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BIODIVERSITY CONSERVATION: STUDIES IN ITS ECONOMICS AND MANAGEMENT, MAINLY IN YUNNAN, CHINA

Working Paper No. 20

The Environment, Biodiversity and Asian Development

by

Clem Tisdell

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Clem Tisdell[2]

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Research for ACIAR project 40, *Economic impact and rural adjustments to nature conservation (biodiversity) programmes: A case study of Xishuangbanna Dai Autonomous Prefecture, Yunnan, China* is sponsored by the Australian Centre for International Agricultural Research (ACIAR), GPO Box 1571, Canberra, *ACT,* 2601, Australia. The following is a brief outline of the Project

Rural nature reserves can have negative as well as positive spillovers to the local region and policies need to be implemented to maximise the net economic benefits obtained locally. Thus an 'open' approach to the management and development of nature conservation (biodiversity) programmes is needed. The purpose of this study is to concentrate on these economic interconnections for Xishuangbanna National Nature Reserve and their implications for its management, and for rural economic development in the Xishuangbanna Dai Prefecture but with some comparative analysis for other parts of Yunnan

The Project will involve the following:

1. A relevant review relating to China and developing countries generally.
2. Cost-benefit evaluation of protection of the Reserve and/or assessment by other social evaluation techniques.
3. An examination of the growth and characteristics of tourism in and nearby the Reserve and economic opportunities generated by this will be examined.
4. The economics of pest control involving the Reserve will be considered. This involves the problem of pests straying from and into the Reserve, e.g., elephants.
5. The possibilities for limited commercial or subsistence use of the Reserve will be researched.
6. Financing the management of the Reserve will be examined. This will involve considering current sources of finance and patterns of outlays, by management of the Reserve, economic methods for increasing income from the Reserve and financial problems and issues such as degree of dependence on central funding.
7. Pressure to use the resources of the Reserve comes from nearby populations, and from villagers settled in the Reserve. Ways of coping with this problem will be considered.
8. The political economy of decision-making affecting the Reserve will be outlined.

Commissioned Organization: University of Queensland

Collaborator: Southwest Forestry College, Kunming, Yunnan, China

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The Environment, Biodiversity and Asian Development in South Asia

1. Introduction

Growth of production in the major South Asian economies has been relatively rapid since 1980 and has accelerated compared to the 1970s. While this growth has been less rapid than that of major low-income East Asian economies, the difference in growth rates between these areas may have been exaggerated in popular discussions describing the East Asian 'economic miracle' (Chakravarty, 1990). However, faster population growth in most South Asian economies than in most East Asian economies has meant that per capita incomes in the former have grown at a much slower rate than in the latter. Some East Asian economies have completed demographic transition or are well on the way to doing so, even though there are notable exceptions such as the Philippines (Ogawa and Tsuya, 1993). Table 1 provides some supporting comparative data on growth of production and population in selected South and East Asian economies.

Table 1: Rates of Growth of Production and Population in Selected South and East Asian Economies

	GDP		Population	
	Annual percentage increase		Annual percentage increase	
	1970-80	1980-92	1970-80	1980-92
South Asia				
Bangladesh	2.3	4.2	2.6	2.3
India	3.4	5.2	2.3	2.1
Pakistan	4.9	6.1	3.1	3.1
Sri Lanka	4.1	4.0	1.6	1.2
East Asia				
China	–	9.1	1.8	1.4
Indonesia	7.2	5.7	2.3	1.8
The Philippines	6.0	1.2	2.5	2.4
Thailand	7.1	8.2	2.7	1.8

Based on World Bank (1994), Tables 2 and 25.

Table 1does not, of course, portray fully the diversity of economic experiences in both regions. If all countries in East Asia are considered, economic performances vary considerably, e.g. if Laos or Myanmar are included, and the economic experience of the Philippines has been less satisfactory than that of most South Asian economies. Differences in growth rates of economic production have sometimes been attributed to whether individual economies are inward or outward-looking in their economic policies. Given the preference of the IMF and the World Bank for structural adjustment and free trade policies, there may have been a tendency to exaggerate any signs supporting this position and underplay other factors; e.g. the role of 'fortuitous' natural resource exports in the growth of some South East Asian economies, e.g. oil in the case of Indonesia, also timber exports in Indonesia's case and a number of other cases.

Both in South and East Asia economic growth is proceeding at a sufficient pace to have substantial impacts on natural environments. Since the 1970s considerable loss has occurred of forested and woodland areas in Asia, and use of agricultural land has intensified

principally as a consequence of the green revolution (Alauddin and Tisdell, 1991), water utilisation and scarcity of 'water has increased, pollution of water and air has risen in many Asian areas and biological diversity has fallen. Economic production is starting to dominate most Asian economies as they increasingly become interdependent market economies (Roy et al., 1992). This is reflected in the pace of investment in infrastructure in Asia for such items as roads, communication systems, electricity supply, water supplies and irrigation, safe water and sanitation (World Bank, 1994). While such developments often improve human welfare and man-made environments, they alter natural environments considerably and contribute to loss of biodiversity.

Asia's environmental problem is not just a matter of the volume of its wastes, but also their concentration. With rising urbanisation in Asia, concentration of wastes in metropolitan areas is rising, e.g., problems of disposal of sewage. While it is true that concentration of population may improve economies of treatment of wastes, the effect of 'treatment' may be localized. For example, more households may be connected to sewers but less nightsoil may be recycled in agriculture and aquaculture. This recycling as has been the past Chinese practice. Thus the organic load of large water bodies such as rivers is increased and spillovers from cities may occur even at distant points from the urban areas. For example, the increasing incidence of red tides in the China Sea (which make fish poisonous to humans) is attributed by some to such factors. Furthermore, this type of organic pollution as well as industrial pollution, threaten China's very large aquaculture industry as China's economic growth proceeds.

2. Digression on the Importance of Natural Environmental, Resource Stock and Sustainable Development

Classical economists emphasized the importance of capital accumulation (man-made as a vehicle of economic growth and development. For example, Marx (1956) stressed its importance and this led Paul Samuelson to suggest that for Marx capital accumulation as a means to economic growth was equivalent to most of the wisdom bequeathed by Moses and all the prophets. In addition, Engels (1957) stressed the significance of scientific and technological progress for economic growth in a trenchant attach on Malthusian economic theory.

Most economic growth and development models favoured in the mid-20th century saw capital and labour (population) as the main determinants of production, e.g., the Solow-Swan model (Solow, 1956; Swan, 1956). Solow (1957) subsequently extended the model to include technological change as an autonomous or exogenous variable in the economy's production function. This growth model was nevertheless not constrained by environmental· or natural resource factors (Tisdell, 1990, Ch. 3). It seemed that capital accumulation via savings and continued technological progress held the key to long-term sustainable growth and economic development. In relation to economic development, approaches such as those of Meier (1976) stressed physical capital accumulation essential and gave little or no attention to the role of natural resources and the environment in economic development.

It is true that in the 1970s neoclassical economic growth gave increasing attention to natural resources, especially depletable non-renewable resources. In general, it was believed that such resources were unlikely to pose limits or significant barriers to economic growth (Solow, 1974, 1986). Neoclassical economists generally remained optimistic about the prospects for economic growth and for continuing economic development and rejected views unfavourable to this outlook such as those associated with the Club of Rome (Meadows, *et al.*,1972, 1992)

The empirical studies of Denison (1962) pointed strongly (at least, in developed countries) to the significance of qualitative factors, such as education and technological progress, as sources of economic growth and suggested that they might be an even more important source of economic growth than increases in the quantity of physical capital and of labour. Furthermore, it was recognized that economies of scale in use of infrastructure could be important.

'New' endogenous economic growth theories, e.g., Romer (1986, 1994) have incorporated human capital (e.g., the production and transmission of knowledge) into their models and have allowed for possible external economies in economic growth. However, these theories, like their predecessors, have tended to ignore possible environmental and natural resource constraints on economic growth. In its respect, they contrast with those of writers such as Mäler (1974), Pearce and others (1990, 1993), Perrings (1987) and Turner and others (1993). These writers stress the importance of conserving natural environmental capital stock in order to achieve sustainable development. Diminution or destruction of this stock either by its depletion for its economic use or by pollution (the environment is used as a sink for wastes

from human activity including economic activity) can threaten sustainable development.

Traditional economic discussions of economic activity have usually ignored the interdependence of such activity with the natural environment. For example, circular flow diagrams of the operation of the market economy have done this. However, the economic system cannot or does not function independently of the natural environment. The natural environment is a sink for wastes from households and productive activities such as those engaged in by business firms. It also provides inputs or resources for production as well as goods and services directly consumed by individuals and households, e.g., fresh air, recreational possibilities, etc. If natural environments are destroyed or depleted this can limit economic activity and the welfare obtained from environmental services by individuals and households. The links are emphasized in Figure 1 which extended the traditional circular, economic flow diagram to include the natural environment. Note that the natural environment may be adversely affected by pollution from wastes arising from economic activity which uses natural environmental resources and thereby depletes or damages these.

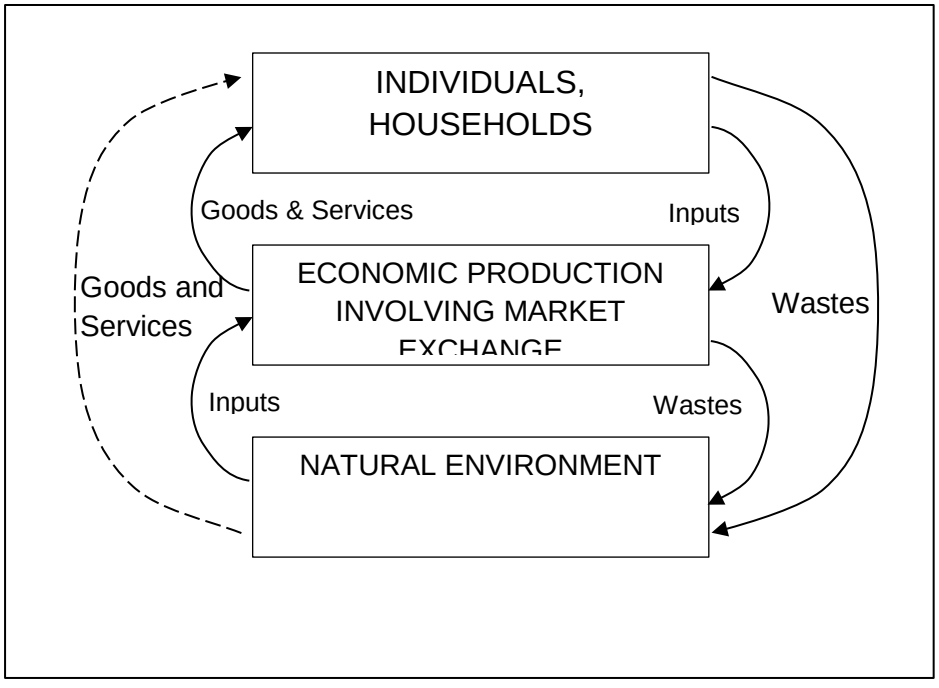

Figure 1: Economic links with the natural environment

In relation to Figure 1, note that with rapid economic growth in Asia, the scale of demands on

the natural environment in Asia are increasing rapidly. Consequently, both the demand to use natural resources for economic production is rising and so too is the demand to use the natural environment as a sink for pollution and wastes from human activity. Thus, concern has arisen about the sustainability of Asia's projected economic growth.

Most environmental economists (Pearce, 1993, Ch. 2) stress that in considering economic growth and development, particularly its sustainability, three types of capital stock play a significant role.

(1) Man-made capital, mostly physical capital.

(2) Human capital, including technical and scientific knowledge and education.

(3) Natural environmental capital.

Possible relationships between these forms of capital and labour as an input into the production of man-made capital are indicated in Figure 2. Social and cultural capital might, in addition, be considered as a part of human capital and includes the stock and nature of institutions in-society. Production of physical capital (and in some cases, human capital) is often at the expense of the natural environmental capital.

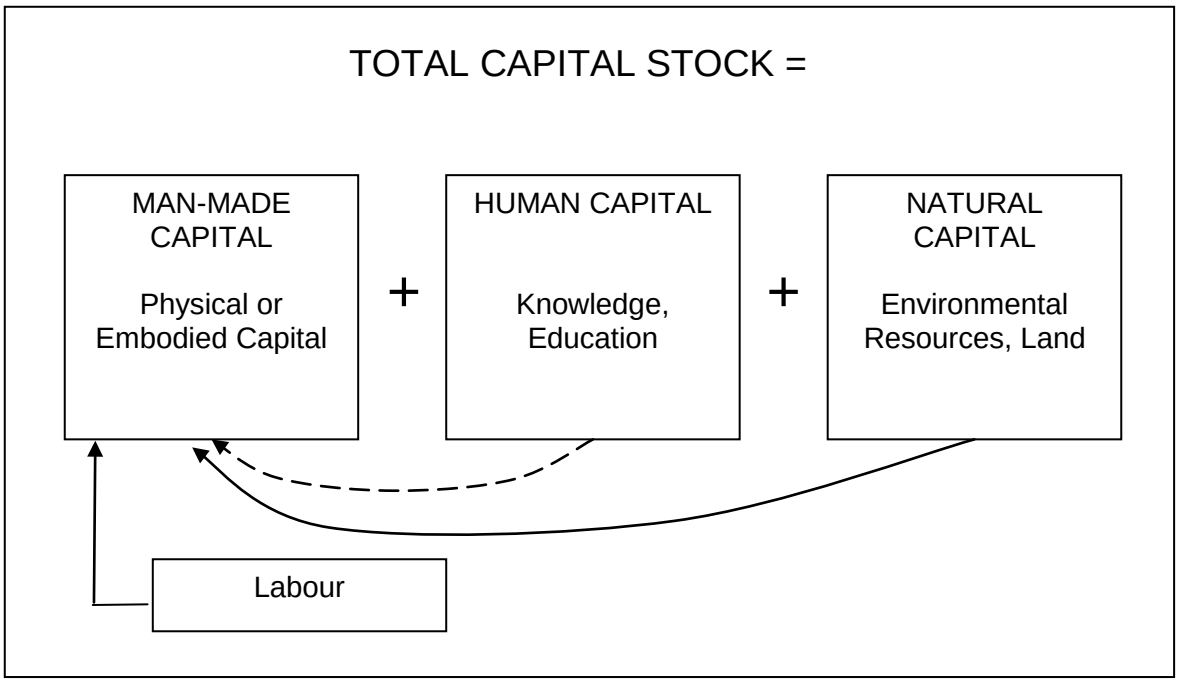

Figure 2: Production of man-made capital usually draws on natural capital and makes use of human capital and labour. Man-made capital is subject to depreciation but natural capital is not usually and the same is true for human capital.

The question has arisen of the extent to which it is possible to safely substitute other forms of capital for the stock of natural environmental resources and still sustain economic development. Two different standpoints have been identified in the literature (Pearce, 1993, Ch. 2): (1) substitution of physical and human capital for natural environmental capital is likely to be compatible with sustainable development (this is identified as *weak sustainability* since it proposes conditions weak conditions for sustainable development) and (2) the view that such substitution is incompatible with sustainable development. This is described as *strong sustainability* since it proposes a strong condition for sustainable development, namely that the stock of natural environmental resources be fully preserved.

The conditions for sustainable development as classified by Pearce (1993) apply to sustainable development in the sense commonly used by economists, namely that the incomes of future generations be no less than those of present generations. There are a spectrum of views about the extent to which natural environmental resources can be forgone and development can be sustained in the above sense. These are summarised in Figure 3 along the

lines suggested by Pearce (1993). In Asia, it appears that weak conditions for sustainability been accepted, at least in the past and that growth optimism is the dominant political force.

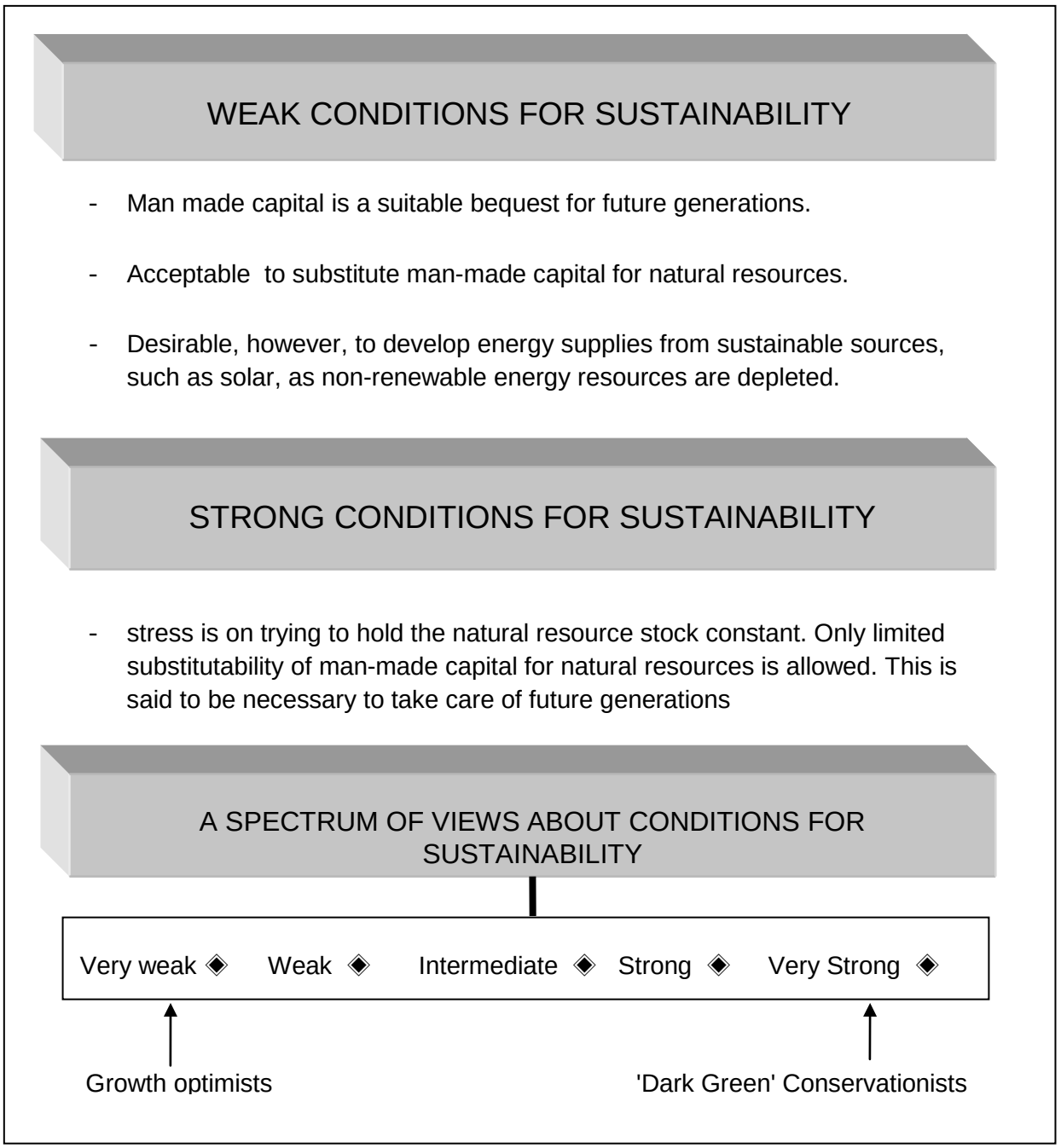

Figure 3: Weak and strong conditions for sustainable development and spectrum of views about those conditions according to Pearce (1993, Ch 2.)

Note that Pearce's classification, given his accepted definition of sustainable development,

anthropocentric. However, ecocentric values should also be considered. Some individuals argue that positive weight should be put on preserving or not extinguishing other species independently of the wishes of individual humans. Given this point of view, some 'dark green' conservationists may in fact favour conserving natural environments even when this is at the expense the income of present future generations. Whether or not Asian countries are likely to put much weight on ecocentism or the preservation of other species for their own sake can be debated. However, features of Buddhism and Hinduism support such ethics and the Chinese traditional view of the importance of balance of mankind with nature can also support wider conservation ethics than purely man-centred ones.

An intermediate position on conservation (not captured in Figure 3) has been proposed by Turner and Pearce (Pearce, 1994, Ch. 2) namely that substitution of other forms of capital for natural environmental capital is consistent with sustainability except for substitution from a *core* of the natural resource stock. Once the stock of natural environmental capital is reduced to the core, strong sustainability conditions apply. Note that as a result of global economic growth we may be rapidly approaching the core of the natural environmental stock for the world as a whole or possibly could have reached it. It is even possible that some individual Asian countries are already approaching a similar situation, e.g., Bangladesh and China. If so, they would need to be wary of increasing their physical capital stocks at the expense of their natural environmental stocks. In any case, all countries, including those in Asia should attempt to preserve their environmental core if they want to achieve sustainable development. Unfortunately, however Turner and Pearce have not provided us with a simple means to identify the core of the natural environmental resource stock.

The above may indicate that while the early economic ascent of mankind obtained by substituting other forms of capital for natural capital was appropriate, this process is less appropriate now because natural resource stocks have become reduced This constraint (if it is a real one) may be especially unfortunate for less developed countries, such as those in Asia, much of the reduction of the globe's natural resources has not been of their own making but brought about by more developed countries. Nevertheless, despite this, it would be pointless the question of whether economic growth in Asian countries is sustainable in view of its likely impacts on their natural environments.

3. Demographic Features

Most neo-Malthusians (e.g.· Daly, 1980; Ehrlich, 1970, Meadows *et al*., 1992) see rising populations and increasing levels of per capita economic production as the main threats to natural environments. While appropriate advances in technology can reduce the adverse impact of these factors, they are unlikely to offset these completely in the longer term as for example suggested by Georgescu-Roegen (1971, 1976). Because Asia contains more than half the world's population, the growth in its population level is of particular interest from an environmental viewpoint.

In most Asian countries, the rate of population growth is declining. However, this is not the case for all as can be seen from Table 1 and rates of population growth are still high for most low income countries in the region, although Sri Lanka and China have relatively low rates of population growth. On the whole, the rate of population increase in South Asia is higher than in East Asia.

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 coming decades. For example, on the basis of the World Bank's 'intermediate' predictions Bangladesh's population is expected to more than double (compared to its 1992 level) before it stabilizes. The same is true for India and Pakistan and the Philippines but not for China, Sri Lanka, Indonesia and Thailand although the population of the latter two is expected to almost double. Estimates and projections of the World Bank for these countries are set out in Table 2.

Table 2: Estimates and Predictions of Population Levels for Selected Asian Countries: Totals in Millions.

	1992	2000	2025	Hypothetical stationary level
South Asia				
Bangladesh	114	132	182	263
India	884	1,016	1,370	1,888
Pakistan	119.	148	243	400
Sri Lanka	17	19	24	29
East Asia				
China	1,162	1,255	1,471	1,680
Indonesia	184	206	265	355
The Philippines	64	77	115	172
Thailand	58	65	81	104

Source: Based on World Bank (1994), Table 25.

Given- these estimates 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 threat for several decades. In addition, growth in these countries can be expected to have significant global environmental impacts, for example in adding to greenhouse gas emissions (Tisdell, 1995).

As can be seen from Table 3, the major South Asian economies have recorded a positive average annual growth rate in per capita GNP since 1982, but their rates of growth have not been as high as in China and Thailand nor that in most East Asian countries. Nevertheless, all East Asian countries have not been high economic performers. For example, in the case of the Philippines, per capita GNP has actually declined.

Table 3: GNP per capita in U.S. dollars 1992 for selected Asian economies, its growth rate 1980-92 and the number of times by which GDP per capita would need to be multiplied to equal that of high-income countries.

	GNP per capita	Av. ann. growth (%) 1980-92	Necessary multiple to equal per capita income in high income economics
South Asia			
Bangladesh	220	1.8	110.8
India	310	3.1	71.5
Pakistan	420	3.1	52.75
Sri Lanka	540	2.6	41.0
East Asia			
China	470	7.6	47.1
Indonesia	670	4.0	33.0
The Philippines	770	-1.0	28.8
Thailand	1,840	6.0	12.0

Source: Based on World Bank (1994) Table 1.

It is apparent from Table 3 that GNP per capita in high-income countries (as classified by the World Bank) exceeds that in the low Asian income countries by several fold. For example, average per capita income in high income countries exceeds that in Bangladesh one hundred fold, in the case of India by more than seventy fold, and in the case of China by 47 times. The income gap between less developed Asian countries and high income ones remains very large, despite the limitations of such comparative statistics. There is little doubt that if by some 'miracle' Asian countries were able to achieve the same level of income as in high-income countries, the environmental consequences could be catastrophic because Asia's production would increase more than fifty fold. The magnitude of this environmental effect would be further increased by the predicted doubling of Asian's population before it stabilizes.

4. Utilisation of Natural Resources, and Environmental Quality

With increasing population and economic production throughout Asia, utilisation of its natural resources has risen considerably. As can be seen from Table 4, this has been manifested in Asia by an increase in the area of cropland, a rise in the area allocated to permanent pasture and a decline in the area of forest and woodland. On the whole since 1979 the extent of deforestation in East Asia has been much greater than in South Asia, even though Bangladesh is an exception, deforestation in Bangladesh has been severe.

Table 4: Land Use in Selected Asian Countries, for Asia, Europe and the World as a Whole – Percentage Change in Area, 1979-91.

	% change				
	Cropland	**Permanent Pasture**	**Forest and Woodland**	**Other**	**Forest as % of Total Area**
South Asia					
Bangladesh	2.1	0.0	-13.4	9.7	14.6
India	0.7	-2.0	-0.7	-1.0	22.5
Pakistan	4.0	0.0	19.7	-2.8	4.4
Sri Lanka	1.5	0.0	17.9	-14.3	32.1
East Asia					
China	-4.0	19.9	-6.5	-14.7	13.6
Indonesia	12.3	-1.5	-6.6	17.4	60.6
The Philippines	2.5	24.0	-16.9	19.5	34.7
Thailand	25.5	29.7	-14.3	-16.1	27.8
Asia	1.3	9.5	-4.9	-4.6	
Europe	-1.8	-3.7	1.1	6.2	
World	1.8	2.4	-7.8	5.5	

Source: Based on World Resources Institute, UNEP and UNDP (1994), Table 17.1

In addition, intensification of cropping has increased in Asia with multiple cropping rising

substantially. Areas irrigated have expanded rapidly and so too has the use of artificial fertilizers and pesticides. This intensification process has had adverse impacts on natural environments.

Freshwater utilisation has risen with economic growth in Asia. It is estimated that in 1987 annual withdrawals of freshwater in Asia amounted to 15% of available resources, the same percentage as for Europe (World Resources Institute *et al*., 1994, Table 2.1). However, the percentage withdrawal differs considerably between countries. In the case of Pakistan it exceeds 33%. Furthermore, these annual figures disguise the fact that in many Asian countries freshwater is in especially short supply 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) have added markedly to the demand for water throughout the dry season in Asia. In some cases, this demand has been compounded by subsidisation of reticulated water supplies and open-access to water supplies.

Furthermore, water bodies have had to carry increasing loads of wastes and emissions from rising economic production and population growth. Consequently the quality of many water bodies in Asia, especially in the dry season, is well below internationally accepted standards. For example, their oxygen content is low and *E. coli* counts for example, are high.

Air quality has declined in many parts· of Asia and is well below world standards in several major cities. This is mainly a consequence of increased use of fossil fuels for energy production but petrochemical and industrial plants contribute as does the increasing use of vehicles. Further economic growth combined with increased urbanisation can be expected to compound these problems.

5. Urbanisation, Wastes and Environmental Problems

Urbanisation is proceeding at a rapid pace in Asia as can be seen from Table 5. Between 1965 and 1995 the average annual percentage increase in urban population in Asia was 3.5%. From Table 5, it can be been that Bangladesh has experienced a particularly rapid rate of urbanisation but most Asian countries have experienced high rates. This has created a need to expand economic infrastructure greatly and has added to environmental problems.

Table 5: Urbanisation in Asia

	Urban Pop. as % of total		Av. annual urban Pop. change %
	1965	1995	1965-95
South Asia			
Bangladesh	19.5	19.5	6.7
India	26.8	26.8	3.3
Pakistan	34.7	34.7	4.2
Sri Lanka	22.4	22.4	2.1
East Asia			
China	30.3	30.3	3.5
Indonesia	32.5	32.5	4.6
The Philippines	45.7	45.7	3.9
Thailand	25.4	25.4	4.5
Asia	22.2	34.0	3.5
Europe	63.8	75.0	1.0
World	35.5	45.2	2.7

Source: Based on World Resources Institute *et al*. (1994) Table 17.2.

Despite this, all major South Asian countries have managed to increase the proportion of their urban population served by safe drinking water and sanitation (as indicated in Table 6) except Sri Lanka's proportionate sanitation coverage has declined. In Indonesia, in the period 1980-90, no rise occurred in the proportion of its urban population with access to safe water and in the Philippines the proportion of its urban population having access to sanitation declined. Thus the absolute number of urban residents without safe water has risen in Indonesia as has the numbers without access to sanitation in the Philippines. Because of the general deterioration in water quality in Asia, the importance of having access to safe water supplies has increased (Cf. Brandon and Ramankutty, 1993, p. 48).

Table 6: Access of urban population to safe drinking water and sanitation in Asia, 1980 and 1990. Percentage of urban population.

	Safe drinking water		Sanitation	
	1980	**1990**	**1980**	**1990**
South Asia				
Bangladesh	26	39	21	40
India	73	77	27	44
Pakistan	72	82	42	53
Sri Lanka	65	80	80	68
East Asia				
China		72		100
Indonesia	35	35	29	79
The Philippines	65	93	81	79

Source: Based on World Bank (1994) Table A.2.

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, Ch. 3).

While urbanisation in Asia is growing rapidly and urban areas account for 34 per cent of Asia's 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 megacities.

6. Protection of Biodiversity

Biological diversity continues to decline throughout the world as economic growth occurs, and this is apparent in Asia. In most of South Asia the percentage of land area in which nature is protected is low compared to that in Europe and the USA (see Table 7). As can be seen from Table 7, only a very small proportion of Bangladesh is protected and then only partially. Most of the protected areas in India and Pakistan are only partially protected. The situation in

Sri Lanka, as far as the area afforded nature protection is concerned, is the most favourable for all of the major South Asian economies.

In the case of China, a smaller proportion of its land area than in India is protected and nearly all of its protected area is only partially protected. The situation in the Philippines while not as unfavourable to nature conservation as in Bangladesh is nevertheless dismal. In relative terms the position in Indonesia and Thailand is much better. Nevertheless, some caution is needed in drawing conclusions from this 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.

Table 7: Protected areas as a percentage of total land area and a percentage of protected area totally and partially protected, 1993, for selected Asian countries.

	All Protected Areas IUCN Categories I-V	Totally Protected IUCN Categories I- III	Partially Protected IUCN Categories IV-V
South Asia			
Bangladesh	0.7	0	100
India	4.0	28.3	71.7
Pakistan	4.6	24.1	75.9
Sri Lanka	11.9	62.8	37.2
East Asia			
China	3.2	0.3	99.7
Indonesia	10.2	71.9	28-.1
The Philippines	1.9	39.4	60.6
Thailand	12.6	52.9	47.1
Asia	4.4	29.1	70.1
Europe	9.3	18.8	81.2
USA	10.5	39.3	60.7

Source: Based on World Resources Institute *et al*. (1994) Table 20.1.

Many mammals, birds and higher plants are threatened with extinction in Asian countries. The numbers threatened in selected Asian countries are shown in Table 8. 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 being high for China, Thailand, India 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 threatened by extinction in Asia is large compared to the number in developed countries. However, comparison of absolute numbers may overstate the comparative position for Asia, particularly for Asian countries located in 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.

Table 8: Number of species of threatened mammals, birds and higher plants in the 1990s in selected Asian countries.

	Mammals	Birds	Plants
South Asia			
Bangladesh	15	27	2,074
India	39	72	2,363
Pakistan	15	25	1,168
Sri Lanka	7	8	1,781
East Asia			
China	40	83	3,340
Indonesia	49	135	4,311
The Philippines	12	39	2,907
Thailand	26	34	3,442

Source: Based on World Resources Institute *et al.* (1994), Table 20.4.

7. The Human Development Index and a Human Development/Conservation (or Biodiversity) Index Applied in Asia

As is well known, GDP per capita is an inadequate indicator of economic development and economic welfare. In order to rectify this partially, UNDP has suggested a Human Development Index (HDI). This involves a weighting of life expectancy, adult literacy and mean years of schooling, and GDP per capita. It has a maximum value of unity (UNDP, 1994, p. 91). As noted for example by Pearce (1993), this implies that the indifference curves of the social welfare function depicted by HDI are linear and that components of the function are perfect substitutes. For instance, an increase in the education variable or in GDP per capita would provide perfect substitutes for reduced life expectancy if HDI applies. One is likely to have doubts about this substitution especially if the degree of substitution involved is large.

It is interesting to see how Asian countries compare in terms of HDI even though one must be cautious about its welfare implications. HDI values for selected Asian countries are set out in Table 9. It can be seen that except for Sri Lanka, HDI values for major South Asian countries are well below that of the selected East Asian countries listed.

Table 9: Human Development Index (HDI) 1992 for selected Asian countries.

Country	Index
Thailand	0.798
Sri Lanka	0.665
China	0.644
The Philippines .	0.621-
Indonesia	0.586
Pakistan	0.393
India	0.382
Bangladesh	0.309

Source: Based on UNDP (1994) Table 1

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 (Ahmad *et al*., 1989, Repetto *et al*., 1989) has been as a way to provide

more information about the sustainability of development. While this, it still has a number of limitations.

Natural resource accounting provides an anthropocentric assessment of sustainability but is ill equipped to take account of the value of preserving biodiversity even from a man-centred 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. Examples of such an approach include Blackorby and Donaldson (1992) and Ng (1986) who take into account animal welfare by means of extended utility approaches. The desirability of preserving biodiversity is, however, not necessarily based on the principle of extended utility maximisation, although 'justifications' are possible on this basis. For many, it is based upon mankind's stewardship or moral responsibility role for the preservation of nature (Leopold, 1966; Passmore, 1974; Tisdell, 1991, Ch. 1). If this point of view is accepted, it is unsatisfactory to have a valuation index for development, such as HDI, which is solely man-centred and ignores the biodiversity element.

One way to allow for this shortcoming is to construct a value of development index which combines anthropocentric and non-anthropocentric elements, for example, one that combines HDI and a conservation of nature index (CI) or a biodiversity index (BI). This development valuation function, V, might be similar in nature to the Bergson (1938) social welfare function.

There are basically two problems to be solved: (1) how to estimate CI or BI and (2) 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 is available on the percentage of their land area afforded nature protection. Few countries have more than 20 per cent of their land area protected in this way so this may be used to provide the upper value of CI and is set equal to unity for scaling purposes. Any country with 20 per cent or more of its area protected would have a CI of unity and any country with no protected area a CI of zero, with those in-between having a CI in proportion

to their protected area in relation to the upper value, 20 per cent. Table 10 sets out the conservation indices for selected Asian countries estimated on this basis. Incidentally, the limit for the index may either be a desired standard or could be based upon observed upper limits; the latter approach is used in estimating HDI.

Table 10 Conservation Index (CI), HDI, and Value Ordering, V = 2/3 HDI + 1/3 CI, for Selected Asian Countries.

Country	CI	HDI	V
Thailand	0.63	0.798	0.742
Sri Lanka	0.595	0.665	0.643
Indonesia	0.51	0.586	0.561
Pakistan	0.23	0.393	0.339
India	0.20	0.382	0.321
China	0.16	0.644	0.496
The Philippines	0.095	0.621	0.446
Bangladesh	0.035	0.309	0.218

Source: Based on Tables 7 and 9.

In constructing V, one has to determine the relative weight to place on HDI and CI since this 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, I shall use the linear form:

$$V = a\,HDI + (1 - a)\,CI \qquad (1)$$

where $0 \leq a \leq 1$. The value a reflects the relative weight placed on human development and the conservation of nature, using the protected areas variable as·a proxy for the conservation of biodiversity. Although this value-ordering implies perfect substitutability between HDI and CI, in practice this may only be so over a limited range.

The 'social' preference or valuation function V can be represented by a series of parallel straight-line indifference curves (iso-value lines) like those shown in Figure 4. Rearranging equation (1), it can be seen that these lines canoe specified using the relationship·.

$$HDI = \frac{1}{a} V - \left(\frac{1-a}{a}\right) CI \quad (2)$$

If for example, a = ⅓,

$$HDI = 1.5V - 0.5CI \quad (3)$$

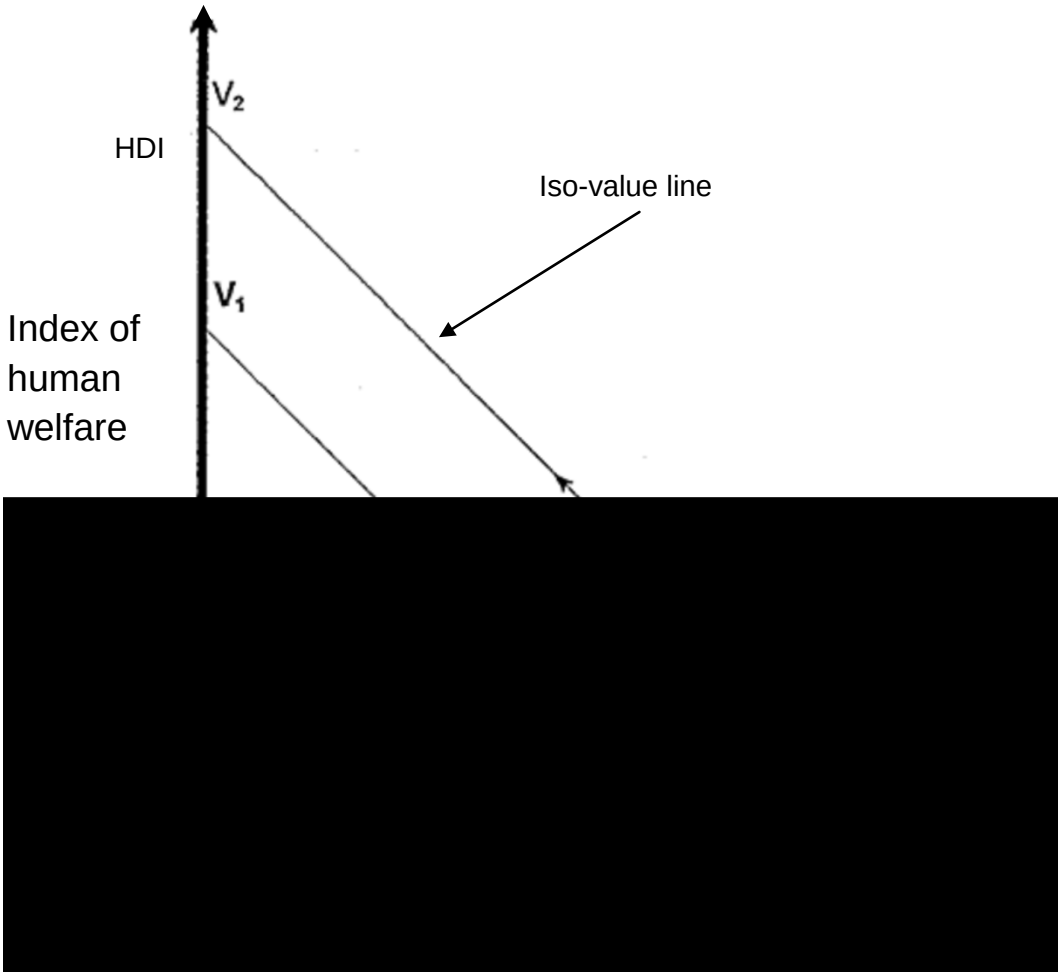

Figure 4: Representation of valuation frontier incorporating human welfare and biodiversity conservation as considerations, trade-off possibilities and optimisation.

Suppose that there happens to be a trade-off possibility frontier between the human welfare element of development as measured by HDI and biodiversity conservation as indicated by the conservation index, CI. Then given the relevant value ordering function based on (1), an optimal combination could be determined in principle. For example, if the trade-off possibility frontier happened to be as indicated by curve ABCD in Figure 4, the optimal combination would correspond to point C.

Note that if only human welfare were to count, the optimal combination would correspond to point B. In this case, the valuation indifference curves are horizontal straight-lines. In the illustration (Figure 4) observe that some nature conservation is necessary to maximise HID. On the other hand, extreme ecocentrism would result in combination D as optimal because the valuation indifference curves would be vertical lines. Other forms of the trade-off frontier can also be considered.

For the purpose of this exercise, *suppose* that a = ⅔. This means that more weight given to human welfare than to species conservation using this crude approach, but that the preservation of biodiversity·is also ethically important. The values of V for selected Asian countries using this weighting are shown in the last column of Table 10. Different weightings on HDI and CI will of ·course give different results.

It can be seen from Table 10 that the conservation indices for these countries are substantially below unity. A very unsatisfactory situation from this perspective exists in Bangladesh, The Philippines, China, India and Pakistan with a much better situation prevailing in Indonesia, Sri Lanka and the Philippines. Nevertheless, all countries fall considerably below per cent protected area standard.

The main consequence of taking into account CI is that Indonesia rises in the valuation rank order of Asian countries considered and China and the Philippines slide down the scale. Furthermore, the degree of disparity between CI and the estimated V-values is considerably higher than for the disparity in HDI-values. A positive association or correlation between HDI and CI values can also be observed. This might suggest a positive causal relationship between HDI and CI and appears to give credence to the Brundtland Committee's view (WCED, 1987) that human poverty is the main source of environmental degradation. However, it would be unwise to draw this conclusion. The situation is much more complicated (Tisdell, 1992) and evidence insufficient to reject neo-Malthusian concerns and

the worries of some conservationists about the likely threat to biodiversity (Wilson, 1992) of rising human populations and of substantial economic growth.

Note that the method used above to estimate the nature conservation index CI is subject to limitations. 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 ad 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.

One might imagine that indicators of the number of species saved from extinction by protective measures might provide an improved measure of biodiversity conservation. The other side of the coin here is the number of species lost as a result of not taking 'adequate' defensive action to save them. A problem, however, of concentrating on the latter is that most developing countries will appear to be 'especially bad' when it comes to nature conservation. This is because most developing countries are located in the tropics or the sub-tropics where biodiversity in relation to land area tends to be much higher than elsewhere on the globe (Wilson, 1992). The same absolute loss of protected land area in these less developed countries can be expected to lead to loss of more numerous species than in countries located in temperate zones, mostly the more developed countries. Given that humankind's stewardship of nature is a global responsibility, this is one reason why protection of biodiversity in less developed countries requires aid from more developed countries, namely more species tend naturally to occur in developing countries.

8. Concluding Comments

Economic development appears to have been mostly defined in relation to man-centred attributes as is for example apparent from the components of HDI. Conservation of natural environments and of biological diversity have no weight *per se* in most indicators of economic development. In practice, measures of the sustainability of economic development are not widely used.

Considerable economic growth has occurred in Asia, both in South Asia and East Asia with substantial loss of natural environments. Given strong aspirations for higher incomes in and unavoidable further rises in Asia's population, further loss and damage of natural is inevitable. Therefore, there is a need for realistic well thought out environmental policies throughout Asia. This is particularly so in the Indian subcontinent still continues to experience a high rate of population growth. A danger exists in some less developed Asian countries, e.g. Bangladesh, of unsustainable development (Cf. Barbier and Markandya, 1993; Tisdell, 1994b) due to the gradual depletion of their natural resource-base and a reduction in the quality of their natural resource-stock. This process may also exact a considerable toll in terms of further losses of biological diversity.

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