ENVIRONMENTALISING ECONOMIC DEVELOPMENT: A SOUTH EAST ASIAN PERSPECTIVE*

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January 2002

Discussion Paper No 299

ISSN 1033-4661

*An earlier version of this paper was presented at the conference on **Second Generation Reforms** in India organised by the Australia South Asia Research Centre, Australian National University, Canberra and Madras School of Economics, Chennai, India. The author wishes to thank the conference participants, especially Dr Robin Ghosh, Professor Yujiro Hayami, Professor Kali Kalirajan, Professor K.L. Krishna and Dr Ric Shand. Acknowledgements are also due to Professor Clem Tisdell and Dr Clevo Wilson for their encouragement and useful comments. Usual *caveats* apply.

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Mohammad Alauddin

Abstract

South Asia's pursuit of economic development has entailed considerable damage to and exposed the fragility of the physical environment of the region like elsewhere in the developing world. South Asia is beset with a number of environmental problems. This paper provides an analytical overview of the of the environmental problems that manifest themselves in South Asia in a comparative perspective with East and Southeast Asian countries as well as selected developed market economies. It is argued that to-date, South Asian development process has been environment-intensive and that environmental problems may set serious constraints to sustain growth in production to feed its growing population. The paper underscores the need for environmentalesque-type process innovation to reverse the trend of high environment-intensity in South Asian development.

Key words: South Asia, biological conservation index, environmentalesque-type innovation, factor proportions, sustainable development, value ordering

(JEL Code: O1, Q0, Q2.)

1 INTRODUCTION

A substantial body of literature identifies a strong linkage between the environment and economic growth. The growth-environment nexus can be delicate and exclusive pursuit of economic growth can entail substantial and often irreversible damage to the physical environment and can threaten sustainability of development (Ahmed and Doeleman 1995; Pearce 1993; Alauddin and Tisdell 1998).

There is a growing body of evidence that environmental problems are taking a turn for the worse in the face of rapid pace of industrialisation and growth in GNP (Tisdell and Dragun, 1999, p.1). The World Bank (1996, pp.4-5) expresses concern in that 'many environmental problems continue to intensify and in many countries there are few grounds for optimism ... costs of inappropriate economic policies on the environment are very high'. Recent evidence (WRI, 2000a) suggests:

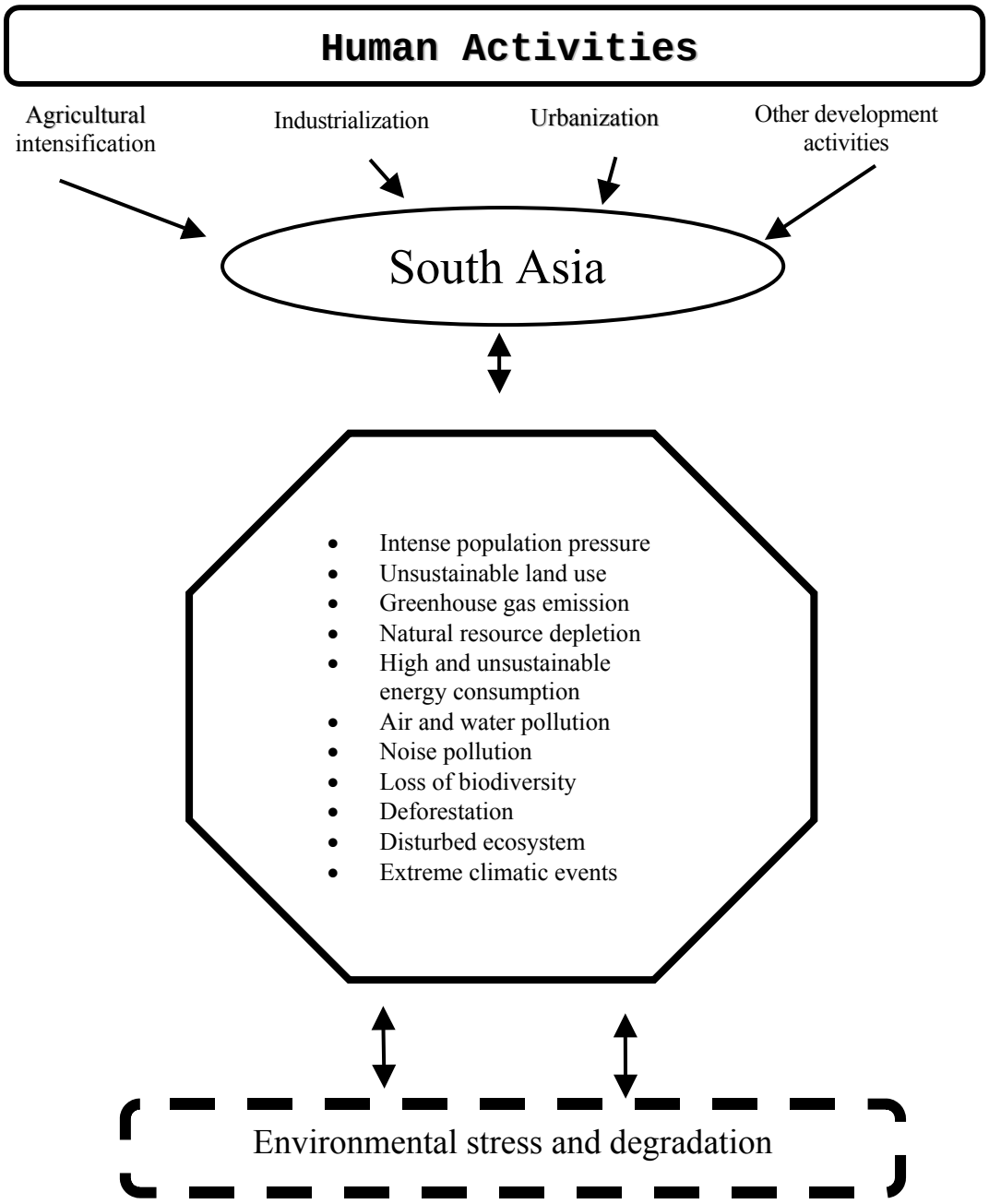
> '… decreased river flows and groundwater levels, increased soil erosion from hillside farming on downstream fisheries and hydraulic infrastructure, and the damage to both aquatic ecosystems and human health arising from fertiliser and pesticide residues in water sources or on crops are examples of negative impact. Loss of habitat and biodiversity from putting land agricultural uses, as well as narrowing of the genetic base and the genetic diversity of domesticated plant and annual species currently in use, are important concerns. Increasingly, agriculture is recognised as influencing climate change by altering global carbon, nitrogen and hydrological cycles'.

Both South and East Asia have enjoyed growth in GDP at a sufficient pace to have substantial impacts on natural environments. According to one estimate (WRI 2000b), Asia has lost almost 95 per cent of its frontier forests. More than half of Asia's last frontiers is under moderate to high threat, particularly from logging. At risk is the Sundarbans, the world's largest mangrove forest and the habitat for the largest and possibly only viable population of the Royal Bengal tiger, located in Southwest Bangladesh and Southeast West Bengal, India. Economic production dominates most Asian economies as they increasingly become interdependent market economies. This is reflected in the pace of investment in infrastructure in Asia for such items as roads, communication systems, electricity generation, water supplies and irrigation, safe water and sanitation (Alauddin and Tisdell 1998). While such developments often improve human welfare in terms of modernisation and human-made environments, their impact on the natural environments has been far from benign.

Human activity critically impacts on the physical environment. South Asia faces a wide range of environmental problems, which include both the urban and the rural environments. Figure 1 illustrates the inter-linkages involving the human activity and manifestation of environmental impacts. To a considerable extent economic growth has magnified the effect of such natural disasters and has exacerbated environmental problems in rural South Asia (Alauddin and Tisdell, 1998, p.81; BPC 1998, p.268).

This paper proceeds first of all with a discussion of the importance of natural resource stock by considering substitution between human-made capital and natural capital and the spectrum of views on sustainable development. This is followed by a discussion on natural resource utilisation and environmental quality. Section 4 provides an overview of urbanisation and related environmental issues while Sections 5 and 6 examines the linkage between biodiversity protection and human welfare. The subsequent section derives and examines implications of the process of continued environmental degradation on the prospect of sustaining production.

Figure 1: Environmental consequences of human activities in South Asia: A conceptual framework (*Source*: Adapted from Alauddin and Hossain 2001, p.180).



2 SUBSTITUTION BETWEEN NATURAL AND HUMAN-MADE CAPITAL AND VIEWS ON SUSTAINABILITY

With rapid economic growth in Asia, there is an ever-increasing demand on the natural resource stock. Most environmental economists (see for example, Pearce 1993) stress that in considering economic growth and development, particularly its sustainability, three types of capital stock play a significant role:

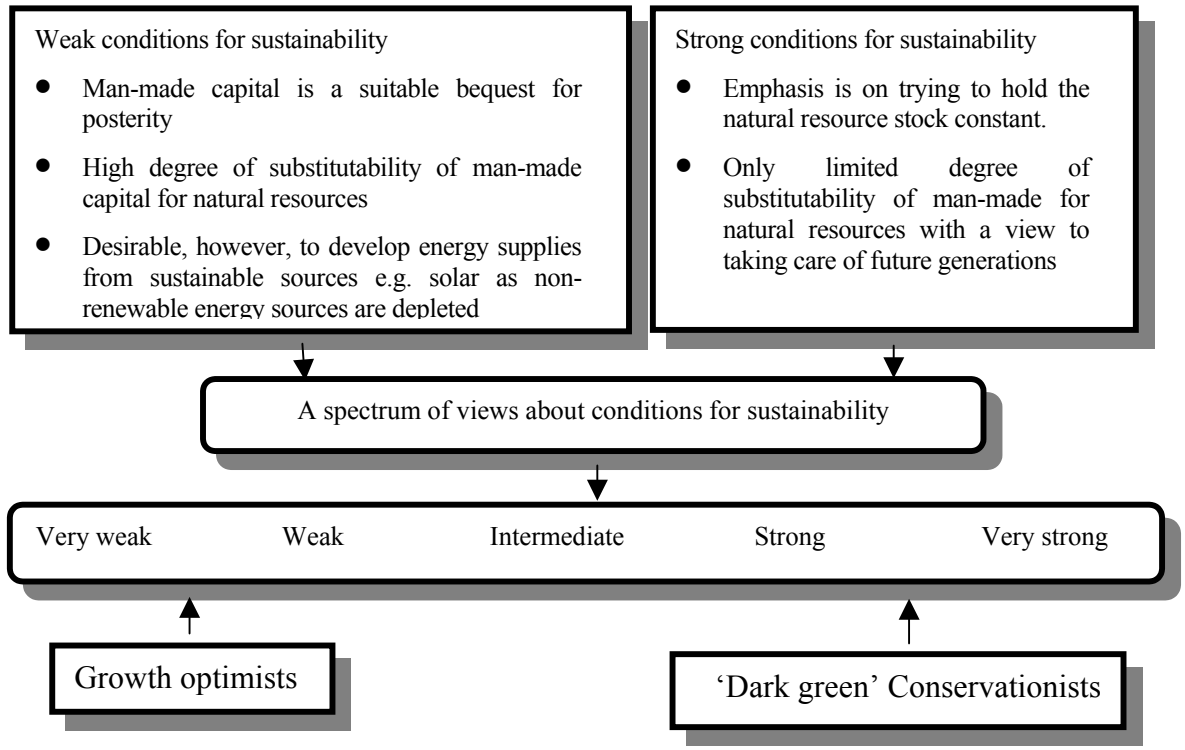
- *Man-made capital, mostly physical capital*
- *Human capital, including technical and scientific knowledge and education*
- *Natural environmental capital*

To what extent is it possible to safely substitute other forms of capital for the stock of natural environmental resources and still sustain economic development? The relevant literature distinguishes between two opposing perspectives (Pearce 1993):

- *substitution of physical and human capital for natural environmental capital is likely to be compatible with sustainable development*
- *the view that such substitution is incompatible with sustainable development.*

The two views are respectively identified as the weak condition and as the strong condition of sustainability. The conditions for sustainable development as classified by Pearce (1993), apply to the concept of sustainable development in the sense commonly used by economists: that the incomes of future generations be no less than those of present generations. Following Pearce (1993) spectrum of views about the extent to which natural environmental resources can be forgone and development can be sustained in the above sense is encapsulated in Figure 2. In Asia, it appears that weak conditions for sustainability have been accepted, at least in the past and that growth optimism is the dominant development discourse.

Figure 2: Weak and strong conditions for sustainability and spectrum of views about these conditions (*Source:* Adapted from Pearce 1993, Chapter 2).



Despite encouraging signs from an environmental point of view of decreases in the rate of population growth of most countries in Asia, the population levels of the majority of these countries is predicted to rise considerably in the coming decades. For example, on the basis of the World Bank's 'intermediate' prediction Bangladesh's population is expected to more than double (compared to its 1992 level) before it stabilises (Alauddin and Tisdell 1998, p.20). The same applies to India and Pakistan and the Philippines but not for China, Sri Lanka, Indonesia and Thailand even though the population of the latter two is expected to almost double.

In the light of the above and given the plans of Asian countries to increase their levels of per capita income, it is apparent that natural environments in Asia will remain under continuing and increasing strain for foreseeable future. Moreover, strive for growth in these countries can be expected to have significant global environmental impacts, for example in adding to greenhouse gas emissions (Tisdell 1995).

3 NATURAL RESOURCE UTILISATION AND ENVIRONMENTAL QUALITY: THE CASE OF LAND AND WATER

Increased population and economic growth throughout Asia and elsewhere has entailed considerable increase in the use of natural resources. Table 1 sets out information on land use in South, East and Southeast Asia and selected developed market economies over a decade to 1992-94. The information contained in Table 1 reveals the following:

- *Throughout most of Asia there has been considerable increase in cropland. For Bangladesh and China cropland has decreased in the early 1990s compared to the early 1980s. In South Asia, Pakistan has experienced the highest increases in cropland while countries of East and Southeast Asia have recorded much higher increases with Malaysia recording the highest increase of nearly 47 per cent and Indonesia a distant second of 20 per cent. The developed world has with the exception of Australia and Germany recorded declines in cropland.*
- *Land under permanent pasture has virtually remained unchanged for Bangladesh, Pakistan and Sri Lanka while India and Nepal have recorded declines in their respective areas. For the rest of Asia, the area under pasture has increased quite considerably. The developed world with the exception of Japan has registered declines in their areas under permanent pasture.*
- *Bangladesh has experienced considerable decline in the area under forest and woodland. Area under forest and woodland has increased in other parts of South Asia and with the exception of the Philippines it has declined in East and Southeast Asia. On the whole the extent of deforestation in east and Southeast Asia has been much greater than in South Asia even though Bangladesh is an exception where deforestation has been severe.*

In addition, substantial rise in the incidence of multiple cropping has resulted from increased intensification of agriculture throughout most of Asia. There has been a significant increase in the incidence of irrigated agriculture, as has been the use of chemical inputs such as fertilisers and pesticides. On the whole, the process of agricultural intensification has resulted in adverse impacts on the natural environments.

Increased utilisation of freshwater has accompanied economic growth throughout the world. Table 2 provides data on the availability of freshwater annual freshwater withdrawals and access to safe water in Asia and selected developed countries[2]. The information contained in Table 2 suggests that:

Table 1: Land use in South Asia, East Asia and selected developed market economies, 1982-94

Country	Land area (000 hectares)	Land use (000 hectares)							
		Cropland		Permanent pasture		Forest and woodland		Other land	
		1992-94	% change since 1982-84	1992-94	% change since 1982-84	1992-94	% change since 1982-84	1992-94	% change since 1982-84
South Asia									
Bangladesh	13017	8849	-3.1	600	0.0	1891	-11.3	1677	45.2
India	297319	169569	0.5	11424	-4.8	68173	1.2	48136	-2.1
Nepal	14300	2556	10	1757	-9.4	5750	4.7	4237	-6.8
Pakistan	77088	21323	4.7	5000	0.0	3477	15.1	4788	-2.9
Sri Lanka	6463	1889	1.3	440	0.2	2100	20.2	2037	-15.6
East and Southeast Asia									
China	929100	95145	-3.6	400000	12.5	128630	-1.1	305324	-11.4
Indonesia	181157	31146	19.9	11800	1.2	111516	-2.6	26695	-8.1
South Korea	9873	2053	5.3	91	30.8	6460	-1.3	1270	16.5
Malaysia	32855	7536	46.6	281	8.9	22248	0.0	2790	-46.4
Philippines	29817	9320	5.0	1280	14.3	13600	15.6	5617	-30.3
Thailand	51089	20488	6.7	800	14.3	14833	-3.7	14968	-5.1
Vietnam	32549	6738	2.3	328	5.1	9650	-3.9	15833	1.4
Developed market economies									
Australia	768230	47023	1.7	415700	-2.8	145000	-0.4	158057	6.4
Canada	922097	45500	-1.3	27900	-3.1	453300	3.9	395397	-3.8
France	55010	19387	1.7	10830	-13.4	14938	2.3	9854	11.5
Germany	34927	11885	-4.5	5255	-10.8	10700	4.0	7087	12.5
Italy	29406	11594	-5.8	4479	-11.2	6794	6.4	6519	14.9
Japan	37652	4467	-7.0	660	8.9	25110	-0.2	7416	4.8
United Kingdom	24160	6224	-10.9	11090	-1.4	2390	8.2	4456	19.7
United States	915912	187776	-1.1	239172	-1.0	295900	1.5	192974	0.0

Note: Domesticated land is cropland plus land under permanent pasture.
Source: WRI (2000c, pp.298-302).

Table 2: Freshwater availability, annual freshwater withdrawals and access to safe water in South Asia, East Asia and selected developed market economies

Country	Freshwater resources per capita, M^3 (1998)	Annual freshwater withdrawals					Percentage of population having access to safe water			
		Billion M^3	Percentage				Urban		Rural	
			Of total resources	For agriculture	For industry	For domestic	1982-85	1990-96	1982-85	1990-96
South Asia										
Bangladesh	9636	14.6	1.2	86	2	12	29	47	43	85
India	1947	500.0	26.2	92	3	5	80	85	47	79
Nepal	9199	29.0	13.8	99	0	1	78	..	20	..
Pakistan	1938	155.6	61.0	97	2	2	77	77	22	52
Sri Lanka	2329	9.8	14.6	96	2	2	76	..	26	..
East and Southeast Asia										
China	2285	525.5	18.6	77	18	5	..	93	..	89
Indonesia	12625	74.3	0.7	93	1	6	60	78	32	54
South Korea	1501	23.7	34.0	63	11	26	..	93	..	77
Malaysia	21046	12.7	2.1	76	13	11	..	100	..	86
Philippines	4393	55.4	9.1	88	4	8	..	91	..	81
Thailand	6698	33.1	8.1	91	4	5	..	94	..	88
Vietnam	11647	54.3	6.1	86	10	4	..	53	..	32
Developed market economies										
Australia	18772	18.1	4.3	33	2	65	..	..	..	..
Canada	92142	45.1	1.6	9	80	11	100	..	100	..
France	3246	40.6	21.3	12	73	15	100	100	95	100
Germany	2169	46.3	26.0	0	86	14	..	..	..	..
Italy	2909	57.5	34.4	45	37	18	100	..	96	..
Japan	3402	91.4	21.3	64	17	19	..	..	..	..
United Kingdom	2489	9.3	6.4	3	77	20	100	100	100	100
United States	9168	447.7	18.1	27	65	8	..	..	..	..

Source: World Bank (2000b, pp.130-133).

- *It is estimated that in any single year between 1980 and 1998, annual freshwater withdrawal as a percentage of the total resources ranged between 0.7 per cent for Indonesia and 61 per cent for Pakistan. The incidence of freshwater withdrawal is relatively much higher for South Asia than for other parts of Asia. One can also note that for several developed countries the incidence of freshwater withdrawals is as high as that of South Asia with the exception of Pakistan.*
- *Throughout Asia, agriculture accounts for the highest percentage of annual withdrawals of freshwater. In general South Asian agricultural sector accounts for a relatively higher percentage of annual withdrawal than the rest of Asia with the notable exception being Indonesia, the Philippines, Thailand and Vietnam.*
- *In the past two decades agriculture accounted for most withdrawal in developing economies averaging 87 per cent, while the middle-income countries accounted for 75 per cent (World Bank 2000b, p.133). The evidence from Asia is consistent with this broad picture. On the contrary over the same period, in the developed countries only 30 per cent of the annual freshwater withdrawal is attributable to the agriculture sector. It can be seen from Table 2 that both Japan's and Italy's withdrawals lie well above this average while Australia's and the United States' withdrawals hover about it.*
- *The average picture presented above masks the fact that in many Asian countries, freshwater is in short supply especially during the dry season. Most of Asia, in contrast to Europe, is subject to monsoonal influences. The extension of green revolution agricultural technologies (combined with population and income growth) has added markedly to the demand for water throughout the dry season in Asia, especially South Asia (Alauddin and Hossain 2001). In some cases, this demand has been compounded by subsidisation of reticulated water supplies and open-access to water supplies (Alauddin and Tisdell 1998).*
- *Industrial usage accounts for the highest percentage of annual withdrawals of freshwater in developed countries with the exception of Japan and Australia.*
- *In general, domestic usage accounts for a higher percentage of withdrawal in developed countries than in less developed countries and middle-income countries. Bangladesh's domestic usage is the highest in Asia with the exception of Korea (26 per cent) and even higher than Canada's (11 per cent).*
- *Access to safe water has increased quite considerably in all countries even though significant inter-country variations exist. More recent evidence, however, shows a very high incidence of arsenic contamination in groundwater in Bangladesh and the adjoining Indian State of West Bengal. In Bangladesh, 41 out of 64 districts and about half its population are exposed to differing degrees of risks of arsenicosis. Hence, the access to safe water figure in Bangladesh needs to be treated with caution.*

The extent and sources of water pollution in major Asian countries and selected developed countries over the 1980-97 period are set out in Table 3. The following discernible patterns emerge:

- *Throughout Asia, emissions of organic pollutants have increased significantly with the exception of the Philippines for which it has fallen marginally.*
- *India emits nearly five times organic pollution as the rest of South Asia. During the period under consideration, Bangladesh experienced the fastest rate of growth in that it nearly trebled the emissions of organic pollutants. Indonesia's emissions more then trebled.*

Table 3: The extent and sources of water pollution in South Asia, East Asia and selected developed market economies, 1980-97

Country	Emissions of organic pollutants				Percentage shares of industry in emissions of organic water pollutants (1997)							
	Kilograms per day		Kilograms per day per worker		Primary metals	Paper and pulp	Chemicals	Food and beverage	Stone ceramics & glass	Textiles	Wood	Others
	1980	1997	1980	1997								
South Asia												
Bangladesh	66 713	186852	0.16	0.16	2.8	6.8	3.5	34.2	0.1	50.9	0.6	1.1
India	1422564	1664150	0.21	0.19	15.5	7.5	8.2	51.5	0.2	11.6	0.3	5.2
Nepal	18692	26550	0.25	0.14	1.5	8.1	3.9	43.3	1.2	39.3	1.7	1.0
Pakistan	75125	114726	0.17	0.18	14.1	5.8	7.3	39.5	0.2	30.1	0.3	2.7
Sri Lanka	30086	55665	0.18	0.17	1.2	8.9	7.2	42.2	0.2	38.3	0.7	1.3
East and Southeast Asia												
China	3377105	7396000	0.14	0.14	20.6	11.9	14.2	28.9	0.4	14.2	1.0	8.9
Indonesia	214010	727496	0.22	0.17	2.4	8.9	8.6	50.2	0.2	21.7	5.3	2.8
South Korea	281900	340035	014	0.12	11.8	17.5	11.7	26.3	0.3	16.6	1.6	14.3
Malaysia	77215	166960	0.15	0.11	7.3	13.1	15.2	32.0	0.3	8.5	8.5	14.9
Philippines	182052	178239	0.19	0.18	5.2	9.8	7.3	54.5	0.2	16.4	22.0	4.6
Thailand	213271	355819	0.22	0.16	6.1	5.3	5.3	42.2	0.2	35.4	1.5	3.9
Vietnam	..	..	..	..	..	..	..	..	..	..	..	..
Developed market economies												
Australia	204333	173269	0.18	0.19	12.4	22.8	6.7	43.5	0.2	5.3	2.8	6.3
Canada	330241	295525	0.18	0.17	9.6	29.8	9.1	34.0	0.1	5.8	3.9	7.6
France	729776	585382	0.14	0.15	11.6	21.2	10.8	37.7	0.2	6.1	1.8	10.8
Germany	..	811315	..	0.12	12.7	16.8	15.5	30.6	0.3	4.8	2.2	17.2
Italy	442712	359578	0.13	0.13	12.1	16.0	11.8	28.7	0.3	16.1	2.5	12.6
Japan	1456016	1468545	0.14	0.14	9.6	21.9	8.9	38.9	0.2	6.8	1.9	12.8
United Kingdom	964510	642362	0.15	0.15	7.4	26.3	10.6	35.7	0.2	7.5	2.0	10.4
United States	2742993	2584818	0.14	0.15	8.8	32.8	10.1	27.3	0.2	7.3	2.7	10.9

Source: World Bank (2000b, pp.134-37).

- *China's emissions have more than doubled. Moreover, it is nearly three times as high as the United States' and more than four times as high as India's.*
- *In per capita terms, all the countries have experienced declining trends.*
- *For developed countries water pollution has declined with the exception of Japan for which it has increased marginally.*
- *In the industrialised world, Japan and United States account for the highest percentage of organic water pollutants.*
- *In the developed world, paper and pulp, and food and beverage industry groups constitute the highest contributors to water pollution. Chemicals and primary metals industries are the next group contributing to water pollution.*
- *Throughout Asia, food and beverage industry is the greatest source of water pollution. With the exception of India, textiles industry is the second greatest source of water pollution in South Asia. This is somewhat similar for the countries of East and Southeast Asia with the exception of Malaysia, Korea and Philippines and China. Throughout Asia, textiles, and food and beverage industries taken together are the most important source of water pollution.*
- *In South Asia major export earners, textiles, are also the greatest contributor to water pollution.*

4 URBANISATION, WASTES AND ENVIRONMENTAL PROBLEMS

Urbanisation is proceeding at a rapid pace in Asia as can be seen from Table 4. The following feature of the process of urbanisation can be noted:

- *Between 1980 and 1998 while differing widely across countries, urban population as percentage of total population has increased quite considerably. In South Asia Pakistan is the most urbanised country while Bhutan is the least urbanised country. South Korea, the Philippines and Malaysia are the most urbanised of the developing countries of Asia. Italy is the least urbanised of the developed countries.*
- *There is an increasing trend of population in urban agglomerations of more than one million people throughout Asia, with South Asia growing at a faster rate. The developed countries in our sample provide a mixed scenario.*
- *Two major South Asian countries, Bangladesh and Pakistan, have the highest concentration of urban population in their largest cities. This has increased over time. In other parts of Asia this trend has declined over time. For Thailand, the largest city is inhabited by more than half of the total urban population while Malaysia and Vietnam have about a quarter of their respective urban populations concentrated in the largest cities. Among the developed countries, Japan, Australia and France have around a quarter of their urban populations living in their respective largest cities.*

This has created a need for a significant expansion of economic infrastructure and has added to environmental problems. Despite this, all major South Asian countries have managed to increase the proportion of their urban population served by safe drinking water and sanitation except Sri Lanka. Sri Lanka's proportionate sanitation coverage has declined (as indicated in Table 3, see also Tisdell and Alauddin 1997, pp.144-45).

In general, air quality has deteriorated to unacceptable levels in many Asian cities and disposal of wastes has become a major problem (see, for example, Brandon and Ramankutty 1993). While urbanisation in Asia is growing rapidly and urban areas account for 34 per cent of Asia's

Table 4: Urbanization in South Asia, East Asia and selected developed market economies, 1980-1998

Country	Urban population as a percentage to total population		Population in urban agglomerations of more than one million as % of total population			Population in largest city as % of total urban population	
	1980	1998	1980	1995	2015	1980	1995
South Asia							
Bangladesh	14	23	5	9	15	26	33
India	23	28	6	10	12	5	6
Nepal	7	11	0	0	0	..	..
Pakistan	28	36	11	19	25	22	23
Sri Lanka	22	23	0	0	0	..	..
East and Southeast Asia							
China	20	31	8	11	14	6	4
Indonesia	22	39	7	13	16	18	12
South Korea	57	80	37	52	55	2	2
Malaysia	42	56	7	6	7	16	11
Philippines	38	57	12	13	15	33	24
Thailand	17	21	10	11	15	59	55
Vietnam	19	20	5	7	9	27	25
Developed market economies							
Australia	86	85	47	58	57	26	23
Canada	76	77	29	36	35	16	19
France	73	75	21	21	20	23	22
Germany	83	87	38	41	43	10	9
Italy	67	67	26	20	21	14	11
Japan	76	79	34	37	40	25	28
United Kingdom	89	89	25	23	23	15	15
United States	74	77	36	39	39	9	8

Source: World Bank (2000, pp.150-53)

population, Asia still has a considerable way to go to reach Europe's 75 per cent urbanisation figure. Further urbanisation can be expected in Asia as its economic growth proceeds. Already Asia contains more than half of the world's 21 mega cities (see for example, Alauddin and Tisdell 1998, Chapter 11 for further details). Alauddin and Tisdell (1998, Chapter 11) shed some light on the environmental problems resulting from growing urbanisation in South Asia. This can be briefly mentioned as follows:

- *An important feature of many Asian especially South Asian cities is that air pollution is well in excess of health standards. On average, the particulate matter in its air exceeds the standards set by the World Health Organization on 268 days of the year. Particulate matter is a major contributor to respiratory diseases. The main source of such particulate matter in Calcutta, for example, is the burning of coal for industrial and domestic purposes. Furthermore, significant emissions of sulphur dioxide and nitrous oxide occur. Although these emissions are lower than in major Chinese cities or Bangkok, they are a cause for concern (World Bank 2000b, pp.162-63).*
- *Domestic and industrial effluents are released to waterways with little or no treatment. Water quality is, therefore, very poor and a threat to human health and aquatic life (for example, in the River Buriganga near Dhaka, Bangladesh). In most cases there are also vast squatter settlements and these are often located in areas experiencing the most environmental problems. Therefore, the poor in cities not only have very low incomes, but also live in the worst environmental conditions, often on land that no one wants because of the environmental hazards associated with it.*
- *In India, only about a quarter of all wastewater generated in major river basins is collected and even less is given any treatment at all (cf. Bowonder 1995, p.161). In the case of the Ganges Basin which receives more than half of waste water generated in India in major basins and contains 80 cities, less than a quarter of the wastewater is collected and treated. While India has extensive pollution control measures, compliance with these measures is poor. Up to a half of industrial firms may fail to comply with environmental standards (Bowonder 1995, p.158).*
- *The Hindu Survey of the Environment reports that 'The city of Calcutta is suffering from serious environmental disorder. Collapsing sewer lines, stagnant canals, obsolete pumping stations, waterlogging, heaps of garbage, increasing noise, air and water pollution, rise in malaria and gastro-enteric diseases and shrinking wetlands are just a few problems plaguing the city' (Bhattacharya 1995, p.146).*
- *Urban waste management (or lack of it) is a serious problem throughout India. Even hospital waste is not disposed of in a safe manner. The Hindu Survey of the Environment 1995 (Ravi 1995) provides general evidence and case studies for 25 towns and cities throughout India showing the appalling state of most urban environments.*

The picture presented above is generally applicable to other low-income countries of Asia, especially Bangladesh (for further details, see Alauddin and Tisdell 1998, pp.194-95**;** see also Asaduzzaman 1998).

5 PROTECTION OF BIODIVERSITY

Declining biodiversity is an issue of global significance as economic growth occurs. This seems to be the pattern in throughout the developing world in general and South Asia in particular. In most of South Asia the percentage of land area in which nature is protected is low compared to that in the developed world (see Table 5). As can be seen from Table 5, only a very small

Table 5: National and international protection of natural areas, 1997

Country	All protected areas (IUCN categories I-V)		Totally protected area (IUCN I-III categories)		Partially protected area (IUCN IV-V categories		World heritage sites		Wetlands of international importance	
	Area (000 ha)	% of total land area	Area (000 ha)	% of all protected area	Area (000 ha)	% of all protected area	Number	Area (000 ha)	Number	Area (000 ha)
Bangladesh	98	0.75	0	0.00	98	100.00	0	0	1	60
India	14273	4.80	3447	24.15	10826	75.85	5	281	6	193
Nepal	1112	7.78	1017	91.46	94	8.45	2	208	1	18
Pakistan	3721	4.83	882	23.70	2839	76.30	0	0	8	62
Sri Lanka	859	13.29	530	61.70	329	38.30	0	0	0	x
South Asia	***20063***	***4.92***	***5876***	***29.29***	***14186***	***70.71***	***7***	***489***	***16***	***333***
China	59807	6.44	49564	82.87	10243	17.13	5	224	7	568
Indonesia	17509	9.67	13550	77.39	3958	22.61	2	298	2	243
South Korea	682	6.91	0	0.00	682	100.00	0	0	1	0
Malaysia	1483	4.51	903	60.89	581	39.18	0	0	0	x
Philippines	1453	4.87	463	31.87	990	68.13	1	33	1	6
Thailand	6688	13.09	3947	59.02	2741	40.98	1	622	0	x
Vietnam	994	3.05	202	20.32	792	79.68	1	150	1	12
East and Southeast Asia	*88616*	*7.00*	*68629*	*77.45*	*19987*	*22.55*	*10*	*1327*	*12*	*829*
Australia	53708	6.99	48455	90.22	5253	9.78	11	42479	49	5067
Canada	92100	9.99	43124	46.82	46984	51.01	7	10664	35	13058
France	6416	11.66	294	4.58	6021	93.84	1	12	15	582
Germany	9414	26.95	37	0.39	9377	99.61	1	0	31	673
Italy	2146	7.30	372	17.33	1774	82.67	0	0	46	57
Japan	2550	6.77	1320	51.76	1230	48.24	2	28	10	84
United Kingdom	4942	20.46	0	0.00	4942	100.00	4	11	107	453
United States	122604	13.39	70244	57.29	52360	42.71	12	10134	15	1164
Developed market economies	***293880***	***10.54***	***163846***	***55.75***	***127941***	***43.54***	***38***	***63328***	***308***	***21138***

Note: Group totals refer to the totals for countries considered in this study.
Source: WRI (2000c, pp.320-21, 328).

proportion of Bangladesh is protected and that too partially. Most of the protected areas in India and Pakistan are only partially protected. Of all the major South Asian countries, as far as the area afforded nature protection is concerned, Sri Lanka is most favorably placed.

In the case of China, a much higher proportion of its land area than in India is protected and more than 80 per cent of its protected area is totally protected compared to India's 24 per cent. The situation in the Philippines, while not as unfavorable to nature conservation as in Bangladesh, is nevertheless dismal. In relative terms, the position in Indonesia and Thailand seems appreciably better. Nevertheless, one needs to exercise caution in drawing conclusions from these data because the legal and *de facto* position as far as nature protection is concerned can differ significantly between countries and these data are based on official figures of the countries concerned.

One can also note significant cross-country variations in respect of World Heritage sites and wetlands of international importance. The developed countries have the highest concentration of World Heritage sites with only a small number located in South Asia. The area under heritage listed sites and areas under wetlands of international importance seem to vary with the geographical size of the country. Australia (13 million ha), France (0.67 million ha), USA (1.2 million ha) and Canada (0.58 million ha) feature very prominently in this respect.

Many mammals, birds and higher plants are threatened with extinction in Asian countries as well as developed countries. The numbers threatened in selected countries of Asia and the developed world are shown in Table 6. The number of plants threatened is very large. Indonesia has the greatest number of threatened species in all categories, but the numbers are substantial in all countries, especially for China, Thailand, India, Indonesia and the Philippines. In relation to its land use, however, the nature conservation situation for Bangladesh is particularly adverse. It will be a major challenge to save Asia's threatened species in the face of economic growth in Asia.

Note that the number of species of higher plants threatened by extinction in the developed countries is large compared to the number in Asia. However, comparison of absolute numbers may overstate the comparative position for Asia, particularly for Asian countries located in tropical areas. This is because tropical countries usually have a greater number of species per unit area than temperate countries, and most high-income countries are located in temperate areas. This is clearly evident from the number of species per 10 000 km^2 presented in Table 6.

6 HUMAN WELFARE AND BIODIVERSITY CONSERVATION: CONFLICTING OR CONGRUENT GOALS?

It has long been recognised that GDP per capita is an inadequate indicator of economic development and economic welfare. To overcome this problem, UNDP has suggested a Human Development Index (HDI) and other related indices [Gender-related Development Index, (GDI) and Human Poverty Index (HPI)][3]. Even though these indices have to a significant extent overcome the limitations of the GDP per capita as an indicator of human welfare, substantial limitations still remain. For instance, weightings and the maximum value of unity in computing HDI and related indices the component elements are considered as perfect substitutes and the indifference curves of social welfare function portrayed by the HDI or related indices are linear. The question that seems relevant is: Is substitution at all possible? If so, is a large degree of substitution let alone perfect substitution possible?

Table 6: Threatened species of mammals, birds, and higher plants in the 1990s in South Asia, East Asia and selected developed market economies

Country	Mammals			Birds			Higher plants			No. of species per 10000 km^2		
	Total number of known species			Total number of known species			Total number of known species					
	All	Economic	Threatened	All	Economic	Threatened	All	Economic	Threatened	Mammals	Birds	Higher plants
South Asia												
Bangladesh	109	0	18	295	0	30	5000	x	24	45	122	2074
India	316	45	75	923	55	73	15000	5000	1256	47	136	2216
Nepal	167	1	28	611	2	27	6500	315	21	70	255	2716
Pakistan	151	4	13	375	0	25	4929	372	12	36	88	1163
Sri Lanka	88	13	14	250	23	11	3000	890	436	47	134	1613
East and Southeast Asia												
China	394	77	75	1100	68	90	30000	18000	343	41	114	3112
Indonesia	436	206	128	1519	393	104	27500	17500	281	77	269	4864
South Korea	49	0	6	112	0	19	2898	224	69	23	53	1360
Malaysia	286	28	42	501	9	34	15000	36000	510	90	158	4732
Philippines	153	98	49	395	184	86	8000	3500	371	50	129	2604
Thailand	265	7	34	616	3	45	11000	x	382	72	168	2999
Vietnam	213	6	38	535	10	47	>7000	1260	350	67	168	x
Developed market economies												
Australia	252	201	58	649	353	45	15000	14074	1597	28	72	1672
Canada	193	7	7	426	3	5	2920	147	649	20	44	299
France	93	0	13	269	1	7	4500	133	117	25	72	1198
Germany	76	0	8	239	0	5	x	x	x	23	73	x
Italy	90	3	10	234	0	7	5463	712	273	29	76	1776
Japan	132	38	29	>250	21	33	4700	2000	704	40	x	1418
United Kingdom	50	0	4	230	0	2	1550	16	28	17	80	539
United States	428	101	35	650	69	50	16302	4036	1845	45	68	1679

Source: WRI (2000c, pp.322-323).

These limitations notwithstanding, HDI and related indices have established the primacy of the primacy of human development (Alauddin, 1999, p.318). As Sen (1999, p.23) argues '… the HDI has served to broaden substantially the empirical attention that the assessment of development process receives…. The crude index spoke loud and clear and received intelligent attention and through that vehicle the complex reality … also found an interested audience'.

It is interesting to see how Asian countries compare in terms of HDI and related measures (HDI, GDI and HPI) even though one needs to exercise caution about their welfare implications. HDI, GDI and HPI values for selected countries are set out in Table 7. It can be seen that except for Sri Lanka, HDI values for major South Asian countries are well below those of the selected East Asian countries listed.

Nevertheless, HDI has, apart from the above reservation, further limitations as an indicator of development and of human welfare. For example, it provides only a partial indication of the quality of life and it does not measure the extent to which development is sustainable.

Natural resource accounting provides an anthropocentric assessment of sustainability, but it is ill equipped to take account of the value of preserving biodiversity even from a man-centered viewpoint because its valuations are based on relatively simple natural resource asset models covering such resource categories as forests, fisheries and minerals. No allowance as such is made for valuing biodiversity as an asset in itself or for the preservation of biodiversity as an ethically desirable goal in itself. The latter goal reflects the growing belief that social value orderings should not be solely dependent on the utilities of individual human beings, but should be based on wider ethical perspectives (see for example, Tisdell 1991; Blackorby and Donaldson 1992; Ng 1986).

The above exposes the limitations of the HDI-type man-centered development or the natural resource accounting-type anthropocentric measures of development. One way to address this issue is to construct a composite development index, that combines anthropocentric and non-anthropocentric elements: HDI or related measures and a conservation of nature index (CI) or a biodiversity index (BI)[4]. There are basically two problems that need to be addressed (Alauddin and Tisdell 1998, p.29):

- *how to estimate CI or BI and*
- *How to combine this index with HDI. Available information limits approaches to estimating CI*

A simple way to estimate CI is to take a similar approach to that for estimating HDI. For most countries, data are available on the percentage of their land area afforded nature protection. Most countries do not have more than 20 per cent of their land area protected (WRI 2000c). Ecuador has the highest percentage of its area protected (43.1 per cent). This is used as a ceiling and set equal to unity. Table 7 sets out the conservation indices for selected countries estimated on this basis, which is analogous to the procedure employed in estimating HDI or related indices.

In constructing the value order index V, one has to determine the relative weight to place on HDI or related measures and CI. This is because it will significantly affect the ordering of development in most cases. Also, one needs to consider the functional way in which these influences should be combined to obtain V. For simplicity, the following linear form is postulated:

$$V_1 = \alpha HDI + (1 - \alpha)CI \quad (1a)$$

$$V_2 = \alpha GDI + (1 - \alpha)CI \quad (1b)$$

$$V_3 = \alpha HPI + (1 - \alpha)CI \quad (1c)$$

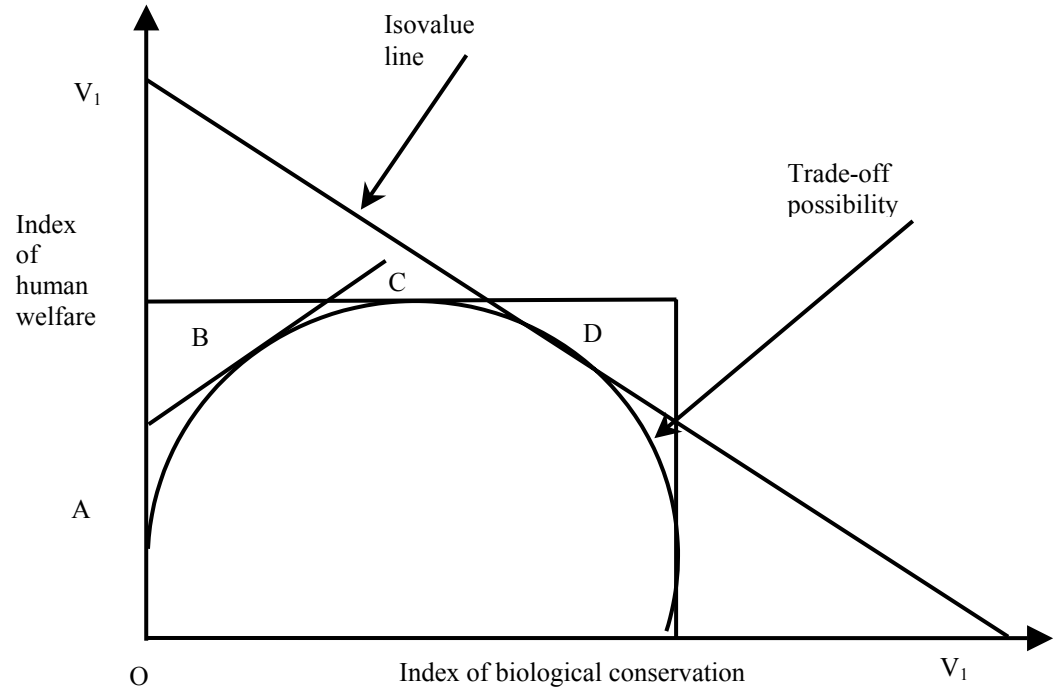
Table 7: Conservation index (CI), human development index (HDI), gender development index (GDI), human poverty index (HPI) and value ordering e.g. $V_1=\alpha HDI+(1-\alpha)CI$ for South Asia, East and Southeast Asia and selected developed market economies

Country	Conservation index and indicators of human development				Value ordering with $\alpha=^2/_3$		
	CI	HDI	GDI	HPI	$V_1=^2/_3HDI+^1/_3CI$	$V_2=^2/_3GDI+^1/_3CI$	$V_3=^2/_3HPI+^1/_3CI$
South Asia							
Bangladesh	0.017	0.440	0.428	44.4	0.299	0.291	0.302
Bhutan	0.492	0.459	0.444	41.8	0.470	0.460	0.443
Nepal	0.181	0.463	0.441	51.9	0.369	0.354	0.406
India	0.111	0.545	0.525	35.9	0.400	0.387	0.276
Pakistan	0.112	0.508	0.472	42.1	0.376	0.352	0.318
Sri Lanka	0.308	0.721	0.712	20.4	0.583	0.577	0.239
East and Southeast Asia							
China	0.149	0.701	0.699	19.0	0.517	0.516	0.176
Indonesia	0.225	0.681	0.675	27.7	0.529	0.525	0.260
South Korea	0.160	0.852	0.845	25.0	0.621	0.617	0.220
Malaysia	0.105	0.768	0.763	14.2	0.547	0.544	0.130
Philippines	0.113	0.740	0.736	16.3	0.531	0.528	0.146
Thailand	0.304	0.753	0.751	18.7	0.603	0.602	0.226
Vietnam	0.071	0.664	0.662	28.7	0.466	0.465	0.215
Developed market economies							
Australia	0.162	0.922	0.921	12.5	0.669	0.668	0.137
Canada	0.232	0.932	0.928	12.0	0.699	0.696	0.157
France	0.271	0.918	0.916	11.9	0.702	0.701	0.170
Germany	0.625	0.906	0.904	10.4	0.812	0.811	0.278
Italy	0.169	0.901	0.894	11.6	0.657	0.652	0.134
Japan	0.157	0.924	0.917	12.0	0.668	0.664	0.132
United Kingdom	0.475	0.919	0.915	15.1	0.771	0.768	0.259
United States	0.311	0.927	0.926	16.5	0.722	0.721	0.214

Sources: Based on Table 6 above and data from UNDP (2000, pp.

where $0<\alpha<1$. The value α reflects the relative weight placed on human development and the conservation of nature, employing the protected area variable as a proxy for the conservation of biodiversity.
V_I represents the valuation function as portrayed in Figure 3. Assume that there exists a trade-off possibility frontier between HDI or related measures and CI. Then, given the relevant value ordering function based on Equations (1a-c), then in principle an optimal combination could be determined. For example, if the trade-off possibility frontier is as portrayed by the curve ABCDE in Figure 3, the optimal combination would correspond to point D.

Figure 3: Representation of valuation frontier incorporating human welfare and bio-diversity conservation as trade-off possibilities and optimisation (*Source*: Adapted from Alauddin and Tisadell 1998, p.31)



Note that if one were concerned only with human welfare, the optimal combination would be represented by point C. In this case, the valuation indifference curves are horizontal straight-lines. One could observe in Figure 3 that some nature conservation is necessary in order to maximise HDI. On the other hand, extreme eco-centrism would result in combination E as being optimal. Note that combination E consists of maximum combination but some human welfare. Note that the segment AC represents complementarity while segment CE represents substitutability between the two indices. For the segment AC the isovalue curves would be upward sloping.

Suppose that $\alpha = {}^{2}/_{3}$. This means that more weight is given to human welfare than to species conservation. The values of *V*s for selected countries using this weighting are shown in the relevant columns of Table 7. It can be seen that the conservation indices for these countries are substantially below unity. Bangladesh performs quite poorly. The situation in the Philippines, China, India and Pakistan seem better than for Bangladesh with a much better situation prevailing in Indonesia, Sri Lanka, Nepal and Bhutan.

Taking CI into account results in Indonesia rising in value ordering rank, while China and the Philippines slide down the scale. Also the position of Bhutan with a very high CI improves in

relation to India, Pakistan and Nepal. A similar rank ordering can be observed in respect of V_2 involving gender-related development index (GDI). The value ordering index V_3 comprising human poverty index (HPI) and CI presents a very different picture. Given that a lower incidence of human poverty is preferable to a higher one, and given that it is assigned a weight of $^2/_3$, a lower value of V_3 is more desirable. In general, the South Asian countries perform poorly in this respect compared to East Asia or the developed countries under consideration. Sri Lanka is an exception. It is interesting to note that for the highly developed countries like Germany, the United Kingdom and the United States, the V_3 values are quite high. In case of Germany, a high CI has contributed to this while for the United Kingdom and the United States, the high V_3 values are underpinned by higher incidence of human poverty.

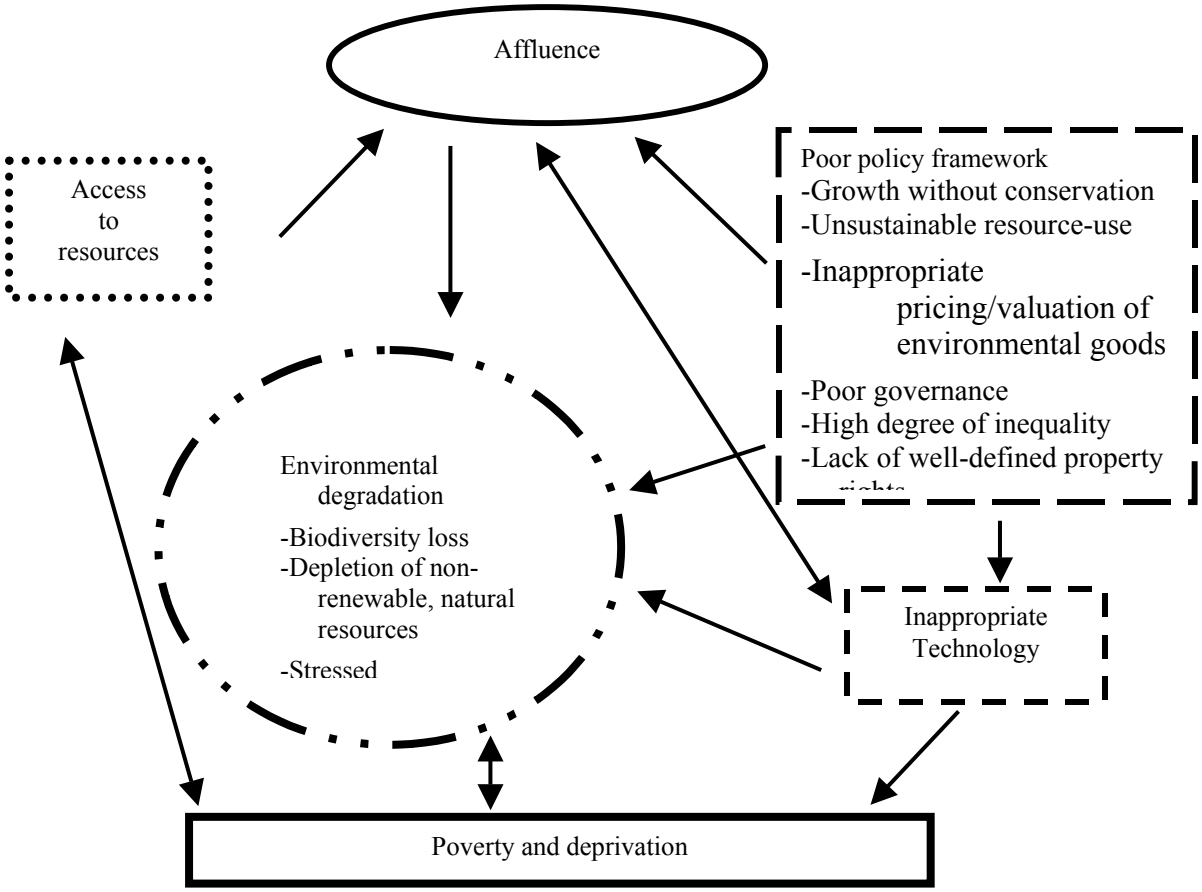
A positive association or correlation between HDI and CI values can be observed (correlation coefficient of 0.287, statistically non-significant). A similar picture emerges in respect of the association between GDI and CI (correlation coefficient of 0.290, statistically non-significant). On the other hand, there seems to exist a weak negative association between HPI and CI (a correlation coefficient of –0.226, statistically non-significant). This might give some support to the Brundtland Committee's view (WCED 1987) that human poverty is the main source of environmental degradation. However, one should exercise caution in drawing this conclusion and the situation is much more complicated than this simple one-way causation (Tisdell 1991).
The links between poverty and the environment remains a subject of considerable controversy or at best much more complicated than a simplistic cause-effect portrayal of the link (see, for example, Alauddin and Tisdell 1998; Lele 1991; Bifani 1992). One should exercise caution against such a simplistic generalisation. Poverty is viewed as a major cause and an effect of global environmental problems. It is, therefore, futile to attempt to deal with environmental problems without a broader perspective that encompasses the factors underlying world poverty and international equality (WCED 1987).

In rural South Asia environmental degradation is mainly referred to as the product of resource-use pattern. The relationship between poverty and unsustainable agricultural practices is also cited in many recent publications (see for example, Alauddin and Tisdell 1998). Imprudent use of agricultural resource base irreversibly reduces the capacity for generating sustainable production. Figure 4 portrays the poverty-environment nexus that captures these complex interactions of the underlying factors.

Note that the method used above to estimate the nature conservation index CI is subject to several limitations (Alauddin and Tisdell 1998, p.32). This is because:

- *It takes no account of whether the natural areas involved are totally or partially protected. In principle, account could be taken of such variations in the degree of protection by using information of the type given in Table 7 even though the appropriate relative weight to place on the different categories of protection would remain contentious.*
- *In addition, these categories are based upon the legal rather than the actual situation. It is well known that in some less developed countries, areas that are legally totally protected are not so in practice e.g. illegal human settlement and improper use of protected areas occurs.*
- *A further problem in that no account is taken of the quality or productivity of the protected areas in relation to conservation of biodiversity. While these are serious limitations, they are less serious than failing to take any account of nature conservation in the evaluation of alternative states of the world.*

Figure 4: A schematic representation of the environment-poverty nexus (*Source*: Adapted from Alauddin and Hossain 2001, p.239).



Despite these limitations, the above underscores the importance of taking account of bio-diversity and nature conservation in evaluating development outcomes.

6 SOME FURTHER OBSERVATIONS

It is now widely recognised that much of economic growth in the contemporary developing world has resulted from resource-depletion both in terms of quality and quantity (Thamapillai and Uhlin 1995). Environmental goods do not have a 'market' in the usual sense of the term. Therefore, when environmental goods are underpriced or unpriced there is a high propensity to 'overuse' the environment (Pearce 1993). To what extent is the divergence between social costs and private costs, and social benefits and private benefits resulting from environmental externalities are being addressed in business decisions? Given that the overall concern with the environment is of recent origin and that the environmental issues are yet to be fully incorporated in policy decisions, the probability of that may not be very high. As Alauddin and Tisdell (1998, p.10) argue that a failure to internalise environmental costs in decision-making could result in South Asia being engaged in 'unfair and unjust' production for international trade. With South Asia in structural reform mode such policies may assume even greater global significance. A similar view is expressed by an earlier study by (López, 1994, p.182):

> … The effects of economic growth and relative price changes on the environment critically depend on the nature of resource stock effects on production and/or whether individual producers internalize such stock effects. … [R]esources that have a

Table 8: CO_2 emissions per km^2 and per capita in selected countries/regions, 1990 and 1996.

Country	CO_2 emissions per km^2			CO_2 emissions per capita		
	1990	1996	% change	1990	1996	%change
Bangladesh	106.944	159.722	49.35	0.144	0.185	28.51
India	205.383	303.345	47.70	0.795	1.038	30.56
Nepal	4.082	10.884	166.67	0.032	0.070	119.13
Pakistan	85.302	118.467	38.88	0.604	0.688	13.94
Sri Lanka	59.091	107.576	82.05	0.229	0.394	71.94
South Asia	171.831	252.961	47.22	0.691	0.889	28.74
China	251.193	350.474	39.52	2.126	2.741	28.91
Indonesia	86.719	128.661	48.37	0.927	1.226	32.19
Korea (S)	2436.364	4122.222	69.196	5.636	8.872	57.43
Malaysia	167.576	360.909	115.37	3.089	5.671	83.58
Philippines	147.667	210.667	42.66	0.720	0.866	20.19
Thailand	186.550	400.390	114.63	1.724	3.367	95.28
Vietnam	67.771	113.253	67.11	0.339	0.488	43.89
East and Southeast Asia	232.097	339.706	46.364	1.951	2.605	33.56
Australia	34.362	47.358	37.82	15.556	19.295	24.04
Canada	41.079	41.059	-0.05	15.457	13.647	-11.71
France	628.470	643.772	2.44	6.262	6.132	-2.08
Germany	2490.756	2412.325	-3.15	11.185	10.502	-6.10
Italy	1325.249	1339.535	1.08	6.913	7.074	2.32
Japan	2832.725	3089.153	9.05	8.670	9.267	6.89
United Kingdom	2299.184	2273.469	-1.12	9.814	9.441	-3.80
United States	515.164	566.104	9.89	19.296	19.780	2.51
Developed market economies	303.433	326.011	7.44	13.134	13.468	2.54

Notes: 1997-mid year population data are used to estimate the per capita CO_2 emissions for 1996.
Group totals refer to the totals for countries considered in this study.
Sources: Based on data from World Bank (2000b, pp.292-93; 1999, pp.190-91; 1992, pp.218-19).

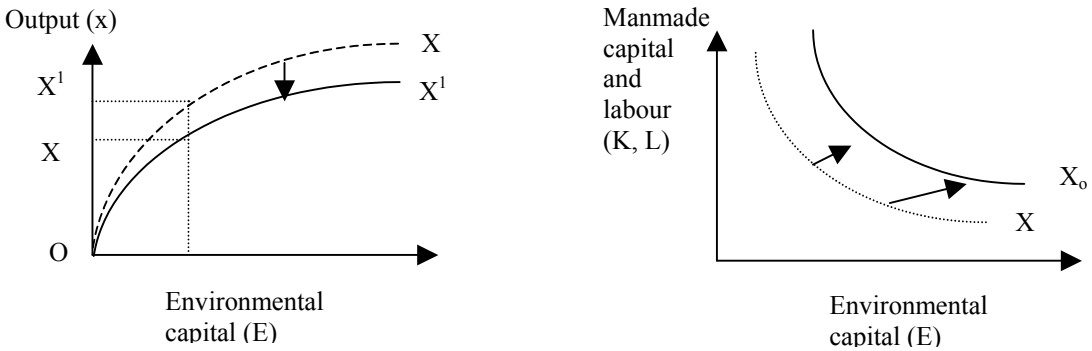
productive stock feedback effect, economic growth and trade liberalization in a typical developing country decrease degradation in both short and the long run if individual producers internalize the stock effect. This is valid whether the internalization is induced by government policy, contractual arrangements among producers or individual private property. On the other hand, the effects of economic growth and trade liberalization on the resource stock are unambiguously negative if the individual producers do not internalize the productive stock effects of the resource. …'.

South Asian countries are increasing the use of fossil fuel over time. As a result the air pollution is on the increase. Bangladesh's capital, Dhaka has one of the highest lead contents in its air in the world. High levels of air pollution are also present in other South Asian cities. Significant increase in the use of fossil fuel has taken place as have CO_2 emissions in developing countries. This can be seen from Table 8. In terms of CO_2 emissions km^2 of land area, Australia performs quite poorly in the developed world. In per capita terms, however, low income countries including those in South Asia, while differing widely among themselves emit only a fraction of those by the high income countries. However, recent evidence seems to indicate that between 1990 and 1996, CO_2 emissions have increased quite significantly both in terms of emissions per km^2 and per capita.[5]

7 SOME IMPLICATIONS

It is well known that innovation in processes leads to an upward shift of the production function or a downward movement of the production isoquant (Koutsoyiannis, 1975, p.85). Figure 5 depicts a situation where environmental capital is treated as an input (measured along the horizontal axis) while all other inputs including man-made capital and labor including human capital are treated as a composite input and is measured along the vertical axis. In the absence of process innovation in 'enviornmaltalesque' (reminiscent of the concept of 'landesque' or 'labouresque' types of capital introduced by Sen, 1960) type, *ceteris paribus*, is likely to lead to a downward shift of the production function and an upward movement of the production isoquant.

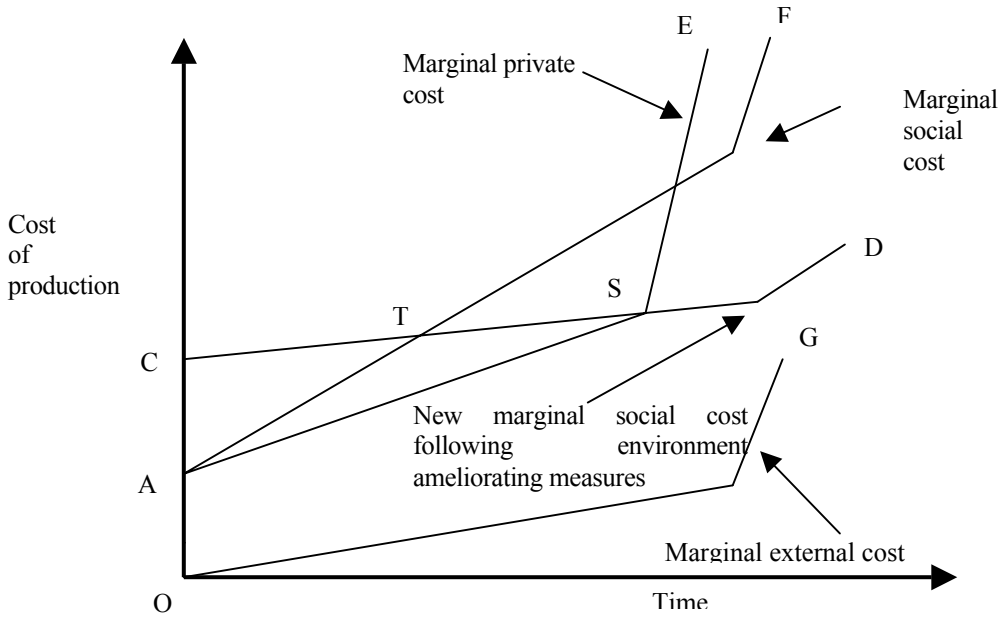
Figure 5: Without environment-augmenting technological progress *ceteris paribus* the production functin shifts downward and the production isoquant shifts upward.



The above point warrants further elaboration. Hayami and Ruttan (1985, pp.309-11) introduce the concept of 'internal land augmentation' and 'external land augmentation'. The former refers to a situation where qualitative improvement in land input takes place for instance through irrigation while the latter refers to a situation where cultivation is based on the extensive margin. With abundant land resources, the frontier can be extended with little or

no addition to the marginal cost. But beyond a certain point where cultivation frontier is extended to marginal areas, cost of production at the margin can rise quite rapidly and the marginal cost curve is likely become very steep. In the case of internal land augmentation, initial investment of say irrigation could be quite high so that the marginal cost curve in such a situation is likely to lie above the one for the external augmentation scenario. In the long run, because of qualitative improvement in land input, marginal cost will fall. Based on the conceptualisation after Hayami and Ruttan (1985), environment-augmenting technological change can lead to a situation as portrayed in Figure 6. Note the differential marginal cost of production resulting from a degrading environment.

Figure 6: Differential marginal cost of production resulting from degrading environment and adoption of environment ameliorating strategies. Note the divergence between private and social costs due to external environmental external cost.



On the basis of discussion in the preceding sections, it seems quite clear that there is an emerging factor proportions problem in South Asia somewhat analogous to the factor proportions problems in underdeveloped areas analyzed by Eckaus (1955). Let us consider the issue in terms of Figure 7 (Thirlwall 1994). The horizontal axis represents environmental capital while the vertical axis represents man-made capital and labor. In case of South Asia, the ray OD applies as production is more environment-intensive given the high propensity to treat environment as non-scarce/abundant factor. On the other hand, the environment-intensity signified by ray OC can be considered to be a desirable environment-intensity. The ray OC could also be applicable to contemporary developed countries. This implies that in the developed world, production is less environment-intensive. Environmental resources are valued relatively more highly in the developed world than in the developing countries.

Figure 7: A hypothetical scenario portraying current and desirable environmental capital intensity in agricultural production in the context of South Asia (Adapted from Alauddin and Hossain 2001, p.251 and Eckaus 1955).

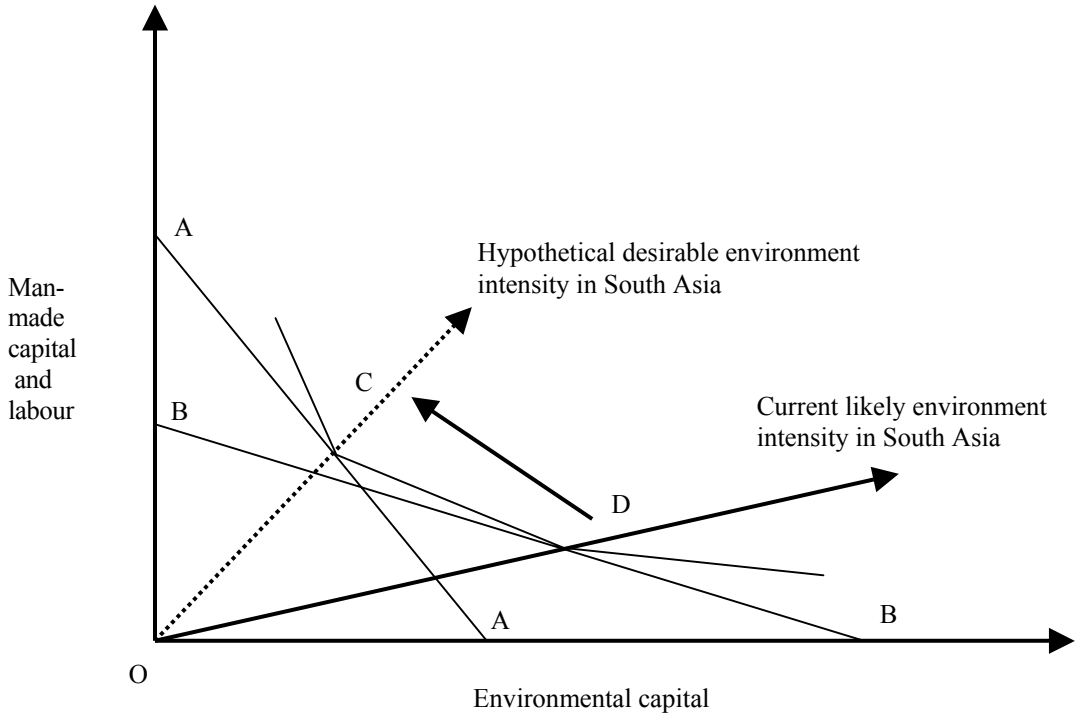


Table 9 sets out information on the impact of environmental degradation on net domestic savings. The following picture emerges:

- *Sizeable percentage reductions in GDP result from environmental degradation such as energy depletion, mineral depletion, net forest depletion and CO_2 emissions. These result in reductions in net domestic savings. Investment in education is considered as an offsetting factor. On the whole the (intrinsic) domestic savings differ from the (nominal) net domestic savings.*
- *Higher rates of investment in education more than counterbalance the negative environmental impact in the developed world. This is clearly evident from the ratio of the two savings rates presented in the last column of Table 9.*
- *The negative environmental effect more than counterbalances the positive effect of investment in education in all countries of developing Asia, except South Korea, Sri Lanka and Thailand. Both Indonesia and Nepal perform dismally, while Pakistan and Vietnam perform poorly.*

The environmental constraints on net domestic savings have serious implications for growth in GNP. For instance, according to the Harrod-Domar model, the rate of growth of GNP varies directly as the rate of savings (s) and inversely as the capital-output ratio (k). More specifically, for a given capital output ratio, the more an economy is able to save and invest, faster it grows (see Todaro 1989, pp.65-67). Given the negative impact of environmental degradation and lower rate of investment in education to counterbalance it, low rates of net domestic savings pose a serious threat to sustain growth rates in several developing countries of Asia.

Table 9: Environmental degradation and net domestic savings as percentage of GDP: Selected countries and regions, 1998

Country/ Region	Net domestic savings (nominal) A	Education expenditure B	Percentage reduction in GDP resulting from				Net domestic savings (actual) G = (A+B)-(C-D-E-F).	Net domestic savings (actual) as a ratio of nominal H = (G/A)
			Energy depletion C	Mineral depletion D	Net forest depletion E	Carbon-dioxide damage F		
South Asia								
Bangladesh	10.9	1.8	0.2	0.0	2.1	0.3	10.0	**0.92**
India	11.8	3.3	1.5	0.4	1.6	1.4	10.3	**0.95**
Nepal	6.1	2.1	0.0	0.0	9.8	0.2	-1.8	**-**
Pakistan	5.3	2.3	1.5	0.0	1.3	0.8	4.0	**0.75**
Sri Lanka	13.9	2.6	0.0	0.0	1.5	0.2	14.8	**1.06**
East and Southeast Asia								
China	34.5	2.0	1.5	0.3	0.4	2.3	32.0	**0.93**
Indonesia	16.4	0.6	7.0	1.6	1.2	1.3	5.9	**0.**
South Korea	22.9	3.6	0.0	0.0	0.0	0.7	25.9	**1.13**
Malaysia	38.5	4.0	3.0	0.1	1.7	0.9	36.8	**0.96**
Philippines	7.9	2.0	0.0	0.1	1.6	0.5	7.6	**0.96**
Thailand	32.5	3.2	0.2	0.0	0.9	0.8	33.7	**1.04**
Vietnam	13.9	2.2	2.2	0.1	2.7	0.8	10.3	**0.74**
Developed market economies								
Australia	9.3	5.3	0.4	1.4	0.0	0.5	12.2	**1.31**
Canada	10.1	6.3	2.6	0.2	0.0	0.4	13.2	**1.31**
France	12.8	7.1	0.0	0.0	0.0	0.3	19.6	**1.53**
Germany	11.8	4.3	0.0	0.0	0.0	0.2	15.8	**1.34**
Italy	9.6	4.6	0.0	0.0	0.0	0.2	13.9	**1.42**
Japan	9.2	6.7	0.0	2.3	0.0	0.8	12.8	**1.39**
United Kingdom	4.0	4.7	0.2	0.0	0.0	0.2	8.2	**1.74**
United States	4.8	4.6	0.6	0.0	0.0	0.4	8.4	**1.83**

Source: World Bank (2000b, pp.168-72).

8. CONCLUDING COMMENTS

South Asia's strive for economic development has lead to considerable damage to and exposed the fragility of the physical environment. This is consistent with the picture elsewhere in the developing world. South Asia is beset with a number of environmental problems. This paper provides an analytical overview of the environmental problems that manifest themselves in South Asia in a comparative perspective with East and Southeast Asian countries as well as selected developed market economies. It is argued that to-date South Asian development process has been very environment-intensive and that environmental problems may set serious constraints to sustain growth in production to feed its growing population as environmental degradation adversely impacts on net domestic savings. The paper underscores the need for environmentalesque-type process innovation to reverse the trend of high environment-intensity in South Asian development.

Notes

1 WRI (2000) citing recent evidence rightly argues that 'degraded agricultural lands threaten world's food production. The unprecedented scale of agricultural intensification raises two principal concerns. First there is a growing concern over the vulnerability of the productivity of the agroecosystems to the stresses imposed on them by the intensification of agriculture. Can technological advances and increased inputs continue to offset the depletion of soil fertility and freshwater resources? As soil fertility reduces and water becomes scarcer, what will be the impact on food prices? Second are the broader concerns about negative external impacts of agricultural production are often accentuated by intensification. These negative impacts include additional stresses that agroecosystems can generate beyond their own boundaries but which are not reflected in agroecosystem management and production costs, nor in the prices consumed pay for food and fiber goods'.

2 According to World Bank (2000b, p.133): (a) freshwater resources refer to total renewable resources which, include flows of rivers and groundwater from rainfall in the country and river flows from other countries; (b) Annual freshwater withdrawals data refer to total withdrawal, not counting losses due to evaporation from storage basins. Withdrawal data refer to any single year between 1980 and 1998; (c) access to safe water refers to the percentage of people with reasonable access to an adequate amount of safe water in a dwelling or within a convenient distance of their dwelling.

3 Following UNDP (1999, pp.127-33) of the measures are defined as follows:
Human Development Index (HDI) based on three indicators: longevity proxied by life expectancy at birth, educational attainment as measured by a combination of adult literacy and combined primary, secondary and tertiary enrolment rates, and standard of living measured by real GDP per capita (in terms of purchasing power parity dollars)
Gender-related Development Index (GDI) based on the same indicators as HDI but adjusted by the average achievement of each country in life expectancy, educational attainment and income in accordance with the disparity in achievement between male and female
Human Poverty Index (HPI) concentrates on the three essential dimensions of human life already reflected in the HDI – longevity, knowledge and a decent standard of living. The firs deprivation relates to survival – vulnerability to death at a relatively early age. The second deprivation relates to knowledge – being excluded from the world of reading

and communication. The third relates to a decent standard of living in terms of overall economic provisioning.

4 This development valuation function is reminiscent of the Bergsonian social welfare function (Bergson 1938). For further details see Alauddin and Tisdell (1998, pp.27-29).

5 At the same time as South Asia is becoming an increasingly important source of greenhouse gas emissions, the region is likely to be seriously affected by a rise in sea level (Alauddin and Tisdell 1998, p.198). Buchdal (1996) claims that a rise in the sea level of 1.5 meters would flood one fifth of all farmland, equivalent to a more than 21 per cent loss in agricultural production.

REFERENCES

Ahmed, I. and Doeleman (eds 1995) *Beyond Rio: Environmental Crisis and Sustainable Livelihoods in the Third World*, London: Macmillan.

Alauddin, M. and Hossain, M. (2001) *The Environment and Agriculture in a Developing Economy: Problems and Prospects for Bangladesh*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.

Alauddin, M. and Tisdell, C.A. (1998) *The Environment and Economic Development in South Asia: An Overview Concentrating on Bangladesh*, London: Macmillan.

Alauddin, M., Mujeri. M.K. and Tisdell, C.A. (1995) 'Technology – Environment – Employment Linkages and the Rural Poor of Bangladesh: Insights from Farm – Level Data'. In I. Ahmed and J.A. Doeleman (eds), *Beyond Rio: Environmental Crisis and Sustainable Livelihoods in the Third World*, London: Macmillan, pp.221-255.

Asaduzzaman, M. (1998) 'When Both Market and The State Fail: The Crisis of Solid Waste Management in Urban Bangladesh', in R. Sobhan (ed), *Crisis in Governance: A Review of Bangladesh's Development 1997*, Dhaka: Centre for Policy Dialogue and University Press Ltd., pp.383-400.

Bergson, A. (1938) 'A Reformulation of Certain Aspects of Welfare Economics', *Quarterly Journal of Economics*, 52, pp.310-14.

Bhattacharyya, M. (1995) 'What Ails the City of Joy?',

Bifani, P. (1992) 'Environmental Degradation in Rural Areas', in Bhalla, A. S. (ed.) *Environment, Employment and Development*, Geneva: International Labor Office, pp.99–120.

Blackorby, C. and Donaldson, D. (1992) 'Pigs and Guinea Pigs: A Note on the Ethics of Animal Exploitation', *Economic Journal*, 102, pp.1345-69.

Bowonder, B. (1995) 'Environmental Management: Redefining Perspectives', in Ravi, N. (ed.) *The Hindu Survey of the Environment*, Madras: Kasturi and Sons, pp.157-61. in Ravi, N. (ed.) *The Hindu Survey of the Environment*, Madras: Kasturi and Sons, pp.146-48.

BPC (1998) *The Fifth Five-Year Plan 1997-2002*, Dhaka: Bangladesh Planning Commission.

Brandon, C. and Ramakutty, R. (1993) *Toward and Environmental Strategy for Asia*, World Bank Discussion Paper 224, Washington, D.C.: World Bank

Buchdal, J. (1996) 'Global Change and its Impact on World Agriculture', Global Change Information Programme', http://www.doc.mmv.ac.uk/cric/agricul.html.

Eckaus, R.S. (1955) 'The Factor Proportions Problem in Underdeveloped Areas', *American Economic Review*, 45(4), pp.539-65.

Hayami, Y. and Ruttan, V.W. (1985) *Agricultural Development: An International Perspective*, Baltimore, Md.: Johns Hopkins University Press.

Koutsoyianiss, A. (1975) *Modern Microeconomics*, London: Macmillan.

Lele, S. (1991) 'Sustainable Development: A Critical Review', *World Development* 19(6), pp.607–21.

López, R. (1994) 'The Environment as a Factor of Production: The Effects of Economic Growth and Trade Liberalization, *Journal of Environmental Economics and Management*, 27, 163-84.

Ng, Y.K. (1986) 'Social Criteria for Evaluating Population Change: An Alternative to Blackorby-Donaldson Criteria', *Journal of Public Economics*, 29, pp.375-81.

Panayotou, T. (1995) 'Environmental degradation at Different Stages of Economic Development', in Ahmed and Doeleman (eds.), pp. 13–36.

Pearce, D. (1993) *Blueprint 3: Measuring Sustainable Development*, London: Earthscan.

Ravi, N. (ed. 1995) *The Hindu Survey of the Environment*, Madras: Kasturi and Sons.

Ray, B. (1998) 'Farakka Treaty – Expectations may not be Fulfilled', *Statesman*, January 16 and 17 (Calcutta).

Repetto, R., Magrath, W., Wells, M., Beer, C. and Rossini, F. (1989) *Wasting Resources: Natural Resource in National Income Accounts*, Washington, D. C.: World Resources Institute.

Roy, K. C., Tisdell, C. A. and Sen, R. K. (eds. 1992) *Economic Development and Environment: A Case Study of India*, Calcutta: Oxford University Press.

Sen, A.K. (1960) *Choice of Techniques: An Aspect of the Theory of Planned Development,* Oxford

Thamapillai, D. J. and Uhlin, H-E (1995) 'Environmental Capital and Sustainable Income: Basic Concepts and Empirical Tests', *Cambridge Journal of Economics*, 21, pp.379–94.

Thirlwall, A.P. (1994) *Growth and Development with Special Reference to Developing Countries*, London: Macmillan.

Tisdell, C.A. (1991) *Economics of Environmental Conservation*, Amsterdam: Elsevier.

Tisdell, C.A. (1995) 'Asian Development and Environmental Dilemmas', *Contemporary Economic Policy*, 13(1), pp.38-49.

Tisdell, C.A. and Alauddin, M. (1997) 'The Environment and Development in South Asia', in K.C. Roy, H.C. Blomqvist, and I. Hossain (Eds.) *Development that Lasts*, New Delhi: New Age International, pp.139-50.

Tisdell, C.A. and Dragun, A.K. (1999) 'Agricultural Sustainability: The Impact of Trade Liberalisation', in A.K. Dragun and C. Tisdell (Eds), *Sustainable Agriculture and Environment*: *Globalisation and the Impact of Trade Liberalisation*, Cheltenham: Edward Elgar, pp.1-6.

Todaro, M.P. (1997) *Economic Development*, New York: Longman.

UNDP (1996a) *Human Development Report 1996*, New York: Oxford University Press.

UNDP (1996b) *UNDP's 1996 Report on Human Development in Bangladesh: A Pro-Poor Agenda*, Dhaka: United Nations Development Programme.

UNDP (1997) *Human Development Report 1997*, New York: Oxford University Press.

UNDP (1998) *Human Development Report 1998*, New York: Oxford University Press.

UNDP (1999) *Human Development Report 1999*, New York: Oxford University Press.

UNDP (2000) *Human Development Report 2000*, New York: Oxford University Press.

WCED (1987) *Our Common Future*, New York: Oxford University Press.

Wilson, E.O. (1992) *The Diversity of Life*, Cambridge, Mass.: Harvard University Press.

World Bank (1996) *Environment Matters*, Fall.

World Bank (1997) *World Development Report 1997: The State in a Changing World*, New York: Oxford University Press.

World Bank (1999) *World Development Report 1998-99: Knowledge for Development*, New York: Oxford University Press.

World Bank (2000a) *World Development Report 2000/2001: Attacking Poverty*, New York: Oxford University Press.

World Bank (2000b) *World Development Indicators*, New York: Oxford University Press.

WRI (2000a) 'Degraded Agricultural Land Threaten World's Food Production Capacity', *http://www.wri.org/press/goodsoil.html.*

WRI (2000b) 'Last Frontier Forests: Regional Overview: Asia', *http://www.wri.org/ffi/lff-eng/asia-2.htm*

WRI (2000c) *World Resources 2000-01*, Washington, DC: World Resources Institute.