

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

Working Paper No. 3

**The Environment and Asian-Pacific,
Particularly East Asia, Economic Development**

by

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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

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THE ENVIRONMENT AND ASIAN-PACIFIC, PARTICULARLY EAST ASIAN, ECONOMIC DEVELOPMENT

ABSTRACT

While rapid economic growth in the Asian-Pacific region is a potential means for low-income countries in this region to improve their lot, it raises international dilemmas and may be unsustainable. Political bias exists in favour of Asian economic growth both in Asia and abroad even at considerable expense to the environment. The theoretical underpinnings of the bias are discussed. A number of the environmental issues involving water, air and soils in Asia are considered, particularly the global greenhouse problem arising from China's use of fossil fuels. Conservation of living resources and biodiversity is difficult given east Asia's rapid economic growth and is made more difficult by the fact that many areas designated for nature protection are inhabited by villagers or are subject to encroachment by migrating groups. Furthermore, in low income countries, nature protection is often considered to be a luxury and/or there is a perception that more distant frontiers are more suitable for nature conservation. It is difficult to provide those inhabiting protected areas with alternative means of livelihood to their utilisation of the natural area. Tourism development is a possibility but it has limitations. In fact, tourism development in the Asia-Pacific is a source of several environmental problems. Increased urbanisation is another environmental feature of Asia and may have positive long term environmental impact by reducing the rate of growth of population. With economic growth, interregional and transboundary conflicts will intensify in Asia. It seems possible that both market mechanism and political ones will be inadequate to deal with Asia's growing environmental problems. The article is critical of the view that economic growth to the neglect of the environment is acceptable even in low income countries and suggests that given the public good/bad dimensions of Asia development that more assistance from high income countries in relation to environmental conservation in Asia's less developed countries is justified.

THE ENVIRONMENT AND ASIAN-PACIFIC, PARTICULARLY EAST ASIAN, ECONOMIC DEVELOPMENT

1. Introduction

The rapid economic growth of northeast Asian countries, which has diffused to the south east, provides new economic opportunities for Asian-Pacific countries as well as European countries. The Asia-Pacific Economic Cooperation (APEC) forum was formed to enable all APEC countries share in East Asia's economic momentum and to promote freer trade. Such new opportunities are facilitated by peace in Asia and increasing accommodation between its nations, e.g., between China and Vietnam and between China and Taiwan.

While APEC nations emphasises increased materialistic opportunities to be obtained from Asian economic growth, they are less vocal about the environmental impacts of this growth and its sustainability. Naturally, more developed countries in the Asia-Pacific would like to enjoy the economic advantages of Asian economic development without its environmental disadvantages. An important question is whether this is possible. To what extent is economic growth in Asia and environmental conservation compatible and likely to be achieved? Since the advantages of economic growth are expected to show up in the relatively short-term whereas many of the easily observable adverse impacts of environmental destruction are delayed, politicians are likely to be biased in favour of economic growth even when it involves considerable environmental cost. Such myopia is likely to be politically advantageous.

Political bias in favour of economic growth without corresponding concern for the environment is buttressed internationally by two viewpoints:

- (1) Greater use of market forces and the adoption of the type of structural adjustment policies recommended by the IMF and the World Bank will provide positive economic forces for counterbalancing possible adverse environmental impacts of economic growth. In other words, thorough-going market systems are environmental friendly (Sebastian and Alicbusan, 1989).

(2) In less developed countries, economic growth should be encouraged even if it is initially environmentally destructive because whenever their incomes remain low, individuals have no incentive to conserve their natural environment. Poor people look upon natural resource conservation as a luxury. Furthermore, for economic reasons, they are inclined to have families of large sizes so rates of population increase tend to be high among the poor thereby placing even greater pressure on the natural environment (Todaro, 1981).

The policy implication of this the latter is that only by economic growth and modernisation which raise per capita incomes sufficiently and alter the structure of society suitably (for example, encourages urbanisation), can low income countries escape from their low-level equilibrium trap involving poverty, large-sized families and environmental degradation. This is a variant of the Malthusian low-level equilibrium theory (Todaro, 1981) to which an environmental destruction component is added. This thesis is endorsed (it seems) by the World Commission on Environment and Development (1987) and the World Bank (1992) has now become a part of the conventional wisdom.

Concerning the first hypothesis, market distortions do have adverse environmental consequences in Asia. Prices for example often do not reflect user costs or externalities in Asia especially when state enterprises are involved in the use or control of natural resources. Considerable room exists for improvement in pricing of natural resource-use in Asian countries. However, it does not follow that market systems lead to an ideal result as far as environmental conservation is concerned (Tisdell, 1992; 1993d). Market failures do occur and the market system does not necessarily ensure sustainability (Hartwick, 1977). Furthermore, the very dynamic success of market capitalism, (Schumpeter, 1942) may be the source of considerable environmental destruction. Market capitalism is a strong force for expanding the scale of economic activity (Tisdell 1992) and expansion in aggregate economic activity usually is at the expense of the natural environment.

Regarding the second hypothesis, it needs to be qualified. Extremely poor people with primitive techniques may be unable to damage the natural environment greatly even though poor people with more advanced techniques could well do so. This is not to deny that some people with relatively primitive techniques have managed to engage in

activity that has undermined economic sustainability. For example, early Easter Islanders are reputed to have destroyed the tree cover on their island with catastrophic impacts on its economy (Ponting, 1991, Ch. 1). Secondly, economic growth utilising natural resources to fuel economic take-off does not guarantee successful escape from a low-level equilibrium trap. A 'premature' attempt to escape may result in irreversible natural resource-depletion making it more difficult to escape subsequently. Possibly this has already happened in the Philippines and Bangladesh. So even if one believes in this modified Malthusian theory, there is a difficult decision to make (in theory) about when to attempt economic growth to escape from the trap (Tisdell, 1994). However, politically governments may have little choice but to always try for growth including when it is bound to be abortive in the medium term.

The World Bank (1992) in general identifies improved environmental quality with higher incomes and uses both cross sectional and time series data to convey this view. Nevertheless some negative environmental consequences are noted by the Bank such as reduced biodiversity and; increased global environmental risks as a result of rising incomes. This underlines the point that environmental quality must to be judged in relation to a set or vector of variables and so at the very minimum involves an index question. For the individual, it involves a preference or utility function with elements or variables such attributes of air quality, water quality, soil quality, biological diversity and so on, and may involve attributes of the natural environmental as well as of the man-made environment. Consider trends in a number of these attributes for East Asia.

I **2. Some Asian Environmental Elements - Air, Water, Soil**

Only some elements of environmental quality and availability can be discussed here for Asia. Consider water, air and soil.

Water

Water is becoming increasingly scarce in Asia. Take China and India. In 1990, their per capita consumption of water was 520 cubic metres less than half of that of high income countries, which in 1990 had a per capita consumption of water of 1,217 cubic metres on average. However the intensity of water use in China and India was higher

than in high income countries because 18 per cent of total available renewable water resources were withdrawn for use in China and India compared to 11 per cent for high income countries (World Bank, 1992, p. 197). The combined population of China and India in 1990 was estimated to be 1,984 million and is predicted by the World Bank to rise to 2,945 million by 2025 and eventually to stabilise at about 3,752 million. This means that per capita renewable water resources *available* for consumption in China and India will fall from 2,345 cubic metres (in 1990) to 1,579 cubic metres in 2025 and to 1,239 cubic metres eventually. Given the same level of water consumption per head in China and India as in 1990, their utilisation of theoretically available water resources will rise sharply by 2025. Both countries can be expected to face serious water problems especially in drought years. The World Bank (1992, p. 192) suggests that countries having less than 1,000 cubic metres of per capita annual availability of water face chronic water problems and these with less than 2,000 cubic metres have serious problems especially in drought years. So China and India will have a serious water problem in the next century.

If per capita consumption of water rises in China and India, as it is likely to do as per capita incomes rise and industrialization occurs (industry is the major user of water in high income countries) this will place an even greater demand on their available water resources. If for example, their per capita water consumption was to reach the level of high income countries then at the predicted (World Bank, 1992) stable population levels for China and India, their total annual consumption of renewable water would approximately be 100 per cent of that theoretically available to them. While it is possible for use of available water resources to exceed 100 per cent due to reuse of water, the economic costs are likely to be high.

The available water resources of China and India could support their projected population increases but water will become scarcer and involve major economic and environmental issues as well as international political conflict when water bodies are shared in the Asian region. High rates of utilisation of available water create many problems. They increase the risk of pollution of water; in the case of underground water use, they may lead to land subsidence; infrastructures for water supply such as dams result in flooding of lands and their loss from traditional uses and often involve significant ecological losses and losses to tribal people such as occurred with

the building of the Kapatar Dam in the Chittagong Hill Tracts of Bangladesh. Moreover altered or regulated stream flows have significant ecological impacts, for example on the functioning of wetlands.

Wetlands in the Yangtze River are likely to be adversely affected for example by the Three Gorges Dam. Furthermore, such changes tend to reduce natural fish stocks and lower stream flows, restrict navigation in internal waterways and in many cases raise the salinity of rivers with adverse economic consequences. Examples of all these problems are available for mainland Asia for e.g. for Bangladesh (Tisdell, *et al.*, 1994).

Furthermore, an additional problem is that water resources are not evenly distributed in Asia, including China and India. In China, for example, the north has a severe water deficit whereas in south China water resources are more abundant. A critical water problem already exists in Northeast China. One must not only take into account the aggregate availability of water in a county but the cost of making use of it at the points where it is demanded.

The World Bank (1992) provides a substantial amount of data on water quality in Asia. In less developed countries in Asia, water quality, using most indicators, is much poorer than in high income countries.

Air

According to World Bank (1992) data air quality is worse on the whole in major Asian cities of less developed countries than in those in high income countries. Unfortunately, air quality in Asian low-income but developing countries can be expected to deteriorate further as their total energy use rises, even though in the very long run, this trend may reverse itself.

Amongst other things, acid rains will become more common in Asia as for example China increases its use of its high-sulfur coal. Already international effects from such rains are present. For example, some believe that the death of pine trees in Hiroshima Prefecture, Japan is due to acid rains transported from China. In Yunnan, there are fears that industrial development could threaten tropical forests in southwest Yunnan containing considerable biological diversity by generating acid rain. However, let us consider briefly the global dimension of greenhouse gas emissions in Asia,

particularly China.

China, because of its extremely large reserves of coal and rapid economic growth, has the potential in the near future to become the world's major emitter of carbon dioxide. Currently the United States occupies this position (World Bank, 1992). By world comparisons the USA is an extravagant user of energy resources and emits about 10 times the carbon equivalent of China (See Table 1). If China were to achieve the same type and nature of energy use as the United States per capita, then China's annual emissions of carbon dioxide in carbon equivalents given its present population would exceed the aggregate level of current global emissions of carbon dioxide. While such a situation maybe unlikely in the very near future, it raises the question of whether the globe has the environmental capacity to withstand a situation in which all countries or a large number attempt to achieve and maintain levels of per capita income approaching those of high income countries.

Table 1: Global Carbon Dioxide Emissions from Fossil Fuels and Cement Manufacture

Country group or country	Total emissions from above sources (millions tons of carbon)		Total emissions from above sources of carbon per capita (tons)
	1965	1989	
			1989
Low-income	203	952	0.32
Middle-income	373	1061	0.96
High-income	1901	2702	3.26
China	131	652	0.59
India	46	178	0.21
Germany (FRG)	178	175	2.82
Japan	106	284	2.31
UK	171	155	2.72
USA	948	1329	5.34

Source: Based on Table A.9, p. 204, World Bank (1992).

Even though China is unlikely to achieve per capita levels of economic activity comparable to the USA by 2025, substantial expansion in Chinese income levels and economic activity can be expected. Possibly China's carbon emissions per person will be in the range of 1-1.5 tons by 2025. This would still be well below the per capita level for high income countries. Its population is predicted by the World Bank to be 1,597 million then. By then it may have overtaken the US as the world's major carbon dioxide emitter or have roughly an equivalent level of emissions.

China's emissions, given the above predictions, would be 1597-2395 million tons of carbon annually in 2025. Given that the United States level of emissions stabilises at its 1989 per capita level and given a predicted population for the United States in 2025 of 307 million, the emissions of the United States would be 1639 million tons of carbon annually in 2025. From a world perspective, the USA would still be a very large carbon polluter, globally, (even the major one) and comparatively a much greater polluter than Europe. If carbon dioxide emissions do really constitute a serious global problem (a public bad), then the equity of some countries maintaining very high levels of per capita energy use and greenhouse gas emissions can be expected to become a major international political issue. While tradeable global carbon emission permits have been suggested as a way to deal with this problem, one stumbling block is likely to be political concerns about the initial country by country allocations of such permits.

Soils

Both in China and India agricultural production has increased substantially since 1965 and annual crop yields have risen significantly. To a large extent, this can be attributed to the use of green-revolution input packages involving high yielding seed, chemical fertilisers, pesticides and irrigation water. An extremely important factor explaining increased crop yields has been the increased incidence of annual multiple cropping, particularly cropping in the dry season under irrigation (Alauddin and Tisdell, 1991). However, increasing scarcity of water in Asia can be expected to limit the expansion of the use of green-revolution technologies. Furthermore, the sustainability of yields from this type of intensification of agriculture must be considered. For example, multiple cropping can result in falling levels of humus in the soil, in deteriorating soil structure and the use of common chemical fertilisers can be expected to lead to acidification of soil. So falling soil fertility as a result of new agricultural technologies is a danger in Asia.

While falling soil fertility can be counteracted up to a point by increasing artificial fertiliser applications, this may eventually become uneconomical and falling yields will then become apparent. In order to obtain a more sustainable yield, it is wise to place greater emphasis on organic agriculture with limited use of fertilisers and pesticides and special emphasis on return of crop residues to the soil to enhance their

humus content to improve their structural properties and increase their resistance to erosion. The "rapid increase in use of chemical fertilisers in Asia may be more a source for environmental concern than an indicator of sustainable development (Cf. Tisdell, 1991, Ch. 9; 1993, Ch. 11). Fertiliser consumption per hectare of agriculture land in China is already very high. It is greater than in the United States but not as high as in many Western European countries.

The natural fertility of soils in much of Asia is being depleted. Furthermore, the quantity of land suitable for agriculture may be slowly declining due to urban encroachment and soil erosion and deterioration. It is estimated that the amount agricultural land has fallen by 0.3 per cent per annum in China since 1965 (World Bank, 1992). This may partly reflect ecological impacts on soils, urban encroachment and less emphasis in Chinese policy on agricultural production compared to production from forests and grazing.

The Hong Kong press has expressed concern about the high levels of pesticides used on vegetables in Shenzhen, China because 50 per cent of Hong Kong's fresh vegetables is imported from China (*The Standard*, January, 15, 1994). Residuals of pesticides on these vegetables have caused food poisoning.

3. General Perceptions of Environmental Issues in Thailand

There is a widespread belief in Thailand that Thais face a severe water shortage. While some believe that the disappearance of much of Thailand's forested area is to blame, the *Bangkok Post*, September 14, 1993, p. 25 reports: 'It is not that there is less rain this year: according to the Meteorological Department, rainfall is normal. But it appears no longer enough to meet our ever-increasing demand and wastage'.

Presumably this situation is being worsened by inadequate water pricing policies.

The King of Thailand has in the last year expressed concern about controversial dams in Thailand, regional foreign policy, the unbearable traffic problem in Bangkok, the proposed road construction linking China and Thailand and the use of the water in the Mekong (*Bangkok Post*, September 5, 1993, p. 23). Currently there is

a scheme for using the water of the Mekong River involving Thailand, Laos, Burma, Cambodia and Vietnam. But it does not include China. The headwaters of the Mekong are in China where it is called Lancang Jiang. China could construct a dam on the Mekong headwaters and divert much of its water for its own use. The flow and level of the Mekong would then be at the mercy of China. Although China has no firm plans in that regard, the King is reported as saying: 'To ensure the success of the Mekong project, we [the Thais] should get China involved as a big brother' (*Bangkok Post*, September 5, 1993, p. 23).

This is a relevant illustration of the international dimension of water problems in much of Asia.

4. Living Natural Resources and Biodiversity

Since 1965, in the world as a whole, the proportion of land area allocated to agriculture has grown, that used for permanent pasture has remained stationary whereas the area used for forest and woodland has declined (World Bank, 1992, Table A6). The percentage of land allocated for other uses such as urban use, has increased. However, since these estimates are crude, it is difficult to be precise about the trends. The decline in forest and woodland is probably greater than indicated because the crown cover of much forested and woodland has been severely reduced.

The estimates for forest and woodland also include forest plantations. Sometimes these monocultures have adverse environmental impacts. Introduced eucalyptus forests in India for example have been criticised because of their environmental impacts, e.g., lack of compatibility with native flora and fauna, high water demands (Tisdell, *et al.* 1993).

In the period 1965-89, the area of forest and woodland in China fell by an estimated 0.8 per cent per annum (World Bank, 1992) and China's forests continue to be harvested unsustainably. However, China is planning for sustainable harvesting. China's Eight Five Year Plan states that:

The negative situation symbolised by the constant decline in the

standing volume of forests should be ended, and the deficit of [use of] forest resources should be eliminated so as to reach the objective of increasing forest area and standing volume. To this end the first step is to achieve balance between the overall increment and consumption of forest resources, the second step is to make, the increment dominate the overall consumption. (Ministry of Forestry, 1992, p. 20).

On average, the proportion of a country afforded official (national) nature protection rises with per capita income levels. In 1990, this proportion in low income countries was 3.8%, in middle- income countries, 4.6% and in high-income countries, 10.2% (World Bank, 1992). Furthermore, the effectiveness with which natural areas are protected usually rises with the per capita income level of a nation. In 1990, the nationally protected area of China was 3% of its land area. This is below the average proportion for all low-income countries and contrasts with 4.3% for India. This is above the average for low-income countries and almost equal to that for middle-income economies.

Many countries on the Asian mainland have to deal with the difficult problem of local people resident in protected areas and their encroachment on such areas. Nature protection often leads to conflict with local people because it interferes with their traditional way of life and may reduce their incomes. Furthermore, local people may fail to appreciate that their economic use of the forests or natural areas is unsustainable.

In remote or resource-poor areas (often occupied by tribal people) where protected areas are often located, it is usually difficult to provide local people with alternative means of livelihood to their use of the natural area. Furthermore their forced relocation away from a protected area is a drastic option which still requires viable economic opportunities for them at their point of relocation if their life is not to be a misery. Employment in tourism related to the protected area or in protected area management may provide some possibilities for employment of locals. Very often, however, such positions are not filled by locals because they lack adequate skills and training. This is a problem in China, India and many other countries in Asia. It is for example a problem being faced in the Xishuangbanna Nature Reserve in Yunnan, Southwest China. It has recently been noted that: 'The location of 90 villages in and around [this] reserve places direct pressure on the protected area's forests which are

still being degraded as a result of tree cutting, fires and hunting in many areas' (Ministry of Forestry, 1993, p. 44). Xishuangbanna Nature Reserve is being given a high priority for conservation by China because it is considered internationally to be an area with great biodiversity.

5. Tourism and The Environment

Tourism provides one way in which local people can gain from conservation of local natural areas. However, in remote areas the economic leakages from such tourism can be large and local people frequently do not get a chance to participate in the local tourism industry on a large scale, if at all (Cf. Hohl and Tisdell, 1993). Furthermore, tourism itself can be destructive of the environment and difficult to manage in relation to its environmental impacts.

In addition unfortunately, there is a tendency for tourism to expand for private benefit at the expense of social benefit. In China, for example, hotel accommodation (a private good), has expanded greatly but without a concomitant increase in funding for conservation of public or semi-public tourist attractions (Tisdell and Wen, 1991).

International tourist developers are active throughout the Asian-Pacific Region. As incomes rise in this region, demand for tourism, including nature-based tourism can be expected to rise. International tourism from Japan is already considerable in the Asian-Pacific area. (Japan is now the main foreign investor in the tourist industry in Australia and its main source of foreign tourists). Tourism from other high income countries in Asia such as Taiwan and South Korea is increasing. However, there is always a chance that tourism development will destroy the natural attractions which are a drawcard for many tourists. In Okinawa, for example, run-off of water containing fertiliser and sediment from golf course constructed for tourists has been a factor in the destruction of coral reefs. While there are still relatively pristine coral reef further afield, many of these are fast disappearing, e.g., in Thailand and the Philippines.

A further danger is that international tourist developers may effectively promote their private interests at the expense of the public interest. They may for example

competitively play one country or region off against another to obtain the use of prime natural sites for their tourism developments and/or in some cases they may make suitable side-payments (bribes) to local politicians for this purpose. Conservationists because of the free-rider problem involving large groups or because they are gagged politically may find it difficult to offset the special interests of private tourist developers in appropriating natural sites to their own use. The final result could be the socially unsatisfactory use of natural tourism assets in the Asian-Pacific area, a development which would be unfavourable in the long run for the tourism industry itself. The problem is akin to that of the prisoners' dilemma.

It is interesting to note that deterioration in Thailand's environment is given as one of the major reasons for declining Japanese tourist visits to the country since 1990. *The Bangkok Post*, September 15, 1993, reported: 'The decline has set in due to several problems, specially the security image of Thailand, the AIDS crisis and the ongoing environmental situation'.

6. Urbanisation

Asia is undergoing substantial urbanisation and its degree of urbanisation will increase in the years ahead. This has both positive and negative environmental implications. On the positive side, it is likely to lead to falling family sizes since the net cost of having children is usually higher in urban society than in a rural one. On the other hand, it will pose increasing problems for disposal of wastes and continuing difficulties in controlling urban air and water pollution. Furthermore, in many large urban areas in Asia, transportation within cities has become a major problem (almost chaotic) e.g. in Bangkok, Jakarta, Manila and is causing major social problems and affecting economic efficiency.

7. Interregional and Transboundary Environmental Problems

Some international environmental problems within Asia have already been mentioned. These include air pollution problems and water use and pollution problems in relation

to water bodies shared internationally. Collective solutions are necessary, e.g., concerning the use of water in the Mekong River.

Even within countries, provincial authorities often fail to take account of their environmental impact on neighbouring provinces. Local authorities in Beijing or example have in the past failed to take account of their additions of pollutants to water on nearby Hebei Province and this imposes extra treatment costs on users downstream (Tisdell, 1993b, Ch. 12). However, Chinese authorities are becoming increasingly aware of the costs of adverse externalities and are increasingly expecting polluters to pay (Zhiyong Hong, *et al.*, 1991).

Some countries in East Asia still have considerable stocks of natural resources which have been little exploited due to their relative isolation from the global economic system. These include Laos, Myanmar and to some extent Cambodia. Large portions of these countries are still covered in tropical forests.

With peace in Indo-China, these economies are likely to be drawn increasingly into the world economy and the international community. Consequently their natural resources may be rapidly exploited by the economic demands of their more advanced neighbours, e.g., Thailand and China, or even slightly more distant ones such as Japan, or other countries further afield. Improved communications in the area will facilitate this process, e.g., the Australian built bridge across the Mekong linking Thailand and Laos, the proposed Yunnan to Thailand highway via northern Myanmar.

Perhaps surprisingly there could still be a frontier mentality in parts of Asia. The point has been raised in China as to why is it important to conserve biodiversity in Xishuangbanna Nature Reserve in Southwest China. A Chinese feasibility study for a GEF loan from the World Bank points out: 'It must also be realised that the great richness of Xishuangbanna is mostly due to the tropical affect. Even richer forests exist further south in Laos and Vietnam' (Ministry of Forestry, 1993, p. 43).

The implication maybe that tropical biodiversity could be conserved further south with greater ease and therefore conservation of Xishuangbanna should not be over-rated. But will conservation further south happen?

Frontiers everywhere as far as nature conservation is concerned are rapidly

disappearing. Once much of Thailand was a natural forest frontier but this frontier has now moved to its neighbouring states. It is not at all clear that the exploitation of the natural resources of Myanmar, Laos, Vietnam and similar Indo-China countries will set them on the path to sustainable development at this time in their history. There is also no guarantee that their rich biodiversity will be conserved.

Conservation of nature and biodiversity is a high priority for many high-income countries. To some extent, it is an international public good. This raises the question of the extent to which high-income countries should pay for conservation in LDCs. The Global Environmental Facility (GEF) of the World Bank provides a subsidy for nature conservation (in terms of reduced interest) to developing countries but large-scale official aid for nature conservation from high income countries may be required (with appropriate delivery mechanisms) if high income countries are to achieve their demands for sustaining biodiversity globally.

8. General Policy Matters

Market-making policies will not be enough to solve all the environmental problems likely to arise from Asian economic growth. Communal and international co-operation (outside market mechanisms) will be necessary.

Even traditional policy instruments proposed by environmental economists are likely to be inadequate, e.g., pollution taxes, Coasian property rights or tradeable environmental-use permits. In many cases geographical zoning of economic activities and in some cases prohibition will be needed on environmental economics grounds (Tisdell, 1993c).

At the macro-level, will the optimistic development scenario be fulfilled in East Asia involving sustainable development and eventually population stabilisation? Or are we to expect severe environmental degradation and global pollution (when combined with the impact of high income countries) resulting in serious global environmental consequences via the greenhouse effect or via biodiversity loss? Market systems do not seem capable of ruling out the latter possibility and as observed earlier political mechanisms are likely to be biased in favour of economic growth at the expense

of the natural environment.

9. Concluding Comments

Economic growth in Asia has already done much to reduce poverty there and promises rising incomes in China and throughout most of East Asia. This economic growth has been welcomed by many high income countries, e.g., Australia and the United States, as providing them with new market opportunities including growing export markets. However, the environmental consequences Asian economic growth have had little public attention in high income countries and 'official' documents (such as those of the World Bank) paint a favourable long-term picture environmentally.

Nevertheless, we need to be more cautious about the environmental consequences of this economic growth. How confident can we be that the environmental results of this economic growth in Asia will be favourable, especially on a global scale? Furthermore, are special measures needed to protect the natural living resources of those southeast Asia countries such as Laos which have not yet felt the brunt of economic growth?

Furthermore, we should be more critical of the view that it is acceptable for a country to deplete or degrade its environmental or natural resource stock to obtain economic growth if its per capita income is low. Such depletion would only seem defensible if it enabled escape from a low-equilibrium trap and possibly should only be attempted at an 'appropriate' time.

In addition, one must be careful that the above philosophy does not result in a nation persisting in environmental degradation for longer than optimal and taking a carefree attitude to environmental destruction. Taiwan may be a case in point. While Taiwan has achieved significant economic growth, it has suffered severely from an environmental perspective. It plans now to make provision for large expenditures on environmental improvement. In its Six-Year National Development Plan 1991-1996, the Taiwanese government intends to set aside 3.5% of its expenditure for environmental protection more than for agriculture, forestry, fishing and livestock fanning, and more than for science and technology (Anon., 1993, p. 34). But if Taiwan had paid more attention to the environment earlier, it might have been able to achieve

its current environmental objectives at much lower cost and have a greater number of desired environmental options open to it.

Even in the early stages of the economic growth process selective conservation of natural resources (as well as man-made ones) is likely to be justified taking into account the likely value of such conservation to future generations as well as current generations. It is probably never optimal to throw all concern for environmental conservation to the wind even in low-income economies, including the remaining low-income economies in the Asia-Pacific region. However, low-income countries are likely to require economic assistance for environmental conservation from high income ones if the conservation objective is to be afforded a high priority. Such assistance needs to be considered sympathetically both from global equity point of view and from a global economic efficiency viewpoint, namely the optimal provision of conservation-type public goods of global value (Tisdell, 1990, Ch. 4). In addition, high income countries may have to shoulder a greater part of the cost of preserving the globe's environment by reducing their levels of emissions of 'pollutants' such as greenhouse gases. Asian economic growth can be expected to accelerate international political concerns about these issues.

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