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

Working Paper No. 12

Reconciling Economic Development, Nature Conservation and Local Communities: Strategies for Biodiversity Conservation in Xishuangbanna, China

by

Clem Tisdell
And
Zhu Xiang

March 1994

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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

Collaborator: Southwest Forestry College, Kunming, Yunnan, China

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RECONCILING ECONOMIC DEVELOPMENT, NATURE CONSERVATION AND LOCAL COMMUNITIES: STRATEGIES FOR BIODIVERSITY CONSERVATION IN XISHUANGBANNA, CHINA

Abstract

The State Council has adopted Agenda 21 for China and biodiversity conservation as one plank of this agenda for China's sustainable development. This paper offers a brief discussion of China's White Paper on Agenda 21 and examines as a case study the problem of sustaining biological diversity in Xishuangbanna Dai Autonomous Prefecture in Yunnan. This area is rated as one of "megadiversity" and one deserving of a high priority for conservation purposes. After discussing the general socio-economic obstacles to biodiversity conservation in Xishuangbanna, it discusses the types of strategies adopted for reducing pressures by local communities on biodiversity and nature conservation. The preferred strategy in China for easing pressures on biodiversity conservation in nature reserves is to try to improve economic opportunities outside of the reserves and raise the income levels of people living in the neighbourhood of the reserves. This approach has been adopted in Xishuangbanna and there are plans to extend it. Community development projects such as agroforestry, joint ventures in tourism and so on are being encouraged. Mechanisms for selecting suitable community development projects e.g. using Rapid Rural Appraisal {RRA), are considered. Without-economic development at the local level, plans for biodiversity conservation are unlikely to succeed in China or for that matter elsewhere in the developing world.

RECONCILING ECONOMIC DEVELOPMENT, NATURE CONSERVATION AND LOCAL COMMUNITIES: STRATEGIES FOR BIODIVERSITY CONSERVATION IN XISHUANGBANNA, CHINA

1. Introduction

China continues to show rapid economic growth and is well on its way to reaching its target of becoming a middle income country in the 21st Century. The question, however, has been raised of whether China's economic growth is environmentally sustainable and whether or not the .cost to its environment is higher than it ought to be. Internationally there are concerns about the potential of China's economic growth to add to global pollution (Tisdell, 1993, .Ch. 12; Hall *et al*., 1994; Tisdell, 1995), e.g., greenhouse gas emissions, to loss of biodiversity and loss of natural environments. It is also believed that ·a number of China's development projects will show negative returns when they are evaluated by means of extended cost-benefit analysis and that economic welfare in China could be increased by adopting improved policies governing the use of scarce environmental goods. To a large extent, China has exploited its environment by treating it virtually as a free good. The Chinese Government has, however, signalled that it no longer intends to do this.

In 1994, the State Council adopted *China's Agenda 21 - White Paper on China's Population, Environment and Development in the 21st Century*. This lengthy document provides an initial framework for China to achieve sustainable development in the 21st Century and will provide a guide in drawing up its medium and long-term plans on economic and social development. It will for example influence the Ninth Five-Year Plan (1996-2000) and the Plan for 2010. It is difficult to say at this stage how much of *Agenda 21* is window-dressing and how it will be put into effect. Furthermore, as is .to be expected, the document provides a broad framework and guidelines rather than a definite prescription for policy. However, we are told in its preamble that: 'The Chinese Government is determined to implement China's Agenda 21. This is not only because Chinese highest leaders take it seriously, but also because it will help to create a sound environment for sustainable economic development, for deepening reforms and opening to the outside world and for establishing a socialist market economy.' (State Council, 1994, p. 3).

Agenda 21 arose from the United Nations Conference on Environment and Development (UNCED) held in Brazil in 1992 when it was resolved that all nations should draw up strategies to achieve sustainable development in the 21st Century (Islam, 1994). China appears to be the first developing country to do this. This helps to .reinforce its aim of being a political leader among developing counties on environmental issues and to allay international fears about China as a possible global polluter. In any case, *China's Agenda 21* is a significant policy document which takes a holistic view of development and specifically rejects the development policy of polluting now and·cleaning up later.

China's Agenda 21 consists of 20 chapters of which one covers conservation of biodiversity. China is a country rich in biodiversity but much of this is under threat ·due to habitat change caused by economic growth and in some cases due to population and hunting pressures. This is for example clear from case studies such as the one for Xishuangbanna Dai Autonomous Prefecture reported here. Xishuangbanna Prefecture which is located in southern Yunnan has been rated as an area of 'megadiversity' and worthy of a special conservation effort from a global point of view (Mittermaier and Werner, 1990; Myers, 1990). However, socio-economic changes in the Prefecture are a threat to biodiversity and are creating difficulties for sustainability of production. Let us consider this matter paying particular attention to the role of the local community in environmental conservation.

2. Socio-economic Pressures· on Biodiversity Conservation in Xishuangbanna Prefecture

The sustainability of biodiversity conservation often depends on political support from local communities and their willingness to avoid taking actions which destroy biodiversity. When agricultural land and other resources are in short supply, and incomes are low or are below levels strongly aspired to by local communities, political pressure is likely to build up to permit 'the development' of areas set aside for biodiversity conservation such.as nature reserves. Furthermore, incursions into such areas by illegal settlement, poaching and use of their resources such as trees are liable to occur without these actions being stopped. This often occurs in developing countries so that the conservation of biodiversity in nature reserves and parks is threatened (Dixon and Sherman, 1990). At the same time as this pressure on protected areas increases, biodiversity and conservation of natural resources is often greatly

reduced outside of protected nature areas as pressure to utilize the land to raise production increases. Pressures of this type are a source of concern for biodiversity conservation in Xishuangbanna Dai Autonomous Prefecture in Yunnan, China. (See Figure 1).

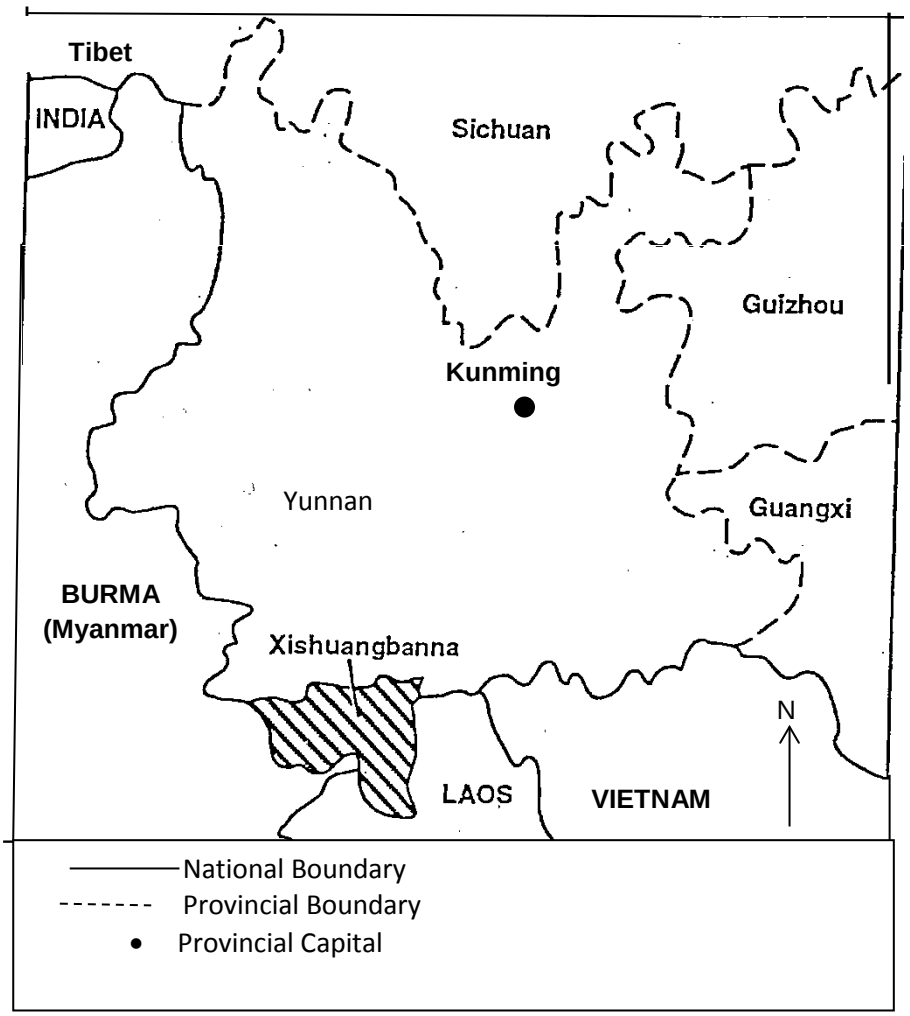

Figure 1: The location of Xishuangbanna Dai Autonomous Prefecture, Yunnan Province, Southwest China.

Satellite imagery indicates that in recent years natural vegetation cover on land outside of protected areas such as Xishuangbanna State Nature Reserve has been severely reduced. Furthermore, hunting pressures in this Prefecture are considerable. It is a common sight to see members of minority groups carrying guns, not only outside the Reserve but even on the roads leading through it. This was observed on many occasions during my field trip in October, 1994, to the area. It is said that some of these guns are home-made. Their use is so

widespread and traditional amongst minority groups that it would be very difficult for Chinese authorities to ban effectively the carrying of firearms in this Prefecture especially in its more remote localities. For many minority groups, hunting is a traditional means of supplementing their incomes and a form of recreation. As human populations have increased and wild animal populations have fallen (to a large extent due to habitat changes), hunting has become an increasing threat, to the preservation of wild· animal populations in the Prefecture.

Population Pressures

The population of the Prefecture continues to increase relatively rapidly because the majority of its population consists of minorities who are not subject to the one-child rule applied to Han Chinese. In the case of the Dai nationality for example, a family size of three is acceptable. However, penalties begin to apply· for the fourth and subsequent children e.g.·, reduced educational support. While the available land to population ratio in the Prefecture is relatively high by Chinese standards, agricultural productivity is low and pockets of poverty occur. Many of the Han Chinese attribute the low agricultural productivity of the land in the Prefecture to the 'inefficient' traditional techniques of the minorities. At the same time, because this Prefecture is somewhat remote from major markets such as Kunming, little manufacturing growth has occurred. Most manufacturing in the Prefecture involves the processing or semi-processing of local agricultural products such as rubber and tea.

Rubber Production

In this respect, it is interesting to consider the local rubber industry. The Prefecture is an important producer of rubber for China. During the period of China's relative international economic isolation and perceived belligerent threats to it (prior to 1978), the area planted to rubber in the Prefecture expanded considerably. At the present time, virtually all rubber plantations are a monoculture and the density of planting and shade cover results in there being virtually no understorey. So these plantations have an extremely adverse impact on biodiversity.

Xishuangbanna is on the northern edge of the tropical zone. Therefore, it is at the northern limit of the region ecologically available for the growing of rubber trees. Rubber trees in the northern part of the Prefecture and at its higher altitudes suffer from leaf-drop in winter.

Conditions for growing rubber are best (because of higher temperatures) to the south the Prefecture and the crop does best in the river valleys. Furthermore, towards the north crop· has low productivity on higher ground because cool weather in the winter· induces leaf-drop thereby reducing latex production. Hence, to achieve satisfactory levels of productivity in the north, rubber plantations need to be confined to lower elevations. However, their planting here is at the expense of other valuable crops and/or considerable loss of biodiversity since natural biodiversity tends to be greater at lower elevations than at higher ones. In some areas of Shangyong and Mengla sub-reserves of the Xishuangbanna State Nature Reserve, concessions have been granted for the planting of rubber trees, a development which would clearly have an adverse impact on biodiversity.

In the past, rubber processing has also had serious consequences for tree cover because timber was used to process the rubber latex. It was estimated for every tonne of raw rubber produced, several tonnes of timber were used .in its processing thus adding to deforestation in the Prefecture. Now greater use is made of electricity in processing but electricity according to the Deputy Administrator of Mengla County is in short supply and a constraint on economic development.

Nevertheless, important changes are occurring which are more favourable from a conservation and sustainable development viewpoint. Farmers are being encouraged to remove older and lower-bearing rubber trees progressively replacing these by cocoa trees and tea bushes so that intercropping develops. In addition, the area of land used for rubber plantations in Xishuangbanna is not increasing. This is mainly because of China's open-door policy and perceived reduction in military threats to China. Rubber is now being imported and imports are actually cheaper than home production. Furthermore, China's production of synthetic rubber has risen and by mixing natural rubber with synthetic rubber a superior tyre to an all-natural rubber tyre can be produced.

Although China's total demand for rubber products has risen, there is a possibility that rubber production in Xishuangbanna Prefecture will decline as a result of imports of rubber and substitution. However, past Chinese polices may slow or prevent this decline. Costs are involved in removing rubber trees and replacement crops such as cocoa and tea take time to mature so adding an extra cost. In addition, local rubber factories rely on local supplies of rubber latex for processing. In the absence of such supplies, most or all of these factories

might be forced to close down and this would reduce local factory employment. ·Politically, this is likely to be unacceptable in Xishuangbanna so local government is liable.to take action prevent it. Whether the factories could operate economically using imported latex or rubber is uncertain, but it seems improbable. Nevertheless, in the longer term, structural adjustment in China as a result of its open-door policy, cannot be avoided and possibly should not be prevented. However, as Longworth and Williamson (1993, Ch. 19) point out in relation to wool, important political considerations are often involved especially if employment of minorities is at stake.

Shifting Agriculture

While most of the Dai and many of the Han people in Xishuangbanna Prefecture are engaged in settled agriculture in the river valleys and basin areas, some minorities engage in agriculture on steeplands. Slash-and-burn agriculture still occurs. With increasing population densities, the length of the cycle of this type of swidden agriculture and the productivity of the soil is being reduced. The growing of corn (maize) on steeplands by minorities is common. Corn can be eaten directly and the grain can be sold in village markets for cash. However, this crop (and many other cereals) exposes the soil to severe erosion during the wet season since no terracing or soil conservation measures of any kind occur. Severe soil erosion combined with a shorter length of the cultivation cycle is reducing the productivity of the land and so agricultural production using this system is gradually becoming unsustainable and resulting in increasing pressures to use land still covered by natural vegetation.

Other Forms of Cropping on Uplands

It is not only minorities who grow crops on uplands in Xishuangbanna nor is cultivation always of a shifting type. Tea is for example, sometimes grown on steeply sloping land but it is often terraced. A few large pineapple plantations also occur on sloping lands for example, near Gunnanba. Because the soil. is left bare between pineapple plants, considerable soil erosion occurs on these plantations.

In any case, Chinese authorities are concerned that agricultural productivity in Xishuangbanna may not be sustainable given many of the current practices being used. Furthermore, there is concern that agricultural production will not suffice to feed the Prefecture's rising population. This may place increased pressure on the conservation of

biodiversity and lead to greater incursions into nature reserves.

3. Strategies for Reducing Pressures on Biodiversity and Nature Conservation in China

The strategy preferred at present in China for easing pressures on biodiversity conservation in nature reserves is to try to improve economic opportunities outside of reserves and raise the income levels of people living in the neighbourhood of the reserves. China is therefore, considering and intends testing models to promote economic development by people living in areas surrounding nature reserves. Development and conservation in Xishuangbanna involves such an approach.

This approach has been explained .as follows: 'Most of China's nature reserves are located in poor natural areas with limited opportunities for economic development. People depend heavily on natural resources for subsistence and cash generating activities. They continue to utilize resources from high biodiversity ecosystems set aside for protection and increasing population and economic growth lead to overexploitation of the land and degradation of the resource base on which the people depend. Pressures then increase to use resources in nature reserves, and ecological damage of surrounding areas threaten the function of protected ecosystems. As a result many nature resources have been severely degraded they were established and some have entirely lost the biodiversity values they were intended to protect' (National Environmental Protection Agency, *et al*., 1994, p. 83).

Therefore, promotion of economic development outside of reserves is seen as important for conservation in nature reserves. It is believed that, 'The future viability of the nature reserve system depends on developing successful programs to address the economic needs of local people while still fulfilling the conservation goals. Instead of simply discouraging unwise development, nature reserve managers need to cooperate with local communities to encourage the search for types of development sustainable over the long-term and compatible with reserve management goals. The issue is whether the natural resources outside reserves can support the human population in the long-term' (National Environmental Protection Agency *et al*., 1994, p. 83).

Although this approach is a promising one it is not a water-tight solution to conserving

biodiversity. Often measures to increase economic productivity outside nature reserves involve intensification of land use and a reduction on biodiversity in such areas. This intensification particularly in the case of agriculture normally involves the greater use of resources external to the land. This could add to pressure on the resources of a reserve, e.g., to use its timber for cons ruction, water resources in it or passing through it for irrigation and electricity generation. Higher incomes could also lead to higher effective demands for speciality items (such as special foods) which can only be provided by a nature reserve. Again the economic damage caused by animals from reserves when they move outside reserves may rise as higher valued and more productive agriculture is introduced. Thus social hostility to the reserve may grow. Furthermore, as economic productivity per hectare rises outside a reserve, the view may be increasingly accepted that the reserve involves an economic waste of natural resources, not because it really does but because the apparent relative disparity in productivity inside and outside the reserve increases. In any case, it would be unwise to relax ·measures to protect reserves as economic development in their surrounding areas proceeds. In fact, a strengthening of these measures may be needed as discussed again later in this essay.

4. Agroforestry and Social Forestry Projects

A popular suggestion for community projects to ease pressures on nature reserves has been to encourage villager& to engage in agroforestry. This is one of the approaches being tested in Xishuangbanna. The Bureau for the protection of State Nature Reserve is willing to supply tree/shrub seedlings free of charge to landholders bordering the Nature Reserve if they wish to engage in agroforestry. Some financial support has been received by the Bureau from WWF for the purposes and trials have begun in Zhong Tian Ba village bordering Mengyang Sub-reserve.

In this village a small stand of mixed trees has been planted on a sloping site (but not a steeply sloping one). This has been contoured and tea has been planted in the depressions of the contours with the trees being planted on the ridges. Both trees for timber and some for fruit have been planted. The trees being trialled are:

Caganus cagan

Cassia siamea

Fiemngia macrophylla

Gliricidia sepium

Sesbania bispinosa

Sesbania sesban

Ligustrum lucidum

Cassisa siamea has been traditionally grown by the Dai people in their villages to provide fuel. It is a nitrogen-fixing species and enriches the soil. At Zhong Tian Ba, some *Cassia* trees have been planted at a second site on relatively flat land where there are now some mature tea bushes and some vegetables. Agroforesty in this village is basically intended to meet subsistence needs. Whether it will be a success remains to be seen.

I- Inspection in October 1994 indicated that little or no attention seems to be given to tending the young trees. Most were being crowded out by weeds. It has been suggested that because the village does not have a serious soil erosion problem, their perceived need for agroforestry is low. However, there are no trees suitable for firewood or timber left on the land of the village. The only nearby possible source of supply is the Sub-reserve. The project appears to have been a top-down initiative rather than one wanted by the village so this may reduce its chances of success.

It should:·be observed that supply of seedlings may be one of the minor costs involved in agroforestry. Planting and tending young trees can be costly and once they become established they take space away from alternative possible corps, compete with them for sunlight and in many cases for nutrients. Also a considerable initial waiting period may be required before any harvesting or fruit-bearing is possible and this involves an economic opportunity cost which economists usually allow for by means of discounting. However, there may be symbiotic relationships with some crops and the nitrogen-fixing properties of some tree/shrub species can be an advantage.

These relationships all need to be assessed on a holistic basis using a farming system approach. Unfortunately, in situ tests involving agroforestry may require many years and no

long-term experiments have been completed in Xishuangbanna on agroforestry. Because of lack of information about the likely economic performance of agroforestry and social forestry in Xishuangbanna, some risks are involved in encouraging local villagers to engage in agroforestry or social forestry. On the other hand, social forestry has been practised for some time in parts of India, so it may be possible to draw suitable inferences from results there and elsewhere. Nevertheless, in situ uncertainty will remain.

The economics of agroforestry and social forestry is liable to vary with location and the economic returns from alternative forms of land use. On degraded land, such as steeply sloping land productivity may be low and economic returns from annual crops may also be low. Therefore, the *opportunity cost* of agroforestry or social forestry on such land is low whereas on agricultural land which continues to be very productive with current cropping systems, the opportunity cost of social forestry or agroforestry may be high. Thus, other things equal, degraded lands and those of low productivity might justify a higher priority for social forestry or agroforestry than agriculturally more productive land. Furthermore, degraded areas my give rise to the greatest adverse external effects, e.g., through higher rates or soil erosion under their present ·use. Hence, the case for adopting social forestry or agroforestry on such land is strengthened if it reduces adverse external effects. Some of the general economic issues involved in adopting agroforestry or social forestry as a land use are discussed in the appendix.

It has been suggested that one of the main purposes of agroforestry in Xishuangbanna is to improve the soil, especially in areas where slash-and-bum agriculture is being practiced. The tree species selected for agroforestry in Xishuangbanna are native species able to withstand poor soil conditions. They are mostly nitrogen-fixing species or trees with crops such as fruit. Therefore, the possibility of improved soil fertility should be taken into account in the economic analysis of agroforestry.

5. Some Alternative Community ·Development Projects and Methods to Benefit Local Communities

Agroforestry/social forestry is just one possible development to provide local economic opportunities and ease pressures for the unsustainable use of nature reserves. Other

possibilities include:

1. The adoption of improved agricultural techniques to increase yields or to enable the introduction of higher valued crops. In Xishuangbanna, many of the agricultural methods and techniques being used are traditional. Rice is for example harvested and threshed by hand. Buffalo are used for ploughing and other draft purposes. Productivity tends to be low.

2. Although Xishuangbanna receives a heavy annual rainfall, this is concentrated in the monsoon season. For at least six months of the year, Xishuangbanna is relatively dry. Irrigation of crops during this period would increase annual agricultural production. In the longer term, however, multiple .cropping can have a negative effect on yields. Furthermore, a number of the suggestions for introducing irrigation possibilities would be at the expense of conservation of Xishuangbanna State Nature Reserve. This includes a proposal to dam the Lancang Jiang (Mekong River). The dam would submerge a portion of the Mengyang sub-reserve but supply electricity and irrigation water. It has also been suggested that small dams or weirs might be constructed in the Reserve itself to allow local irrigation on the currently fanned 'river' flats located in or near the Reserve. However, such development might conceivably have an adverse impact on ecosystems in the Reserve.·

3. Opportunities for villagers to make greater multiple use of economic resources in the Reserve may be considered if these uses are compatible with conservation objectives. Currently, some multiple use by villagers is permitted in Xishuangbanna State Nature Reserve. For example, concessions have been granted for the cultivation of a local special ginger *Amomum villosum* which only grows on the shaded forest floor and which is used for medicinal purposes. Its culture does not appear to compromise conservation values. However, this is not so of all multiple uses. For example, concessions to grow rubber trees or passionfruit would compromise conservation values in the Reserve. Concessions for rubber plantations have been given in Shangyong Subreserve and for growing passionfruit in Menglun Subreserves. Ecotourism is another possible multiple use of a protected area. Ecotourism within the Nature Reserve has been used at one site to increase the economic

opportunities of local villagers. A joint business venture has been started between a local farming co-operative and the management of Xishuangbanna State Reserve to utilize the site at the Forest/Limestone Cliffs site near Menglun for ecotourism. The capital for developing this site e.g., bridge construction and construction of walking tracks, has been provided by the local farming co-operative. At another site in the Reserve, San-Ca-He, the Nature Protection Bureau has invested· in tourism development without local participation or a joint venturer. It seems likely that it will lose financially from this development.

4. Another possibility is to employ local people in the management of the Nature Reserve. This is in fact done now in Xishuangbanna and village people (mainly villager leaders) are paid a retainer to act as guards for the Reserve.

5. Still another way to increase local economic opportunities is to expand employment opportunities in urban areas and encourage migration from the countryside to urban areas. Most towns in Xishuangbanna have economic development zones and some are eligible for international trade concessions as a part of China's drive to increase cross border trade with Laos, Mynamar and Vietnam. Considerable expansion in service industries are under way, many intended to cater for the expected expansion of the tourist trade. However, the capacity of Xishuangbanna to absorb a large proportion of its population in urban areas may be limited by its cost of transport of commodities to and from major markets. Such costs combined with the small local market may make most local manufacturing uneconomic. If on the other hand, outward migration to larger cities in Yunnan such as Kunming becomes easier, this would ease population pressures in Xishuangbanna Prefecture.

6. Searching for Suitable Projects for the Economic Development of Villages

Traditional cost-benefit analysis concentrates on choosing between projects the set of which is already known. However, often the more important and difficult issue is to discover and see that all promising possible projects are included in the set of decision possibilities.

How does one go about this?

Sometimes projects are suggested from above by authorities living outside the village. This appears to have been so for agroforestry and social forestry projects in Xishuangbanna. Suggestions have also been made from above that villagers should grow rice on hilly areas using terracing even though opinions differ about the desirability of this. For one thing, terracing is costly. Although those villagers practicing slash-and-bum agriculture are being encouraged to abandon it, few viable economic alternatives seem to have been made available to them or discovered. It is important to find economically viable alternatives and all alternatives should at least be subjected to preliminary economic analysis before being recommended to villagers.

An alternative to the top-down approach is to involve villagers in the search for community development projects. This may be done for example using Rapid Rural Appraisal (RRA) techniques. These involve direct interviews with villagers and on-the-spot appraisal of villages. Villagers have an opportunity to indicate the community projects or the type of projects that they most prefer. These are then likely to be projects that they will be motivated to support if they are funded. Furthermore, as a result of such direct interaction authorities may discover new promising potential projects which would not otherwise be considered by them. These might not only have economic value in the village where they are suggested, but in other villages as well.

It is sometimes claimed that projects suggested at the village level are likely to be more soundly based from an environmental and economic perspective than those originating from the top. However, such a generalization would appear to be dangerous. In reality, the knowledge sets of villagers and those of outside 'experts' are limited and they often have different knowledge sets. By sensitively combining their knowledge, these two groups can usually improve their decisions relating to villages. This involves a side-by-side approach rather than either a top-down approach or a bottom-up approach. A further reason for not relying solely on the preferences of villagers for projects is that they may assess projects solely on the benefit to their own village ignoring any adverse external effects.

Conceptually this knowledge situation may be like that illustrated in Figure 2. The points in the rectangular set D might represent all the potential development projects available to a village. The set A may indicate those known to the villagers and the set B those known to authorities outside the village with the overlapping set C representing those potential projects known both to the villagers and to the authorities.

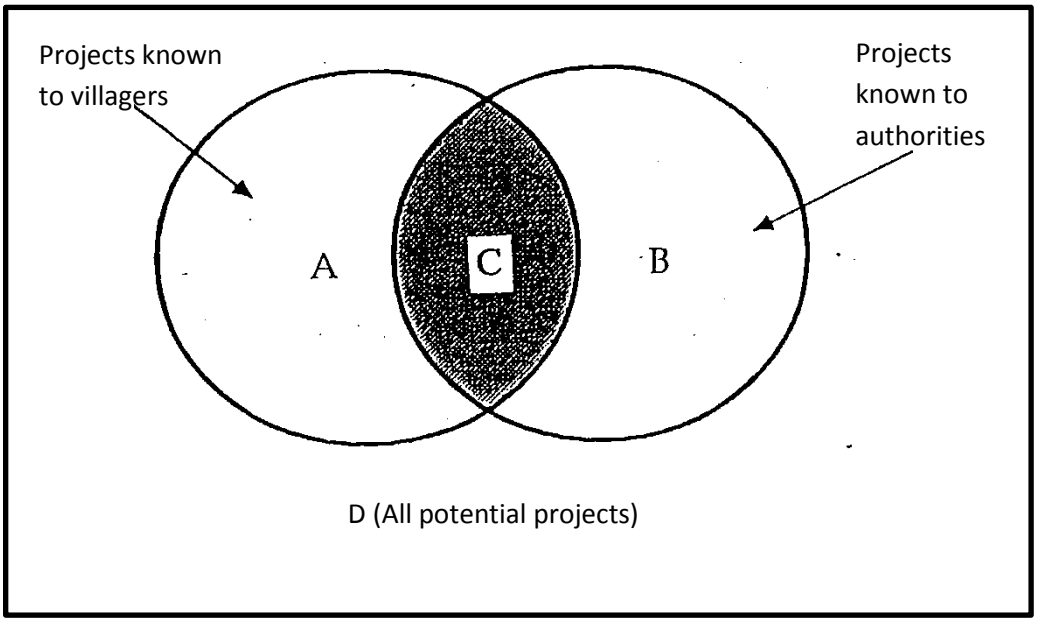

Figure 2: Knowledge sets relating to possible community development projects

Having discovered a set of economically viable development projects supported by the villagers, a government may wish to provide financial assistance for some or all of these. For villages in areas surrounding Xishuangbanna State Nature Reserve, it might be thought that economic benefits obtained by the villagers from pursuing such projects will ease their pressure to utilize the resources of the Reserve. ·However, there can be·no guarantee that this will be so. For this reason, it may be wise to enter into a formal agreement with village leaders to the effect that in return for governmental financial support for their community projects, they will assist in protecting the Reserve in their area. Currently, the Ministry of Forestry is exploring this strategy and is considering a revised system to encourage the reporting of poachers.

7. Concluding Comments

In relation to the whole procedure for conserving Xishuangbanna State Nature Reserve, the question is likely to be raised as to why conserve it at all. Possible answers include the following: (1) the returns from agricultural use or logging of it may be low and not very sustainable and (2) once the Reserve has been fully utilized for commercial purposes, such as agriculture and logging, the problem of inadequate natural resources will occur again. At best the intensive utilization of the Reserve would be a temporary palliative or solution to natural

resource shortages. Furthermore, economic benefits from its conservation would be lost. The conserved area has some economic value for tourism, maintenance of waterflows and so on. It may have considerable existence value both for China as a whole and individuals overseas who know about it. It is very rich in botanic specimens some of which may have future use-values. The benefits from using the Reserve for intensive 'development' purposes seem in all probability to be very low in relation to the likely alternatives foregone. To utilize the Reserve in this way would be to pursue short-term gains at the expense of long-term benefits. Politics is unfortunately often heavily influenced by short-term perspectives. So nature reserves, particularly in less developed countries, are always subject to the risk of economic incursions by special interest groups searching for economic gains. This problem is present both in socialist and non-socialist countries.

Without economic development at the local level, plans for biodiversity conservation and unlikely to succeed in China or for that matter elsewhere in most of the developing world. Nevertheless, economic development at the local- level does not assure conservation of biodiversity and natural living resources. As pointed out, additional measures may be needed. Furthermore, because a large portion of benefits from biodiversity and nature conservation spillover globally or internationally, total benefits are not captured by local communities (Pearce and Moran, 1994). Therefore, they are likely to engage in less conservation than is desirable from a global welfare point of view (Tisdell, 1990, Ch. 4; 1994) and international assistance to them for conservation purposes is likely to be justified. In particular, both on welfare efficiency and equity grounds, assistance from developed countries to communities involved in conservation in less developed countries seems justified. However, policy measures to affect these transfers are not straightforward. Some are being trialled, e g., the Global Environmental Facility (GEF) and much research is being undertaken to devise additional measures.

Biodiversity conservation (and environmental conservation generally) involve interdependent processes, including socio-economic ones. The design of conservation policies must be completed within an interdependent framework if these policies are to succeed. *China's Agenda 21* is a useful first step in this process as far as China is concerned.

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APPENDIX

Notes ·on Economic Aspects of Agroforestry and Social Forestry

C.A. Tisdell

In considering whether to recommend to villagers projects for agroforestry or social forestry, one needs to consider the flow of net benefits from these relative either to the best alternative projects or those which would be otherwise adopted. Suppose that one is considering a planning interval of length $t = t_n$. Then as a first step, it is necessary to compare the flow of net benefits over this interval ($0 \leq t \leq t_n$).from the agroforestry or social forestry project under consideration with the alternative. The alternative for example may be cropping with annuals with no tree planting. Let

$$J = J(t) \tag{1}$$

represent the net benefits to be had from the alternative land use, e.g., continuation of current practice and let

$$F = F(t) \tag{2}$$

represent the net benefit from the agroforestry or social forestry project being considered. Then

$$G(t) = J(t) - F(t) \,. \tag{3}$$

represents the opportunity cost .of the agroforestry or the social forestry project.·

It is difficult to say *a priori* exactly what form function *G(t)* will take. One possibility is, however, a form like that shown by Curve *ABCDE* in Figure A.l. A net cost is incurred initially, e.g., planting and weeding costs for the young trees. Some loss of other crops to leave space for the newly planted trees can be expected, but intercropping may be carried on quite successfully. However, as the trees mature, they may shade and compete with intercrops reducing their yields. Benefits from the trees may only start to be realised when they come to maturity. The discounted stream of net benefits will need to be positive if the villagers are to

find agroforestry or social forestry an economic advantage.

The possibility considered in Figure A.l is however, just one of the possibilities. In some respects, the trees may have symbiotic relationships with intercrops or provide windbreaks which add to productivity. Some high valued intercrops may also require shade order to thrive, e.g., this would be so for cocoa for example. Much depends upon the exact type of agroforestry or social forestry being promoted. However, a major obstacle is likely to arise in the introduction of agroforestry or social forestry at the village level when a considerable period must elapse before net benefits are achieved and upfront investment is needed

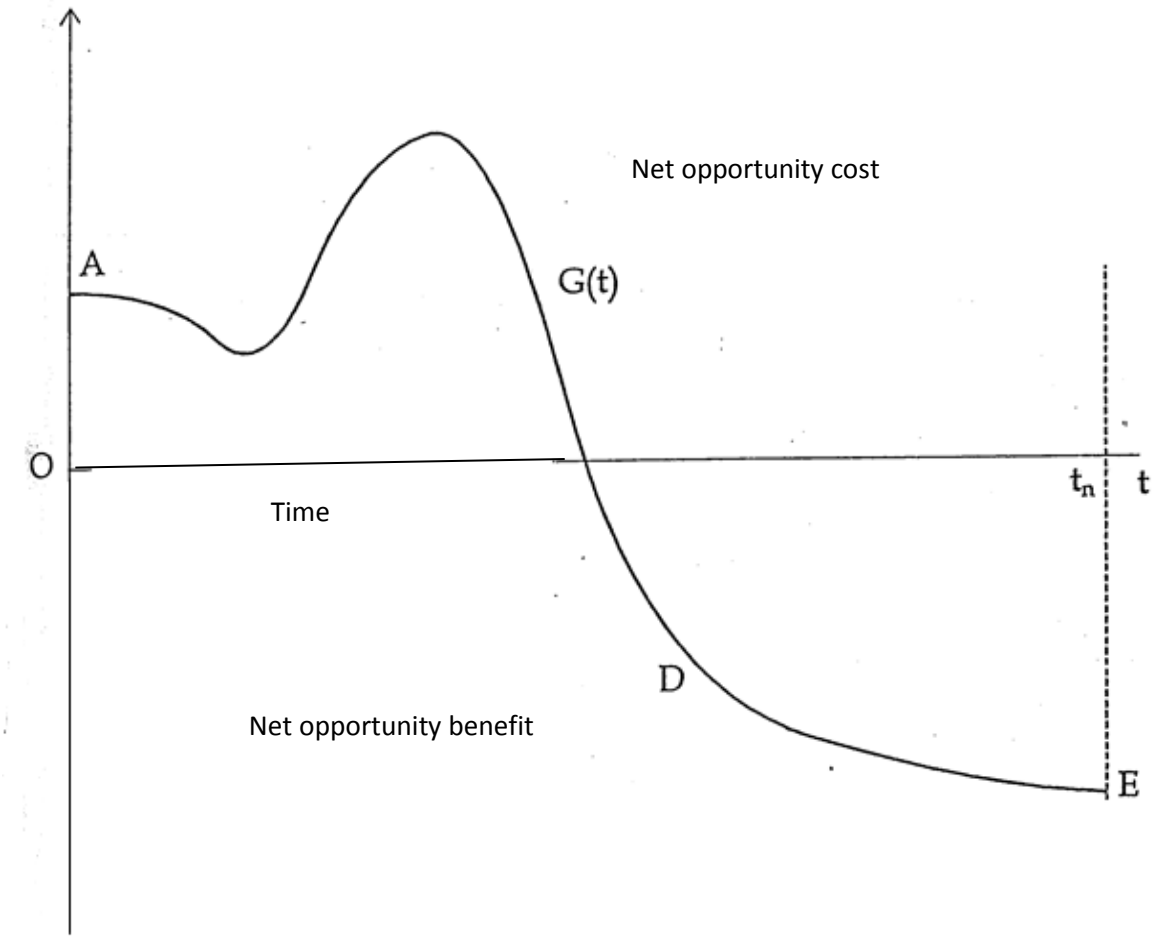

Figure-A.l A possible opportunity cost curve for the introduction of agroforestry or social forestry.

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