculture projects covering more than 4 ha; industries formulating more than 50 tonnes of toxic chemicals a day and hydro-electric stations generating more than 50 MW.

For people inhabiting the higher reaches of the Himalayas, a fear of avalanches invades every heart. Now, steps are being taken towards mitigating this apprehension and by 1996 automatic, all-weather stations could help in avalanche forecasting. The automatic weather station project system is being developed by the Snow and Avalanche Study Establishment (SASE), a research institute under the Defence Research and Development Organisation (DRDO), at Manali in Himachal Pradesh. Scientists at SASE started work on the project in 1994 and plan to set up 400 automatic weather stations all over the Himalayas. Crucial to the prediction of avalanches is data on snow density. The higher the density of snow, the greater the bonding between the snow grains and hence, the fewer the chances of avalanches. Presently, data on snow pillows and snow depth—which determine snow density—and wind speed and direction, relative humidity, solar and other radiation are collected manually from 29 research stations spread over Jammu and Kashmir and Himachal Pradesh. On the basis of this information, SASE issues regional forecasts that are broadcast regularly on radio and television (Bahal, 1995).

Bangladesh's early warning system for cyclones had already alerted those vulnerable on the coastline and helped limit the usually terrible human toll to a minimum in the 1994 cyclone. The lesson was well-learnt; this time, the human cost was minimized as Bangladesh swung effectively into action. The 30,000 strong volunteer force of the Cyclone Preparedness Programme (CPP) of the Bangladesh Red Cresent Society started a massive operation to evacuate some of the one million villages on the coast and on offshore islands.

The state-owned Bangladesh Television suspended its normal programmes to broadcast storm warnings. Radio Bangladesh aired special cyclone bulletin, hinting at cyclone rushing towards Bangladesh at 210 km per hour, in local dialects on evacuation procedures and safety measures. The early warning system worked like a dream.

Containing the Calamity



Source: Khan, Masud N, *Down to Earth*, July, 31, 1994

The government of Bangladesh has accorded high priority to environmental protection. Formulation of a comprehensive and updated ordinance named "Bangladesh Environment Preservation Ordinance" is in the process of finalization. The World Bank has formulated a high-tech Flood Action Plan (FAP) for Bangladesh, involving the

construction of dykes to prevent flooding of the Brahmaputra, Ganga and Meghna rivers. The FAP, however, has been frozen following strong criticism from an international coalition led by the Brussels based Campaign Committee.

In Pakistan also public pressure has finally been able to serve notices to the industries which so far remained free from its environmental responsibility. A successful 9-month campaign against a foreign firm has instilled a new sense of confidence among the local environmentalists. A fall out of the battle; a move to import a mercury cell based chlor-alkali plant from Denmark has been halted in its tracks. Instead, the importing unit, Ravi Alkalis, has been forced to settle for the relatively safer membrane cell technology. The key concern of environmentalists is the need for revision of the national environmental quality standards and making them more industry specific, or establishing ambient quality standards.

In Pakistan concern for environmental degradation resulted in the Environmental Protection Ordinance in 1983. In 1993 Environmental Protection Council approved industrial effluent, gaseous emissions, motor vehicles exhaust and noise, for immediate enactment. In March 1992, the Cabinet accorded approval to National Conservation Strategy (NCS) and set up a Cabinet Committee for implementing environment action programmes.

Pakistan has identified fourteen priority areas for environmental protection. These include: maintaining soils in crop lands; increasing irrigation efficiency; protecting watersheds; supporting forestry and plantations; restoring range land and improving livestock; developing and deploying renewable resources; preventing and abating pollution; managing urban wastes; supporting institutions for common resources; integrating population and environment programmes and preserving cultural heritage (GOP,1994).

One success story relating to environmental regeneration which has been increasingly replicated in India relates to drought-afflicted village of Ralegaon Siddhi in Maharashtra under the leadership of Anna Hazare. It involved trapping of rain water by small check dams to recharge wells. Fruit, fodder and fuel plants were then grown. In a few years there was enough fodder to feed domestic animals. The dung thus available was used to set up biogas plants to cover all energy needs and the residue used as rich organic manure to fertilize crop lands. In no time farm produce expanded and today the village sells its surplus grain,

fruit and vegetables and runs its own school, dispensary, panchayat and other village institutions (Jayal, 1994).

To prevent the impact of earthquake hazard and its vulnerability, there is a need to initiate measures with regard to the formulation and implementation of long-range policies and management strategies. In the South Asian region, risk assessment study is totally ignored or not properly understood and utilized. Therefore, it is essential to incorporate risk assessment study in earthquake hazard management. It is not possible to maintain a large army of relief workers and to keep them alert in all risk prone areas. For, it would mean a huge expenditure from the state chequer. Therefore, there is a need for community preparedness. If communities have a more realistic understanding of the disaster risks, they will take more practical measures to protect life and property by themselves and also to reduce their vulnerability. The public information and education in this issue is an essential factor, though they are often the forgotten elements in any attempts towards reducing these risks.

The practical policy measures, i.e. land-use management regulations, building codes, zonings and mapping of vulnerable areas, information and communication, contingency planning for pre-disaster period, during disaster and post-disaster periods and insurance are very vital issues in this regard.

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Economic Resources and Environment in South Asia

Godfrey Gunatilleke

INTRODUCTION

The main focus of this chapter is on the economic dimensions of the principal theme of the main study—the environment, peace and regional security in South Asia. It examines the interrelationships between economic development and the environment in South Asia and their implications for peace and stability both within countries and in the region as a whole. It then places these in the context of regional economic cooperation and its potential to improve the conditions which could promote regional peace and stability. Accordingly, this chapter will not deal with areas of conflict and regional tensions which may arise solely from economic causes such as trade disputes and rivalries, and which are not directly linked to environmental issues. When such concerns are left out and attention directed to the economy-environment-security link there are several issues which need to be addressed. First, underlying some of the processes which are conflict-ridden and threaten the stability of the region are problems of sharing the economic use of important natural resources and ecosystems which cut across national boundaries in the region. Second, if current national development strategies which are growth-oriented and which rely primarily on market forces do not pay special attention to their environmental and social implications and adjust to them, they will tend to produce regional externalities which could impair the ecosystems that sustain development for the region as a whole and exacerbate the areas of conflict between South Asian nations. With rapid industrialization, air pollution and water pollution and other major environmental hazards will not be contained within national boundaries. In this context the countries of the region need to examine carefully the development options available to them and cooperate in designing strategies which promote the sustainable development of the South Asian region.