

**REVIEW OF ITTO PROJECT PD 39/98 Rev.2
(M) CHINA**

“Research on Value Accounting

for

Tropical Forest Environmental Resources

and

Bringing them in Line

with the

National Economic Accounting Systems in China”

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1. Introduction

This section describes the project and presents a brief summary of the tasks the consultant has been requested to perform.

1.1 The Project

PD 39/98 Rev.2 (M) is a globally important and pioneering project* whose objectives are to make an assessment of China's tropical forest resources and to develop a theory and methodology by which they may be valued and incorporated into the country's national accounts. There is a presumption that these values are currently set at zero or at least *below their true level*, as part of one specific objective is to "renovate tropical forest values".

Recent policy directions, both in China and globally, underpin the relevance of this project. China Agenda 21 forestry proposals had already addressed the issue of forestry accounting in 1994, a practical need for, *inter alia*, implementation of a policy to retire certain categories of farmland and plant them with forest trees, a policy requiring a fair means of assessing compensation to the farmers affected. Furthermore, by 1998, the Government had banned logging in natural tropical forests, adding urgency to the task of valuing the contributions to national welfare of the non-timber and intangible benefits originating in these forests.

The project builds on earlier work undertaken on natural resource accounting in China by Li Jinchang, an external adviser to the current project and also upon the study conducted by the present Project Director and his team in 1995 which computed a value of 13,000 billion yuan for China's total forest asset, mostly environmental value. International research also provided some pointers through the UNSTAT "System of Integrated Environment and National Economic Accounting" (SEEA) in 1994 and work by international organizations such as the OECD and the EU, besides a number of studies at the national level in Europe, Canada and Japan. It is now over a decade since the UNCED Conference had urged nations to incorporate environmental values into the national accounts.

Two provinces, Hainan and Yunnan, were selected for the case studies in which the project team would attempt to account comprehensively for the environmental benefits of tropical forest. However, using remote sensing technology and existing published research it was possible to make a general ecological description of all China's tropical forest areas with detailed coverage of the components in Guangdong, Yunnan, Hainan, Fujian and Taiwan Provinces and the Guangxi Region. Only the description of the uniquely interesting tropical forests in the lower reaches of the Brahmaputra (Tibet

* This assessment is supported by the comments of the Swiss Delegation at the 29th Session of the Committee on Economic Information and Market Intelligence in November 2001. The Delegation noted "(the project's) innovative approach and its potential to provide important outputs relevant to ITTO tropical producer member countries"(ITTC Doc. CEM(XXIX)/5).

Autonomous Region) remained incomplete. These astonishing forests thrive up to six degrees north of the Tropic of Cancer by virtue of their location in deep, warm, high rainfall valleys.

1.2 Progress to Date

The project was approved at the 26th ITTC Session in Chiang Mai, Thailand, in May 1999 and commenced in January 2000. The budget was relatively modest for the ambitious development objectives. Of the total US\$ 416,834, 82% was provided by ITTO; the remainder comprised the salaries and expenses of the permanent project staff and three external advisers together with the project office rent and facilities. Although most staff had other duties, the budget wisely allowed a full-time allowance for the project director in the final year.

The project staff quickly moved into action on data collection and establishment of the two experimental sites in Jianfengling, Hainan Province, and Xishuangbanna, Yunnan Province, so that after only a few months the project director was able to report (in March 2000) that 90% of the tropical forest data had been assembled and by the end of March most abstracts had been received for papers to be presented at the International Symposium on Value Accounting. However, it proved difficult to finance speakers for the symposium, and transportation problems for the surveys of remote valleys retaining tropical forests in Tibet proved insuperable. Also, the quality and quantity of existing data on the environmental benefits of tropical forests was often inadequate.

By the end of the second year (31 December 2001) the project team could look back on several achievements:

- The publication of 16 reports and in particular a 141-page book on China's tropical forest resources. The contents of this study illustrate in a specific task some of the general problems attending the project as a whole. The first part gives a general introduction of all China's tropical forests and then lists the public good forest products the project team will analyse, namely carbon sequestration, oxygen production, water conservation, soil improvement, soil protection, air pollutant and pathogenic bacteria absorption, biodiversity protection, landscape and tourism values, recreational space, promotion of environmental consciousness, and minority culture protection. There are also some private benefits, such as employment and investment opportunities. Some quantitative data is adduced in this section, but this is very limited – a general project difficulty. In the second part, each tropical forest area is discussed in detail. Climate, soils, species, ecosystems are described well and in several cases good area and volume data are available, but less often reliable increment data. General project difficulties show in the difficulty of moving beyond the ecologically descriptive to the economically quantitative as the examples shown are not convincing, either because the results are unrealistically high or because the logic of the calculation is not wholly sound. Finally, the actual tropical forest area was

still not known exactly, owing to difficulties in distinguishing sub-tropical from tropical species on the images, thus restricting the benefits of GPS analysis.

- The international symposium on “Tropical Forest Environment Accounting” had been successfully held in Beijing in October with 50 papers of good quality submitted. Although not so many focussed on tropical forest accounting as had been expected, nevertheless methods discussed, such as the “green” system of national accounts, were applicable to tropical forest. Proceedings were published on Chinese and English. The symposium papers addressed the background theory, several new approaches, developments in other countries, valuation of specific forest services, and the introduction of results into the national economic accounting system.
- Both experimental areas had been established and surveyed. However, the research report on these case studies remained to be written.

Some short-term overseas training had also been done, but the research report on the theory and method of tropical forest environmental accounting was close to completion but difficult to finalise on account of the high diversity of approaches included.

By mid-2002, at the time of the 32nd ITTC Session, the case studies had been completed and the Committee agreed to a one-year extension with no additional budget to accommodate another workshop in late 2003, and to the present consultancy. At the 33rd Session in November of the same year, a work plan and budget proposal for the October 2003 workshop were provided, together with Terms of Reference for the consultancy. The workshop hoped to attract 80 participants, including 20 foreign invitees, of whom half, from tropical developing countries, would be able to recover their travel and accommodation from the project budget. The objectives of the four-day workshop would be to discuss the tropical forest valuation methods and national accounting approaches introduced by the project, to debate the key problems left unsolved and to decide on institutions and policy mechanisms to implement the results.

At the close of the original three-year term the project was making an impact on public perceptions of the social and environmental values of tropical forests in China, with discussions in the mass media. The core team of ten staff at the Chinese Academy of Forestry (CAF) had established close links with relevant personnel in key Government agencies such as the State Forestry Administration (SFA) and the Ministry of Foreign Trade and Economic Cooperation (MOFTEC) – both with representatives on the Project Governing Committee. They also worked with the provincial government agencies, such as the Statistical Bureau of Hainan Province, several regional Universities, the Chinese Academy of Sciences, and the Chinese Academy of Social Sciences. Last but not least the project had given several young research students the opportunity to contribute, including those who would qualify for their master or doctor level degrees through their participation.

1.3 Consultant's Tasks

This review is being conducted after the end of the original three years but in the early part of the extension into a fourth year. An important focus is the different methodologies applied by the various researchers working on aspects of valuation of non-marketed forest benefits. The issue of harmonising these approaches and integrating them into a valuation package is one where the consultant is required to advise.

The assessment of progress is to include the more general questions that are typically part of the ITTO Manual for Project Monitoring, Review and Evaluation i.e. whether the project assumptions are still valid, whether progress has matched the implementation plan, whether the planned impacts can be expected to materialise, and whether the project has unearthed any new problems or not. At this juncture, the consultant's advisory role is to answer these general questions and to provide guidance on successfully concluding the project.

The extra year's extension is primarily directed to an international workshop in October 2003, and the consultant is required to advise on the selection of speakers and the reporting format. He must also attend the workshop and deliver an overview paper. The complete terms of reference are set out in Annex 1.

2. Review of Methodologies

2.1 General Comments

The project is wholly concerned with tropical forest values and their estimation. Valuation is a series of techniques for assessing the worth of a resource to its owner, in this case the people of China and the people of the world. Since the late-nineteenth century economist Alfred Marshall, price and value have not been separated by economists, except for Marxist economists, who continued to adhere to the labour theory of value prevalent earlier in the century, and formalised by David Ricardo. The latter can explain several economic phenomena, such as comparative advantage in international trade, but it is problematic in dealing with forest resources, where a virgin forest of great ecological value would be assigned an economic value of zero. It is also difficult to accommodate the behaviour of those who store labour as capital. This review uses the Marshallian viewpoint now traditional.

In a sense, many services of the tropical forest illustrate the notion of the paradox of value, a paradox solved in economics by the discovery that price is set by the *marginal* value of a good, not by its *average* value. Prices are set by supply as well as demand. So soil and water conservation services rendered by a tropical forest are important for their *marginal* value, as the average value is low, since large quantities of soil and water are already conserved.

The project team has tackled the problem of assessing non-marketed environmental values of tropical forests by dividing these values up for separate study by

members of the team or through sub-contracts to other academic researchers. An unstated assumption of this approach is that these values are simply additive i.e. that total forest value can be computed by simple addition of the list of values. In other words, it is assumed that there is no negative feedback between two or more components of value, no trade-off between one component and another. If the function is:

$$TV = \sum_i^n V_1 \dots V_n$$

where TV is total value, the assumptions are that any V_i can attain any value irrespective of the value of any other V_i , and that, irrespective of the mathematical sophistication in the techniques used to determine each V_i , TV will still be the simple arithmetic sum of all V_i .

It may be recalled that one of the values eliminated from the study is that of timber harvest, because logging has been banned in these forests. It can readily be inferred that the reason for the logging ban was the damage inflicted on environmental values by this activity. Thus we have evidence of one output affecting the quality and quantity of others, but despite this evidence we note the opposite assumption that the remaining forest values do not affect each other. If we suppose that sustainable forest management had been substituted for destructive logging, instead of a total logging ban, the possibility that the components of forest value might affect each other must still be entertained. Some specific suggestions are discussed below under each section.

Another tacit assumption is that all environmental values are positive in respect of human welfare. There are some exceptions, for example where the recreational value forest is reduced by a congestion factor, to account for over-use by tourists and subsequent degradation of the resource. There is, however, a more obvious example in the case of the activities such as shifting cultivation. It is clear that the shifting cultivator regarded the forest as at least partially negative to his life's ideals although he realised that he needed the forest to return after his few years of agricultural crops in order to restore the fertility for future use. Nor should it be forgotten that in the future the forest may be perceived to have a negative value for developers, a case in point being a possible expansion of the rubber plantations in both Provinces, as Hainan and Yunnan are China's first two provincial producers of this commodity. After all, most of Malaysia's rubber estate was established on former tropical forest.

The rapid expansion of Yunnan's traditional Chinese medicine and biochemical industry may seem to favour forest, but the creation of external estates of major herb species may reduce the value of collection of wild plants from the forest. Then, the prospects for tea, tobacco and other important agricultural crops may also impinge on the forest estate. Nothing is immutable about forest value, nor can it be assumed that all economic agents will view forest in a wholly positive light.

The use of different methods for different components of forest value also introduces the possibility that one method may be biased in favour of higher figures than another, thus exaggerating the contribution of the component of forest value to which it is

applied. The results for total value achieved so far are interesting if the components are ranked in order of their contribution to the total (6926 yuan/ha/annum): Flood prevention is greatest at 29%; water conservation, recreation, and oxygen production follow at 17-19% each; soil improvement, fertilisation and carbon fixation account for 5-6% each, and soil stabilization is only 1% of total benefits. The question is whether, if a single method were used to quantify all these forest services, would the order remain unchanged, and, indeed, would different total values be found for each method tried?

The project team did provide a critique of different methods for evaluating the land value and the tree value in a forest and essentially do find in favour of the standard cost/benefit method, using discounted cash flow analysis, according to which the value of a forest at any given time t is the discounted sum of benefits occurring annually in perpetuity, less the discounted sum of costs incurred in managing the forest, again in perpetuity.

This approach will serve equally well for marketed or non-marketed forest products and services, but of course the data for the latter will be harder to collect, and more subject to dispute. However, those addressing each component of forest value in their work have been free to use whatever methods they find most appropriate, and indeed it is not at all clear in some cases whether the value is expressed solely as x yuan/ha/annum or as the capitalisation of all annual future values, x/d , where 'd' is the discount rate as a decimal.

The treatment of forest land in the project team's analysis of different methods is also rather unconventional, as normally land is a factor of production that may move to the most efficient use. But here, the government's administrative *fiat* that permanently reserves forest land and forbids trading is taken as a sign that the land has no opportunity cost, although in reality it still does (a new future government could have a different policy). The study also recognises the difficulty of using transactions evidence; in fact, even in countries where forest land and forests can be freely traded, forests are too heterogeneous to allow this method to function other than just as a check for results calculated from discounted cash flow analysis.

2.2 The Beijing Study

Before turning to specific forest services studied by the project team, it is worthwhile examining one complete general analysis. An interesting and influential study was published in late 1999 on the value of the forest resources in Beijing. Although not part of the ITTO project, and in a cold temperate, not a tropical zone, the project was a collaborative venture between the Beijing Forest Bureau and CAF, the Executing Agency for the current project. The CAF author undertook research work for the current project and the Project Director reviewed the draft of the book.

The capital of China, founded as the Mongol capital by Kublai Khan in the late thirteenth century, has a population of 13.8 million and an area of 16,800 km². Surprisingly, only 5% is classified as urban. 86.5% of the total area is mountainous, and

the mountains hold most of the forest, but the plains also include some forests, many orchards, and roadside trees. However, the proximity of the urban area ensured there was sufficient demand for forested land to enable the researchers to collect and collate actual market values for different categories of forested and non-forested land. Transactions evidence from a statistically diverse sampled population is recognized as the most reliable approach to valuation, so this kind of evidence already gave the Beijing study a major data advantage over the tropical sites in the project. For example, the total value of forested land was assessed at 20.88 million yuan, or an average of 25 yuan/ha. Furthermore a good market existed for all kinds of produce, allowing the researchers to determine an average price of 232.7 yuan/m³ for timber.

Beyond this treatment of marketed goods, the authors must then proceed to value environmental and social benefits, and they address water storage, water quality improvement, and reduction of sedimentation (flood control and micro-climatic effects were not assessed); erosion prevention and soil fertility retention, carbon sequestration, oxygen production and solar energy transformation; air pollution reduction through absorption of sulphur dioxide, hydrogen fluoride, nitric oxide, and dust particles as well as fungicidal and noise abatement functions; shelterbelt-induced crop yield increments, sand-stabilization; other marketed produce such as wild vegetables, medicines, and mushrooms; recreation; biodiversity conservation; and socio/economic benefits such as employment, education, and culture. The study, adding all the non-timber goods and services, produced a total forest value nearly eleven times that from the timber alone. In deriving this ratio, it appears that a capitalisation formula with a 10% rate has been used on the assumption that the benefits recur each year in perpetuity (Zhou et al. 1999, p.102 of the Chinese original), but this seems to be one of only two instances of awareness of the importance of discounted cash flow analysis in valuation.

The study has attracted a great deal of interest in Beijing. There are some features of its environment that are well-known to all citizens – it is one of the world's most polluted cities and is also prone to sandstorms, particularly severe in 2002 – both of these problems can be alleviated by forests and indeed sterling efforts are being made by the city and central Governments to combat the causes including a major planting of protective green belts around Beijing and Tianjin to trap the sand originating from a huge area stretching back along the desert margins and loess plateau to Hebei, Shanxi, and Inner Mongolia. Of course, another reason for the book's influence is the readership. Beijing's workforce has the most advanced level of education in China, and therefore a higher environmental consciousness than average can be expected.

Probably as a result of the study local authorities have raised their estimate of the minimum desirable proportion of forest cover from 30% to 50%. Also other provincial governments have shown significant degrees of interest in the study. In particular, emphasis has been laid on the *composition* of the forest value, rather than the calculation of its final *magnitude*.

It has been worth the effort to digress into the Beijing study because the lesson to be drawn from it is that the potential effect of the final project report after the closing

symposium could be equally strong. Moreover, this published book provides a useful summary of all the methods that can be used to value non-marketed goods and services.

2.3 Specific Forest Services

The main environmental services furnished by the forest can be broadly grouped under the headings of water, soil, atmosphere, biology, and society, the last-named further sub-divided into welfare and recreation. The project generally uses almost every known type of method for examining unpriced values. User, existence and option values are all addressed, especially for biodiversity. We also find replacement value approaches, defensive expenditures, the hedonic price method, and the controversial experimental market, with the problem of incorrect and biased replies to questionnaires. As noted above, the capitalisation market approach is ideal for dealing with a perpetual stream of annual benefits, but requires an acceptable discount rate. There is one example in the project papers of a calculation for this rate.

2.3.1 Water

The history of China over the past two thousand years shows an increasing severity of flooding in the plains of the Yellow and Yangtse Rivers as forest cover in the upper reaches of these rivers was reduced from 60% to 10% by increasing human settlement there, so it may be best to begin with water.

Forest hydrology principles are used to examine different manifestations of what is essentially the same characteristic behaviour of forest in respect of precipitation, evapo-transpiration, stem-flow, and run-off. Flood control is the most important aspect for the Chinese agricultural economy, but in the project team's study it is valued separately (and additively) to water storage in forest humus and soils. This means that some other use (other than flood control) must be envisaged for the water whose natural descent rate is reduced by the forest. If this were not so, valuing both benefits would be double-counting, impermissible in any cost-benefit analysis.

The method adopted is fuzzy mathematics, based on the opportunity cost notion of assessing how much physical engineering infrastructure would be needed to produce the same water conservation effects. But the assumptions first deserve attention, as they are focussed on the ability of forests to intercept rainfall at the canopy, through stemflow, and in the sponge-like layer of leaf litter on the forest floor. This capacity enables an upland forest cover to regulate runoff, alleviating peak flood effects and reduces the sediment burden of descending water. However, civil government water managers are also concerned throughout the world at the *negative* effect of forests on the rate of filling of their reservoirs, and, more importantly, the evapo-transpiration effect that may lead to a permanent loss of water availability as incident rainfall is returned to the global water system for re-precipitation elsewhere. They recognize *quality* improvements such as reduced turbidity, but sometimes their concern over the *quantitative* effects will outweigh that recognition. However, the project study assumes all hydrological effects are positive for human welfare. Even the Hainan Provincial Government taxes water at a marginal

rate of 0.02 yuan/m³ showing awareness of the value of water. Elasticities of demand must be calculated to distinguish tax incidence from tax impact.

The water study illustrates many problems that are common to the whole project. For example, Hainan Island has a rich water resource, in terms of both rainfall and of underground aquifers; moreover, several sites, especially at Jiangfengling, are equipped with concrete structures and attached instrumentation, using lead/acid batteries discharging over three months to take good measurements of run-off. (At this site in 1992 a typhoon produced 2m³/sec). Some emplacements were created under ITTO Project PD 14/92 Rev.2 (F) but others are older still. However, it is not known if these results can be generalised to other forests in other provinces. Another feature of this transfer is the distributional weights to be allocated, if any, to beneficiaries of water conservation in different income groups; willingness-to-pay will differ among them.

Water quality is also hard to model in the same system as water quantity (a mass matrix model was under consideration). Where substitution (opportunity cost or next-best approach) valuation is used, one has the choice of engineering works, coastal desalination plants, average reservoir construction costs, and the complication of additional benefits that might accrue from hydroelectric power generation. Hainan has several large reservoirs in the mountainous interior – Niululing, Songtao, and Daguangba, for example, and several smaller catchments with hydro-electric plants.

Flood control benefit estimation often requires non-forested control catchments that are economically and socially unacceptable, no matter how scientifically desirable. Earlier research in cool temperate forests in China also revealed perverse situations where runoff was *reduced* by logging, and this research also found that catchment size influenced the results.

The fuzzy set approach enables matrices to be constructed with precision but still does not overcome the fundamental problem of how to secure numerical data of adequate quality to fill the cells of those matrices.

2.2.2. Soil

The project team adduces a large number of derivatives from the basic observation that forests help to build up soils and stabilise them. These include lessening soil erosion and sediment deposition, arresting sand drift, restraining avalanches, and fertilisation including nitrogen-fixation by legumes. The basic method consists of comparative analysis of forested and bare hillsides, a difficult experimental situation to locate. Moreover, several of the sub-components appear to interact with each other, or to duplicate effects considered under water run-off, or possibly double count if added to each other. The logic of some sub-components needs examination. For example, what is a measure of soil improvement? This seems to be a simple measure of increase in N, P, & K macronutrient levels, or perhaps of other micronutrients. But why is this of additional value and to whom? If the trees themselves or other woodland flora are using marginal increases in fertility for growth, the value of the increase is captured already in the value

of the trees, of course not for timber in this instance, but for other values such as their photosynthetic activities or their value in landscapes or for recreation.

Again, worldwide research of forest soils suggests that certain types of tree cover may lead to podzolisation and leaching of nutrients with acidification of some lower soil horizons. Quite possibly local soil science research has shown that tropical forest soils do not show this condition in South China. If that is so, it should be stated. When certain types of pine forest are cleared for commercial agriculture, mild acidification can be corrected by the use of lime and other fertiliser within a few years, but there is a cost. True, these tropical forests in China are permanently protected, so the opportunity cost of agriculture may be irrelevant, but if so, we still confront the double-counting issue by which the trees are subsuming the soil fertility values and therefore the latter should not be quantified as well. One cannot simply assume that increases in macronutrients are *ipso facto* good i.e. have a positive value in yuan, nor that this “fertility” is a separately accountable value from the value of the plants that metabolise these nutrients.

The soil studies also evaluate using the savings in costs when forest can be shown to prevent erosion and downstream siltation and other costly effects on engineering structures and upon agriculture. In these cases of off-site benefits (sand drift reduction is another example) the model looks more credible, if it is indeed possible to find the numerical data to enter into the formulae.

2.2.3 Atmosphere

The project team studied some well-known atmospheric effects of forest such as carbon sequestration and air purification together with one less commonly valued, oxygen production. The carbon work shows that Chinese scientists are well abreast of international research in this field and the algorithms developed are entirely plausible, carefully including all the possible sources of carbon fixation and carbon emission to calculate the flows and stocks as precisely as possible. In the case of natural tropical forest a major source of uncertainty is eliminated as they are no longer subject to periodic clear felling and re-planting as are plantations so the uncertain levels of carbon flux in the temporarily bare soils need not affect the calculations. However, the general sources of imprecise data that affect all research in this field worldwide, such as the predicted lifetimes of wood products, clearly affect this work too. The case study was not in the tropical area, but in Shandong Province where the forest is actually an enterprise of fast-growing poplars whose silvicultural systems are well-known. But worldwide natural tropical forests tend to be in or close to equilibrium, with increments ranging from 0 to 3 m³/ha/ann (compared to 15-35 m³/ha/ann for temperate zone plantations of purpose-bred tree species), so a good deal of work remains to be done for the tropical forest situation.

Unfortunately there is a major obstacle to the next logical step of introducing these carbon sequestration values into the national accounts to reflect full forest values. China is a signatory to the Kyoto Protocol, so it is obliged to endeavour to control emissions, though without the specified targets of OECD countries. However, to date the Government of PR China has opposed the inclusion of forest-based offsets in the Clean

Development Mechanism. Therefore, carbon sequestration values computed for Chinese forests cannot be included in national or provincial accounts without a serious policy inconsistency. This is a pity when the efforts of her scientists in this field are considered, but the logic of the exclusion must be clear.

On the issue of oxygen production, it is relevant to note that the conversion of atmospheric carbon dioxide to carbohydrates and water, with emission of oxygen, in the biochemical process of photosynthesis through the agency of chlorophyll are one process, although some types of plants cycle through a slightly different group of biochemical intermediaries. Since sunlight powers the operation, energy generation from daylight photosynthesis must exceed the opposing and twenty-four hour process of respiration to achieve positive growth. It is not absolutely clear that net oxygen production is a separate benefit from carbon fixation. Moreover, we are forced to the odd, but logical conclusion, that all the forest fauna, which is terms of numbers, species and total biomass will be largely invertebrate in any forest, is a *negative* factor for oxygen value as it simply respire. Its positive biodiversity value will have to outweigh this negative oxygen value. Although the Shendong study finds the oxygen value to be only one-tenth of the carbon sequestration value, this is still surprisingly high, given the misgivings noted above, and the possibility that the unit value of the oxygen may have been over-valued using industrial processes as a benchmark. In more general terms, it may be wise to recall that ours is largely a watery planet, and possibly photosynthesis of phytoplankton in the oceans dwarfs the contribution of forests. At this stage of research, the rationale for the inclusion of oxygen-generation seems to be unproven.

The team also studied the role of the tropical forests in reducing damage caused by acid rain active ingredients such as sulphur dioxide SO_2 , the nitrogen dioxide group NO_x , hydrogen fluoride HF, chlorine Cl_2 , and then the damage caused by minute suspended particulate matter in the air. However, Hainan already has a good air quality so the marginal value of cleaner on Hainan is much lower than in the polluted cities of the north and east. It attempted to estimate differences in mortality and morbidity for various diseases and of particular note was the study of the value of SO_2 absorbed by Jaingfengling Forest on Hainan Island. This highlights the difficulty of eliminating confounding factors in the statistics because demographers have noted that the average expectation of life on Hainan is about 73, four years more than the average for China as a whole. Moreover, the study area also has ethnic minorities, so the genetic and environmental effects need good experimental design to segregate them, even before the beneficial effect of the forest is considered. Furthermore, according to the World Health Organization, China has the second highest proportion of adult male smokers in the world (67% - the highest is Mongolia), so the results of this fact alone are probably little alleviated by the small amounts of pollutants absorbed by forests. The model is useful but again the problems of data collection and confounding of factors statistically may limit its usefulness in practice. The Beijing study showed that there were significant air pollution reduction benefits from forest there, and probably this would be true of all the great northern and eastern industrial cities, but the arguments for similar effects of forest in the purer air of oceanic Hainan or high altitude Yunnan seem far more tenuous.

In the original project plan 17 benefits were to be studied, both marketed and non-marketed. N-recycling by leguminous tree species was not addressed. The plan was already very ambitious, so it was probably a wise exclusion, as the subject is biochemically almost equally as complex as photosynthesis. An ideal candidate for experiments at a later date would be *Acacia mangium*

2.3.4 Biology

The study of biodiversity is notable on several counts. Firstly it looks at the opportunity cost of the production of all forest products from China's own forests as a means of valuing the alternative – the biology of the untouched forest. This would have seemed an obvious first step for the whole project, but of course it only needed to be done once, and it would be necessary to determine which forest values were unaffected by the cessation of logging.

Secondly it endeavours to calculate the appropriate discount rate – also a standard first step. In several other studies, it is unclear whether the value is computed as x yuan per hectare per annum (a flow) or is capitalised to an absolute value (a stock). If the former, then the discount rate is needed to calculate the value of a stream of annual benefits in perpetuity, which will be x/d , where d is the discount rate as a decimal. Also, the discount rate calculated, 5.0% -5.7%, seems quite credible, whereas the rates of interest found commercially in China e.g. only 1.5%/annum on ordinary Post Office passbook savings, suggest administrative control as they are even below a typical time preference rate of 3%/annum. Use of such low rates would exaggerate forest values.

Thirdly, market prices are used as far as possible for traded wild animals and plants (Yunnan Province, for example, is China's largest producer of cut flowers, and the genetic pool is constantly refreshed by further explorations in the forest). All three approaches begin from the limited amount of known theory and available data, rather than beginning to frame hypotheses or adapt overseas methods. The opportunity cost and market value results can be blended by calculating variances and minimising these in the composite value. However, the results give implausibly high values, over one hundred times the commercial values they replace. But despite this, and the inadequacy of raw data, a good start has been made.

Biodiversity in China is considered to be very high, because most of the country was not affected by the last Ice Age, so allowing many ancient species to survive. China is, with Mesopotamia and Andean America, also one of the three major world sources of cultivated plants that set humanity on the road through the Neolithic Revolution. There is an emphasis on existence value and genetic diversity to improve production, but this is at variance with forestry developments in the south-western USA and in the southern hemisphere where the southern pine resource genetic diversity has been reduced to clonal regeneration. There, remarkable productive results have been achieved by narrowing the genetic pool. It is interesting to note that the highest degrees of biodiversity are found in tropical areas (taiga forests may only have a single species over vast areas), but this very biodiversity is a major marketing problem wherever tropical forests are still harvesting

for timber, owing to the limited market acceptance of various species and to the economics of harvesting small numbers of valuable trees at low densities of occurrence. So the logging ban actually introduces a reversal of priorities in forest values.

Again there is a need to examine negative aspects. If genetic diversity is the objective, China already has 400 *ex situ* conservation and reproduction bases for rare genetic combinations – what is the rationale for persevering with *in situ* genetic conservation efforts. The advantages of conserving wild animals, like the elephants in Xishuangbanna, in the natural forest situation, must be carefully outlined, and costs against the cost of maintaining zoos or small, manageable reserves. There appears to be evidence of increasing elephant herd size in Xishuangbanna since the logging ban was imposed. But, a farmer who clears forest is a legitimate economic agent acting rationally according to his own lights; it may be a case of “the tragedy of the commons” but we need to accept the valuation of the forest at zero or negative by some groups. Also, the ban on hunting may permit the forest to retain an equilibrium between flora and fauna, but then, especially in the case of exotic species of animals, population peaks may occur with subsequent damage to the forest from over-browsing. Countries often find they need to re-introduce hunting at a controlled level to restore the balance between browse and browser.

2.2.5 Society

The recreation sub-component of the social aspect has a history of analysis dating back to the work of Marion Clawson about 35 years ago and is probably easier to deal with first. The travel cost method developed as a means of valuing single forest recreation sites in the USA where most visitors arrived by car and the distance they had travelled could be determined, allowing a demand curve to be constructed and the consumer surplus to be estimated by integrating the area under the curve between the average and the marginal visitor. As the method was more widely applied, many defects appeared, such as interview bias, substitute sites, the value of whole experiences, site accessibility, time factors complicating distance estimates, and so on. The project team have shown awareness of all these and of the research which has been done to minimise their effect. They studied indicators of area, bearing capacity, standard area, and examined the interaction of area, quality and access. An ecological fragility factor was introduced to cope with over-use damage. They also considered landscape, using contingent valuation methods.

Eight methods were discussed but only three actually tested. In studies of forest recreation from 1995 to 1997 the travel cost and contingent valuation methods seemed to be best. But to what extent were food, tickets, travel, the opportunity cost of time, photos, and souvenirs necessary costs? Contingent valuation was used to estimate willingness-to-pay in surveys, and used a bidding game approach. Some attention was also paid to option and existence values under the same approach. Information bias was fourfold – difficulty of describing the object accurately, starting price bias, selfish hypothetical bias, and instrument bias.

In the travel cost method every visitor could be assumed to have some marginal activity, cost zero. Consumer surplus could be calculated. GIS was used to check travel time. Individual models were needed to account for local people's use (they travelled a short distance but still valued the resource highly). Hainan Island populations were not used to contingent value methods so Li Jinchang's development stage coefficient method was used to adapt general results.

One UK commentator, Colin Price, in his "Theory and Application of Forest Economics" writes "Elegant and straightforward though it is, the Clawson method suffers defects whose cumulative effect is serious. Of these, the most serious is that it does not specify the course of action to which its value is relevant. No better method has yet been devised, however". This rather depressing commentary may be generalised to most of the methods used for other unpriced values in the project. There are defects, but often no substitute method.

Accounting for more general social benefits was more difficult, but some elementary points were established. Every possible aspect of economic and social life was discussed but after principle component analysis ultimately only simple linear regressions were used for some factors in the well-studied Jiangfengling region on Hainan Island. This project site was particularly appropriate, as the transition from logging to other forest uses had been monitored. Unfortunately the study could only proceed with figures from 1995 up to 1999, and there had not been time for the changes to show in any statistics by 1999. The Hainan Provincial Government had invested about 40 million yuan as a loan to help the Forestry Bureau, and this was supported by a larger loan from the Asian Development Bank and the grant from the ITTO project PD 14/92 Rev.2 (F). Most variables did not show any changes that could be directly related to changes in forest policy, but obviously continuing the study is worthwhile.

An important feature of the project sites in Hainan and Yunnan is the presence of large ethnic minority groups. The latter province has 25 registered minorities, more than any other province of China, and one-third of the 43 million total population (Xinjiang's twelve "minority" groups actually account for 60% of the 19 million population, however). As it is central government policy to try maintain ethnic minority living standards at the basic level of the majority, and as deleterious activities such as "slash-and-burn" agriculture are encouraged by poverty and traditional to minority groups lifestyles, improving incomes from non-forest activities must be promoted by the project's re-valuation of forests. In Yunnan this approach will be a harder path to tread, as there are over 4000 forestry enterprises, with thousands of small sawmills and furniture factories, mostly able to survive on the 2 million hectares of plantations, but also able to purchase extra logs where such sales are tempting as a supplement to the meagre incomes of some ethnic groups. Forestry is still only a small part of provincial income, perhaps 3%, but in smaller rural counties it may be a disproportionately large proportion of their tax revenue.

Socio-economic evaluations of the local economy are essential. Incentive issues are very important, for without local participation technology is useless. The background of local people needs investigation to convince them of the gains from the 10 to 20-year

project. Local community training courses are organized but more fundamental issues require cash income for labour.

2.4 Ability to Pay

Most of the project team has utilised a method devised by Prof. Li Jinchang to cope with the disparity in incomes distorting the “willingness-to-pay” approach. The method uses a coefficient derived from Engels law which states that, for a given set of tastes, the proportion of income spent on food decreases with income. This is not to be confused with the Gini coefficient derived from Lorenz curve as the curve drawn is a standard sigmoid curve with different segments displaying different coefficients. By multiplying the coefficient with the maximum result found for any given component of forest value, a reduction for lower income effects is computed.

This approach is desirable, as it tries to cope with the implausible assumption that everyone has an equal ability to pay for any forest product or service. It also conforms to the accounting precept of conservatism, which advises the use of the lowest of all possible likely values in the case of returns and the highest in the case of costs.

3. Case Studies

3.1 Hainan Province

Hainan wants to develop its reputation as the “ecological” province. The experimental area for the project is at Jiangfengling, a 60,000ha* site in the south-west of the island, which had also benefited from the large ITTO project PD 14/92 Rev.2 (F) and earlier Asian Development Bank and Hainan Provincial Government loans, but the consultant visited other areas with the project team, all of which carried some lessons concerning the project execution. Most of the sites visited are discussed here, not merely the project areas. The tropical forest is very biodiverse and one hectare may hold nearly 200 tree, climber and shrub species, including those endemic to the site of the island, such as *Castanopsis jiangfenglingensis* and *Hopea hainanensis*.

Jiangfengling Nature Reserve in the island’s south-west is in the tropical monsoon belt, with distinct wet and dry seasons, 1300-3500mm. of precipitation occurring mainly from May to October. Temperatures range from 19 to 25° and the site cover sandy deposits at sea level through lateritic soils up to 1412m at Jiangfengling Peak, largely above granite. The area was originally sparsely populated by people of Li and Miao nationality but the former group came to dominate and the population rose to 20,000, still living by shifting cultivation. From 1994, the Hainan Government stopped the logging operations and strengthened protection of the Reserve.

* Including the buffer zone; the forest area is about 47,230 ha.

3.1.1 Inventory

The Forestry Bureau in Haikou has a digitiser, and associated software and plan printers. There are 74 total staff and 25 in training, including one in Switzerland. 49 staff have been trained to date. Topographic forest maps are prepared at a scale of 1:50000, and the satellite images used are TM, SPOT and hybrids of the two; the full map of forest can be split into natural and artificial stands. There are 11 land-use classes, groups of stand age classes, and four density groups for natural forest.

Although the GPS work and resultant images and maps have been most useful for planning purposes such as roading and efficiency gains have led to a staff reduction from 218 to 168 with the budget halved, nevertheless from the project's point of view the results have been disappointing, when compared to the investment. Even experienced trained staff members have not been able to demarcate tropical forest from sub-tropical and seasonal forest on the images.

There were once 11 logging camps; compensation of 6 million yuan was paid between 1984 and 1988 to stop logging. Of the 660,000 ha of classified forest land on Hainan actual forest covers about 53%, and has a strong protection role. The 2010 goal is 60% coverage and that for 2030 > 65%. Foresters need to beware of forest cover targets, as they may bear no relationship to economic necessity. For example, forest cover in both Finland and Japan is about 67% but the former country is sparsely populated with undulating terrain, the latter densely populated with very steep terrain. In the first case the cover is almost entirely productive for the important forest products industry, in the second case its protective role exceeds that of production and domestic forest from the steep interior cannot compete with cheaper imports. It does not follow (except to a forester) that more forest brings a country or region closer to the economic optimum state. Careful thought must be applied to proposals to increase forest areas, and the costs and benefits of "green-for-grain" programmes should be evaluated.

3.1.2 Plantations

The harvesting ban only affects natural forests. Plantations still produce an output of 4 billion yuan/annum. Probably this income, from *Acacia mangium* and *Eucalyptus* spp. in the main, could be vastly improved by research and development work on initial spacing and thinning regimes. At present, antiquated Central European-style very close spaced initial establishment regimes with no thinning and short pulp rotations are almost certainly sub-optimising economic returns, and possibly volumetric returns as well. Mixtures of *A. mangium* & *Eucalyptus* spp. grow faster than *A. mangium* alone, the latter of unknown Malaysian provenance. It costs about \$US100-150 to establish one hectare. These forests can be valued in the standard manner by deducting the discounted costs of management and harvesting from the present moment up to the time of harvesting from the discounted returns over the same period of time (see 6.2.2).

Among other direct sources of revenue is the sale of trees raised in nurseries. For example, the mangrove nursery near Haikou uses only 1 ha to raise a million seedlings

per year, sold for 2 yuan each, close together in plastic pots and periodically irrigated with fresh water, as too much salt, especially near the tidal limit, will kill them. The 4000 ha reserve with 34 mangrove species attracts tourists who may cruise through the mangroves in fibreglass boats.

Tree seedlings of at least 5 species are also sold to farmers; if they plant the trees in theory they are the owners but in practice a felling licence will still be needed. This is a serious problem; tree values are sharply reduced when harvesting rights are compromised in this manner. If control is a concern, the use of management plans approved by Forestry Bureau officials is a much more efficient method than individual tree felling licences. The effect of the felling licence on forest value is serious. For example, if the farmer perceives the risk of a licence being refused to be, say, 0.3, then forest value is immediately reduced to 70% of its natural level; if there is a fee for the felling licence, that must also be deducted.

Annual farmer income has tripled in six years, but there was a severe drought last year. The ITTO Project PD 14/92 Rev.2 (F) alone has led to improved plantation increments and 8-10 million seedlings planted. Apart from the improved nursery and silvicultural operations, some infrastructure created by the project is permanent. A 43m fire tower at the 1000 masl contour has a remote sensor.

There is a Sino-German nursery project to produce native species of high value e.g. *Dalbergia odorifera* (Papilionaceae), *Aquilaria sinensis* (Thymelaceae) and *Syzygium fluviatile* (Myrtaceae), worth 1000yuan/tonne, with a good market for the young trees.

3.1.3 Research & Extension

The research station on Hainan has 20 staff, 10 technical, the main task being to address the production of high value species for the market, with economic and social benefits the main aims. Sales of young trees for medicine and to farmers and enterprises are good; government enterprises use them too. They plant trees for firewood too, and 13,000 ha per annum of bamboo. All projects have a 5-year payback time. A Chinese medicine factory nearby encourages demand for largely non-destructive forest uses, and these medicines use 90% local species. Wild orchids and other cultivated flowers and bulbs are sold in Haikou and Guangzhou. CAF has collected 500 species of tropical trees planted on another 20 ha site; they mostly show rather poor growth, but assist research. 20 species are from Africa and South America, others are local and from elsewhere in South China. Maintenance only involves cutting weeds three times a year. The site also contains a collection of 60 palms.

Extension staff teach farmers how to protect forest, and grazing is restricted to private areas. The consultant and project team visited a 60-year old farmer with cutting rights over a 10 ha hillside logged before 1982 and replanted with *A.mangium* and other species, including rattan. He was able to supplement his income from cash crops on the plain and a small village shop with income from the rattan, whose price had moved from 0.01 yuan to 0.25 yuan as it came into increasing demand for furniture over six years.

Research cannot be generalised easily; conditions are very different even between Bawangling and Jiangfengling. Altitude, ecology and even local ethnic group are all different. Only Jiangfengling has a fully equipped observation station.

Bawangling provides a useful example with a population of 2,820 in the village, of whom 1912 are working in the bureau, 700 are retired, and there are 210 others. The organization structure is into 5 departments, including non-traditional divisions for rubber, industry, and hydropower. Over the 71,000 ha research on biodiversity has studied 239 spp, but actually there are more than 3000 to study. 28 species of endemic animals are 85% protected, 6 nationally, and at the 2nd level there are about 46 endangered species.

The heyday of logging was from 1957 to 1974. During the second phase of management, 1975-1993, the forest was classified. 1975 saw the first nature reserve. Sustainable forest management was introduced in 1994, and in 1998 forest reserves and hydropower reserves were created among the 4 ranges of mountains and 3 rivers. 10 power stations and reservoirs were built and loggers re-trained as power station staff. Rubber is also produced. Annually the 3 towns with 260,000 people whose main source of income is still agriculture received 150,000 visitors last year.

Among other post-logging changes are the increased efforts to stop wildfires, and hunting of wild animals. Improved cooking skills and energy-efficient stoves use less fuel. The transportation system is better. Forest crimes are down from 100 per year to 10. In addition to the ITTO sustainable forest management project PD 14/92 Rev.2 (F), the Chinese Government has an ape protection programme, and the EU has a Natural Forest Management Programme. Water levels are said to have recovered after logging ceased, but there is no quantitative evidence to support this contention.

3.1.4 Tourism

In the South China Sea, Hainan is nevertheless set to rival Pacific island holiday resorts with sandy beaches, clear seas, and the forested interior. Tourism accounts for 16% of the GDP of the Province and six million visitors, mostly from other parts of China, came in 2002. This number is growing at over 7% per year, although the higher-spending international component is fickle, and has declined over 2002-3, despite new interest from South Korea and Japan. Sanya is the main attraction, but the Boao Forum for Asia is billed as Asia's answer to the World Economic Forum in Davos, Switzerland. The former fishing village on an obscure estuary is growing rapidly, now only 90 minutes from Haikou, although last year's Forum out-ran the existing support facilities. Sanya and Haikou both suffered from real estate booms that caused a concerned central government to cut back on credit. But there is certainly a very good prospect for tourism to move back into the forested areas. With improved roads, especially the completed ring road, it is now possible for tourist parties to lodge in a Sanya hotel, but take a day trip to forest areas such as Jiangfengling and return to the hotels at night.

There is a well-kept tourist village just below Hainan's highest peak Wujishan (1800m) with cabins costing 100yuan/night and a restaurant also on site. Attracting

domestic tourists demands more investment in infrastructure than might be expected for wilderness areas in say, the USA, but 99% of the area remains untouched, as it is only necessary to upgrade facilities where visitors are lodging. Carefully managed, forest tourism could well prove the most profitable of all the forest's non-timber services.

3.1.5 National Accounting

Hainan is notable for the direct cooperation with the Statistical Accounting Bureau, which has eight staffing in accounting and six in the management of fixed assets. The programme was introduced last year, and the Bureau chief taken a personal interest in the progress of the scheme. The legal section in the Forestry Bureau is also collaborating. The latter Bureau supplies the data, which are then analysed and used. In June 2003 Phase II of the process should be complete. The Bureau has had the green GDP go-ahead from Government. A good deal of energy has been expended on the programme. The problems are the new collection routine needed by the programme, the widespread nature of the data, their difficulty of collection, and the fact that ecological services are unpriced.

The Statistical Bureau hopes that forestry will become a model in accounting for other natural resources. This is an interesting comment because in many countries mining interests oppose the introduction of green accounting in the national accounts because they fear their own activities would be valued as resource-depleting and that when adjusted for this negative factor, their contribution to GDP, and general status, would be reduced. The extreme instance is the USA, where a Senate representative of a traditional mining area has promoted a Bill to restrict or prohibit the use of green accounting.

Hainan Province has good ores of aluminium, iron, tin, and copper, besides more than half of China's titanium and zircon deposits, not to mention the natural gas exports of 1.8 billion yuan per year and significant offshore oil reserves. It is surprising that no mention was made of any mining interest's opposition to green accounting in forestry, as this might be have been seen by them as the "thin end of the wedge".

16% of Hainan's output has been from forestry compared to 6.4 – 6.5% for China as a whole. The current GDP of 62.3 billion yuan includes agriculture at 21.9 billion yuan (38%) and industry 16%, construction 7%, and other services 40% (tourism 16%).

3.2 Yunnan Province

The Province is large, mountainous, and has a high altitude monsoon climate, allowing it to support more than half of China's flora and fauna species. Tropical crops include tea, sugar cane, rubber (second after Hainan, with 100,000ha of modern cultivars, on former tropical forest land), bananas, and tobacco (the last-named China's largest at a quarter of the total and also a quarter of total provincial revenue). Forest area has declined from 50% cover in 1949 to less than 10% now and the project site, Xishuangbanna, is situated close to the Lao and Burmese borders, with mostly ethnic minorities from these and Thai groups. The forest is more complex than in Hainan and contact has been lost with those who undertook the original survey for the project; also,

the national accounting aspect is not developed here. Earthquakes are very frequent in Yunnan Province, and the historic town of Lijang, in the foothills of the Himalayas, North-West Yunnan, was struck only a few years ago.

Yunnan's forest lands cover 9.8 mill. ha or 25% of the total 39.4 mill. ha in 9 prefectures and 44 counties. In the 'fifties forests covered 60% of the province, the loss being mainly due to cutting for agriculture. Barren areas cover 3.3 mill. ha and most of the forest is in under-developed areas where 17 ethnic minorities have traditionally farmed. Tropical forests comprise 31.1% of the total forest area and 37.5% of the total growing stock estimated at 340 mill. m³, so their importance is clear. Typically they are very bio-diverse (>7000 species) with little of any one species. 109 rare species are found of which 3 are of the 1st grade, 46 the 2nd grade & 60 the 3^d grade protected levels. There are many fast-growing timber trees (>60 species), but efficiency in use was always low.

To manage the forest well access has been planned according to site conditions. The most degraded areas receive first priority, followed by ecological areas, and then by normal areas. Foresters are always seeking quality seed. In the last ten years 10 species were planted including *Pinus halepensis*, *Betula ermanoides*, and Chinese fir. Farmers, according to the Forestry Bureau, still do not know how to use these and other species.

3.2.1 Project Region

Xishuangbanna is the southernmost Prefecture of Yunnan Province. Its 1.85 mill ha comprise 1.41 mill ha of forest. This 76% cover compares with a 10% figure for the whole province. 0.27 mill. ha is designated as a natural reserve. As elsewhere in China, the "grain-for-green" initiative operates whereby farmers receive 150kg rice per annum for 5-8 years in return for retiring 0.068ha from cultivation. Within the reserve, 21 plants are fully protected, 24 species provisionally protected and, of more than 11,000 herbal medicines used in Chinese traditional medicine, 18% are found in Xishuangbanna. Indeed, 70% of China's rare medicinal plants exist in Yunnan. It is a fast-growing and profitable industry; there are plans for modernised production of these medicines with five herb farms, five processing centres and three demonstration zones. Three counties in the prefecture are home to 36 families of wild animals, including 129 species of mammals. 28 species hold the highest national grade of protection, 16 the 2nd grade, and 26 are protected by the provincial government. Among the most notable mammals are Asian elephants, wild buffalo, Indian tiger, and puma.

Hunting was a traditional activity of at least thirteen ethnic minorities. As the ecological benefits to forest tourism and biodiversity have become better understood, the prefectural government reinforced protection and forbade hunting. Virtually every family had up to three guns, and these were forfeited under an amnesty, with arrest if not handed in on time. Some local people joined the forest guards, and with extension work promoting protection there were volunteers as well. Trees have begun to appear on some formerly barren mountains, but of course if recreational hunting pressure on wild animals is reduced, excessive browsing may reach the point where forest regeneration is damaged, and renewed culling may be necessary.

Classified just before the logging ban, the forest had a growing stock of 118 mill. m³, and an average annual increment of 3.51% or 4.15 mill.m³. The original classification was as protection (including reservoir catchments) or production (including firewood) plus 1.1 mill. ha of special forests for social benefits. 68.6% of total forest area, or 50,730 ha was originally designated for production. Later, the provincial forestry bureau allotted 300 million yuan per year for the protection project, undertaken by the former loggers. However, the economic problem has increased since there has been no income since 1998 from wood production, only from medicinal plants. There is a tree improvement scheme to obtain high quality seeds of *Betula ermanii*, *Parmesia veronii* and other species.

The “grain for green” compensation system reduces shifting cultivation. Reforestation demands 750yuan/ha for seedlings, plus 300 yuan/ha for education and medical care. Compensation depends on the species, it continues for five years if an economic return will occur, and for eight years if the species are “ecological”. There is some uncertainty over the sustainability of the scheme after the compensation expires. The Forestry Bureau and the State pay 1 billion yuan each year in compensation but it is stated to be hard to calculate forest benefits, which is surprising, as it should be easy. So there is a plan to collect the costs as tax at the end of the scheme. Little work has been done yet on improving plantations; aerial seeding was not successful - many seeds germinated but few survived.

The project used nearby Simao Prefecture to investigate the general situation and the ecological benefits separately. In effect the whole area was the project site. For herbal medicines it was easy to find the market price but for ecological benefits interviews revealed positive views, but again without quantification. There appeared to be a ten-year lag before the eco-benefits started to appear. Simao County is noted for the harvest of pine resin. Resin is harvested later from small trees due to the high price, but degraded timber results, so separation of the forests is needed. There are future plans to have specialised plantations combined with natural forests, and to have people later pay to use these forests.

95% of plantations are State-owned. Some thought has been given to buffer zones, still in collective ownership. These forests more difficult to manage than State forests. Property rights are a serious issue. Minority nationalities still retain some sacred forests as reserves.

The project site is in Xishuangbanna Forest Park. Asian elephants are the main attraction in the park, which was opened to the public in 1996, and now attracts 200-300 tourists/day in the holiday season, although not yet advertised on television. The site also takes the opportunity to display the cultures of minority nationalities, including dancing.

At another site, a 1700 ha former collective-owned forest had been converted by a Szechuan company into a tourist attraction in 1997, a 36 million yuan investment designed to show wild animals, tropical forests, and mountain scenery. Although described as a “primeval” forest park, the evidence of former logging is readily apparent on some hillsides where bamboo and other pioneer species have colonised open areas.

The public is guided within a small part of the area through large wild bird cages and other attractions partly on sealed roads in electric vehicles, and then on paths constructed of bamboo. 298 personnel, including 13 ethnic groups, work in the company's parks, and farmers working there part-time bring the total to 600. 380,000 visitors were recorded last year, and a similar number in 2001. A Japanese delegation recently decided to hold a conference in the facilities at the park.

4. National Accounting:

The project is specifically concerned with bringing the value of forests into the national accounts. Sovereign states maintain such accounts to capture all types of transactions for the whole economy and for important groups such as government, business, and households. The accounts track the prices and costs of all kind of business activities, the incomes earned by various groups, how much is saved and how much spent, and state the financial and trading relationship with the rest of the world.

Gross Domestic Product (GDP) is calculated for the economy as a whole and its annual change is the popular measure of economic growth. It is also calculated by broad groupings such as primary industries – agriculture, forestry and mining, secondary (manufacturing, utilities and construction), and tertiary, or service industries, including the retail trade, government administration, finance, transport, accommodation, and communications. Essentially a measure of value-added, it is determined by deducting the value of intermediate goods from the value of final consumption goods. “Gross” means that no allowance is made for depreciation (expenditure on capital goods for replacement purposes). “Domestic” means that only the value of goods and services produced within the country (even if produced by foreign-owned firms) is included; income from investments abroad is excluded. GDP is usually calculated “at factor cost” rather than “at market prices” because market prices include indirect taxes, such as consumption tax, and subsidies. This is the measure from which international comparisons of economic growth rates are conventionally drawn. It is consistent with the incomes paid to factors of production.

The components of GDP compiled by Government statisticians are “compensation of employees” (wages and salaries), “operating surplus” (profits, and surpluses in State-owned enterprises) and the adjustments for indirect taxation and subsidies. Another way of approaching GDP is to look at the expenditure upon it, which must logically be of the same magnitude. “Gross National Expenditure” (GNE) consists of the sum of expenditures by private households, central and local government, plus gross fixed capital formation (investment) and changes in inventories. GNE may then be adjusted for the balance of trade (add the value of exports and deduct the value if imports) to give the expenditure on GDP. In practice, because of the different methods of assessment there is a statistical discrepancy between GDP and expenditure upon it, which may typically be as much as 1% or more, but it does not affect the principle of their equality.

4.1 Forestry in the National Accounts:

Forestry is for the most part an industry like any other. It is in the calculation of the item “changes in inventories” and “gross fixed capital formation” (part of the calculation of Gross National Income) that we see the special features of forestry. Manufacturers and most other industries will value inventories directly in financial terms but in agriculture and forestry it is sometimes easier to calculate physical changes and to convert these to financial values by using a standard price. Forestry is typically different from all other industries in that the latter are subject to sharp annual fluctuations in inventories according to the market conditions (e.g. good prices may run down inventories). In agriculture, farmers may switch from cattle to pigs or vice-versa, for example, changing inventories of both. However, forestry values should show long-term increases where plantations are being undertaken and long-term decreases where destructive logging without re-planting is occurring.

Since the introduction and dissemination worldwide from 1968 of the United Nations System of National Accounts some attention was given to the valuation of forest stocks. This was, however, in the context of timber production forests. A discussion of valuation techniques is given in the following section. As far as the project is concerned, non-marketed benefits must now be considered, but it is important that fundamental principles such as the use of discounted cash flow analysis should not be forgotten when non-marketed benefits are considered. The other vital issue is the decision on the boundary of the actual forest-growing component within the whole forest sector. A sawmill is part of manufacturing, a secondary industry, and newspapers are tertiary (service industry) but the trees from which they manufacture their products are part of the primary sector. At what point is the boundary? In a vertically integrated industry or where the State owns the forest, stumpages may be artificially low to promote industrial development – this will present a false picture of the contribution of the forest to GDP, and this feature is common in the national accounts of many countries. The same will apply to non-marketed products – if a tourist village is built within a forest park, as can be seen at Wujishan on Hainan Island or at Xishuangbanna in Yunnan Province, are the buildings and the income they earn part of the forest (primary industry) or part of the accommodation and tourist industries (service or tertiary sector) – the latter choice would be more normal for a statistician working with national accounts? These are issues that must be resolved in any attempt at “green” national accounting.

Two years ago the State Statistical Bureau in Haikou became the implementing unit for this part of the project and it identified nine aspects in Hainan Province. The Forestry Bureau of Hainan supplied the data, and they were also responsible for quality control of the raw data, but not of course for the accounting treatment. The first part of work consisted of analysis of three books of forestry statistics relating to 1990-4. Market prices were still available at this stage. In the final stage, it is hoped to combine tables from the World Bank and UN System of National Accounts data, to complete the work by the end of June 2004.

In China “environment” tends to be used with a narrow meaning that excludes natural resources, so there is a need to integrate this concept into the current world model.

4.2 Commercial Forest Valuation

At this juncture a short digression is needed to examine commercial forest valuation. This is not part of the project and is not mentioned in the project document but it is relevant for two reasons:

- Both Hainan and Yunnan have significant areas of forest plantations. When a full valuation of their forests is prepared for the national or provincial accounts, these forests cannot be omitted.
- Forest valuation techniques for commercial forest are much more established and generally agreed than those for non-marketed forest products and services. If possible, any lessons learned or general techniques used in the former could be transferred across to the latter.

Valuation is undertaken not just for sales and purchase and other property transactions but also for other purposes such as taxation assessment, compulsory purchase or sale compensation, collateral for a loan, insurance, statutory accounting reports by companies, State-owned enterprises, or local authorities, project proposals, and variety types of equity transfers. In a free market situation it helps buyers and sellers move towards a price where they both feel a transaction may fairly take place; in other situations it enables sensible decisions to be made concerning the use of an asset because, in the absence of a valuation a developer who wishes to use the asset for another purpose may rate its value at zero (to maximize his profit) and at the other extreme one who lives in another place far from the forest and wishes the asset to remain unchanged for his or her possible future use could equally well maintain that the asset is priceless.

The last situation has been well exemplified by the case of forestry in Thailand, where it was observed that the ban on logging did not lead to a reduction in forest loss. The reason for this unexpected result was that the elimination of timber values initially eliminated all forest values by inference. Non-marketed values had never been determined economically, so once the timber value was gone it became easy for developers to justify the replacement of forest with rubber, oil palm and other plantations and non-forest developments. This lesson demonstrates the importance of PD 39/98 Rev.2 (M) as the project's objective is to value the forest by valuing its non-timber services; in principle, this should protect it from conversion to other uses, or at least make the would-be alternative user demonstrate the economic superiority of the alternative use against the non-timber values.

This consultant's review adopts the position that valuation should as far as possible adhere to the established body of knowledge and practice on forest valuation. The rationale is an attempt to emulate within economics the principle of scientific method known as "economy of hypotheses", whereby investigators do not frame new hypotheses if they can explain their research results within the existing statements of laws. This argument was strikingly embraced by Sir Isaac Newton's famous statement: "Hypotheses non fingo" (I do not make hypotheses).

This is not to suggest that the numerous methods developed for estimating unpriced values are “hypotheses” in this sense, since they may fairly be found to emerge from fundamental principles of economics such as opportunity cost. Nevertheless the plethora of different methods for different forest products and services does imply that we are far from solving the problem because in principle it should be possible to utilize the same theory for non-marketed products as for marketed ones. It is worth looking at some general principles of forest valuation to determine whether they can successfully be moved across to deal with non-marketed products and services without framing new hypotheses to do so.

Most asset values can be inferred by direct comparison with prices in the market for similar or identical assets. But transactions evidence can be unreliable where the market is imperfect, and it usually is, due to monopolies or oligopolies, taxation, advertising, and many individual preferences. In the case of forests, such imperfections are much stronger. To begin with, most of the world’s forests are owned by sovereign States, and this is true in China. Such forests have rarely been sold on an open market, recent exceptions being afforded by Chile and New Zealand.

In the latter case sales took place in two stages, firstly from the State to a State-owned Enterprise (in which the State owned 100% of the shares) and then a few years later the State-owned Enterprise was sold to the highest bidders for each forest or region. Ultimately the present situation was reached in which the forests (the trees and rights of land use, not the land itself) were owned by interests from, among others, Japan, PR China, USA, Korea, Malaysia, and local companies plus many farmers and other small owners. During the negotiations for the initial sale, consultants (primarily professors of economics from North America) were hired by the both the seller (the Government) and the buyer (the State-owned Enterprise) and their forays into forest valuation made particular attempts to use the capital asset pricing model. Nevertheless, studies by local researchers of the final prices after the last sales in 1990 showed that the prices could be inferred from the underlying characteristics of the plantations and from simpler more standard forest valuation techniques.

This example suggests another approach to transactions evidence is to infer the characteristics of value from past sales. However, this approach will be of no use either in a situation without any sales. The market is too illiquid, and there are too many complications, such as other assets bundled up with the forests, strategic factors, little public information, and forest scale.

Normally, therefore, commercial forests are valued using a net present value approach in which the discounted future costs from any time t are deducted from the future discounted revenue using a rate that reflects the opportunity cost of capital. This can be undertaken for a single stand plantation or for a forest estate. In the latter case there will be assumptions about, for example, a non-declining harvest and re-planting. This NPV method has become the preferred method ahead of cost-based approaches except sometimes in the case of very young stands.

However, a difficulty arises in that accountants operate under the precepts of objectivity and conservatism. The historic value of money spent on a forest during its development is the traditional means by which forests are valued. Thus, the State-owned forests of many countries of the world actually have very low values if the books are consulted as cost is equated to value, which it is not, and no allowance is made for interest costs, or for inflation, or for technological change, or of course, for the expected future value discounted to the present time.

As commercial forests represent investments some important principles are to be borne in mind in the standard valuation procedures:

- The accounting precepts of objectivity and conservatism still apply. When assessing future timber revenues n years hence, it is improper to assume higher prices than are current, or to assume higher grades than silviculture to date has created, or to assume new, as yet untouched markets, or, similarly, to assume lower than current harvesting, transport and milling costs, or lower than current management and forest protection costs for the rest of the rotation.
- Discounting has to be applied in all cases to future revenues and costs, irrespective of the type of economy, capitalist, socialist, or even theocratic, in which the forest enterprise operates. This is primarily because time preference is common to all human beings as economic agents, owing to their universal mortality, and secondarily because there is always an alternative use for the funds invested in the forest (opportunity cost) and the decision to keep the forest must be made after comparison with these alternative rates of return.
- The “arm’s length” criterion should determine the degree to which the data from any transaction or sale is useful in any valuation. Any price, cost figure, or other estimate that is affected by price control or other forms of administrative pressure will introduce an upward or downward distortion in the value estimates.

These principles can and should be utilised as far as possible in the valuation of the non-marketed products and services of the forests. The first principle should be fully transferable with use of objective data and adherence to the principle of conservatism in selecting it. In the case of the second principle above, there are somewhat slender references in the texts of most of the project studies, but one good one in the biodiversity study, in which a rate of 5 –5.5% per annum is calculated from existing behaviour of economic agents. This rate also neatly illustrates the third principle too, because if a regulated interest rate were chosen instead (not an “arm’s length” transaction between borrower and lender), forest values could be dramatically augmented. Imagine that the project team calculate the total value of the environmental and social services of the tropical forest in China as 7000 yuan/ha/annum and that this output can be maintained in perpetuity without additional costs other than those already incorporated. Then the capitalised forest value at 5.5% would be 127,273 yuan/hectare, but at the current post office passbook savings rate of 1.5% used as the discount rate it would be 466,667 yuan/hectare!

This digression into commercial forest values has been designed to show the need to adhere to general valuation principles and also to point up the need to include commercial tropical forest plantations in the national accounts as soon as practicable.

5. Environmental Policy

The project is not only designed to introduce environmental values into the national accounts but also to underpin environmental policy formulation. For example, the existing “grains for green” ecological compensation policy of retiring farmland and planting with forest trees can be assessed for efficiency. The price of the rice used as compensation from 5 to 8 years is known, and the value of the forest that replaces the rice field can be calculated for comparison.

The project work on this subject, contracted out to Nanjing University, concentrates on how to develop policies and to create institutional arrangements to correct negative externalities and market failures. Fiscal policy is proposed as the main tool in the form of an ecological tax, administered by the central government, to fund the changes in forest management.

Tax proposals are cast in the Pigou mould, instead of in the current economic fashion of trading rights for pollution, carbon release, etc. Pigou was a classical economist whose macroeconomic ideas were largely rejected in favour of those of Keynes during his lifetime but he did make important contributions to welfare economics, distinguishing private and social product, and explaining how practical policies could be implemented by dividing economic agents into groups with similar economic aims. However, in the case of the present project much more information is needed about the elasticity of demand for the ecological services of forests before any tax can safely be designed and its rate set. Several forest tourism enterprises in Yunnan Province have been established by companies investing considerable funds to protect the forest and its wildlife and open access for the public. It is not clear whether any proposed ecological tax would be levied on such companies or on the general forest user. In the former case, the company would be paying extra for the same activity, or for conserving forest elsewhere, and the latter would, if demand elasticities are high, abandon the forest experience for other types of recreation in large numbers.

6. Discussion

One of the most important, perhaps *the* most important piece of information a consultant must collect is the opinion of the project team itself, and especially of the Project Director. One cannot venture one’s own ideas without first listening to those of the people who know the project best of all. It should be borne in mind, however, that this is the consultant’s interpretation, so any misunderstandings are on the consultant’s side.

6.1 Project Director's Assessment

The six outputs of the project are environmental values of tropical forest, the theory and method of environmental accounting, the case studies, national economic accounting, environmental policy, and the international symposium. The economic aspect included the issue of compensation, and the sustainability of social benefits.

The environmental report on the total resource had been completed except for the fieldwork in Tibet, but even here some data was presented. A detailed report from each province was available, boundary of the tropical area was still unknown, as the species could still not be identified from GIS maps. However, at a meeting in Beijing of six forestry officers from provinces with the State Forestry Bureau and the Ministry of Trade it was found that other projects were already using this project's tropical forest descriptions, indicating they were considered reliable.

The research report on the theory and method of tropical forest environmental accounting was actually complete by the first half of 2001 in draft but the Project Director delayed publication as he was not satisfied that sufficient depth had been achieved for it to be presented to other ITTO member countries. Researchers also needed to absorb research from other member countries; Palmer's "The Economics of Environmental Resources" was translated into Chinese for this reason. Of the 4 activities 2 ½ had been completed and were now in draft form in Chinese. But a few results did not appear scientific, or not credible, or not operational. True, the studies had enhanced environmental economics in China but many ecological benefits remained very difficult to quantify, in particular air purification, noise abatement, and genetic biodiversity. Some methods gave a 0/ 1 result. Each component of value had been given to an individual expert, and some ideas might be good but impractical. Other ideas were just emerging.

On the positive side, the project had produced new methods for evaluating oxygen production and biodiversity and new ideas on nitrogen fixation. Water conservation studies had developed good methods and the Beijing authorities were very interested in these. The author of the work on biodiversity had been invited to lecture in Taiwan. Other methods were derived from the regular approaches of overseas scientists. But the crucial fact was that a real breakthrough still eluded the researchers. The Project Director believed the theory and method had to be presented for further criticism at the final workshop. Meanwhile, translations into English, French, and Spanish were in train. The training of two academic staff had not yet been completed.

The case studies included six activities. The main difficulty was that where the theory was still not agreed the method could not proceed and even if the method could proceed it might be good in theory but prove impractical. And if both theory and method were developed and practical, there might be no or inadequate data. Thus, a series of hurdles had to be overcome. Nevertheless, some complex examples, like carbon fixation, had been completed. The local population would cite benefits of the cessation of logging, but give no quantitative data. Social values were investigated in Hainan and Yunnan; the former were more typical, the latter more idiosyncratic. Hard data was still wanting.

The first international symposium had worked well; there was strong media interest and many requests for the published proceedings.

The problem of combining each study into one system remained. One possibility was to use Prof. Li's development stage index in which different areas would have different levels of ecosystem services, and there had been a suggestion of allotting a coefficient for each eco-service. Nevertheless, the results had already been incorporated into the National Statistical Department databank. A half-year design effort would soon be available in Hainan.

Another beneficial feature of the project was the size and the technology that could be tapped in the six academic and research organizations involved – the Environmental College, Beijing University, CAF, Nanjing University (the forest policy study), the State Forest Economy Study Centre and the Forestry Bureau. There had also been some intermittent participation by Shanghai University and other provincial contributors.

The Project Director felt that one possible route to a solution was through the setting of some simple practical indicator developed from the work of each specialist; local people could easily record and edit these. But it was hard to organize a team of specialists, and expensive. The help of the State Forestry Bureau has been sought on this matter, and they had expressed interest but not yet agreed. So the team had still largely relied on the formulae developed in Western environmental economics research. This also was often inadequate. The Project Director had found, on a recent visit to Nancy University, that even in France specialist agreed enough work had not been done on this subject.

In sum, the Project Director believed that the project's progress was normal; some results had been delayed, but others were on time and of good quality. Also the State had spent its own money on project, and the contribution of the State Statistics Bureau had been quite ambitious and substantial.

6.2 Consultant's Assessment

This section summarises comments made in previous sections and formally examines each term of reference except for the advice and guidance on the selection of speakers for the final international workshop, which is made the subject of a separate report (the workshop reporting format and other issues are, however, dealt with here).

6.2.1 Methodology and Outputs

These were discussed in section 2. The published description of the Chinese tropical forest resources produced by the project is a valuable document, despite the inability to do the fieldwork in Tibet. There is no conflict of methodologies, since although some ecological parameters are valued in financial units for Hainan, Guangdong, and a little for Guangxi and Fujian (but not for Yunnan), in general there is no discussion of the methods underlying these estimates. By limiting the discussion to

what had actually been achieved in the field of forest resource accounting, the project team produced an excellent handbook and indeed a *vademecum* for any ecologist visiting China's tropical forests. There has been independent testimony of this statement through reports of other Government and Provincial agencies using the book as a reference.

However, the problems of differences in methodology have been sufficient for the Project Director to delay publication of the report dealing with the theory and method of environmental accounting. Actually these differences do not originate in theory, as all researchers begin with the same basic principles of economics. For example, the travel cost method of evaluating forest recreation depends on the concept of consumer surplus and the valuation of water conservation by reference to the cost of substitute engineering depends on the concept of opportunity cost. Both concepts are elementary economics.

Indeed, the problems do not even arise from methodological differences. Most researchers have derived their methods strictly from the theory, or have cited and followed earlier researchers who did so. The problems really occur as a result of the difficulties or sometimes the impossibility of finding data to evaluate a methodology. Data may be inadequate or unreliable as well. There has been a tendency to pursue the method irrespective of its practicality in the circumstances of the project, and to justify this by constant reference to the correctness of the theory, a proposition none can deny, but one that does not guarantee practical success in the field.

The Project Director's comments on the method or methods that might be used to combine the results into one system of course show a complete awareness that the simple additive model is not convincing, and suggest a way towards a solution. In the time left to conclude the project, however, it is suggested below that the emphasis be shifted from the theory and methodology to the practicalities of national accounting.

The case studies will inevitably be affected by problems in using methodologies with data difficulties but probably they have no intrinsic difficulties in themselves, except that Hainan is more straightforward and has less idiosyncratic features than Yunnan. As decades of international experience show, methods like the travel cost method for recreation gradually become established, and constant use leads to refinements that slowly eliminate or neutralise bias and other deficiencies of the method. We cannot expect to achieve this result in the remaining few months of the project, so a change of approach and emphasis is necessary.

The more important and achievable target is to ensure that some recognition is immediately given to ecological and social values of tropical forest in the provincial accounts and the national accounts. A sensible goal is the accounts for Hainan Province. This is a focus for collaboration during the remaining months of the project. It also furnishes a theme for the final workshop, which should avoid returning to the questions posed by diverse valuation methods. If the workshop adopts theory and method as its main theme, it will simply attract speakers who will repeat with different methods and case studies the ground covered by the first International Symposium. It is essential to make progress in the final workshop, and that progress must be national accounting for

ecological resources, *not* a repetition of experiences with general unpriced values, and not a re-visit to academic debate on the statistical validity of various methods.

There are some specific issues about theory and methodology that can be addressed, however.

Firstly there is an unproven and implausible assumption made by all researchers that forests only generate positive values. Virtually all the project team are engaged at forestry Universities or other forestry organizations, and, like the present consultant, also a forestry graduate, may find it hard to envisage negative connotations of forests, but, as scientists, it is really necessary for us to entertain and evaluate any negative values that do exist. A few examples have been mentioned, for example the water manager who sees losses from forested catchments due to evapo-transpiration, or the farmer, rubber estate developer, or roading engineer who might see the forest as an obstacle. Do we deduce that the oxygen that forest fauna respire is a negative amount to deduct from the oxygen that forest trees photosynthesise? Actually this matter stems from the project document, which only mentions positive ecological benefits.

Secondly, the principle of conservatism in accountancy must be followed just as much in ecological accounts as in financial accounts. It seems that many forest products and services have been valued by choosing the *most expensive means* of producing a substitute, rather than the *least cost means*. This introduces a speculative note to the calculations, which should not be permitted. If we begin from the Government's decision to ban logging, we can deduce two statements on the assumption of economic rationality:

- The Government decided that the non-marketed benefits of the forest must be worth at least one yuan more than timber revenue (this is a null hypothesis – the Government might be surprised by the calculations showing these values to be ten or one hundred times more than the timber revenue)
- The Government rejected the sustainable forest management option for harvesting (or, decided it could not enforce it, for whatever reason). This must be true, otherwise the country could have both the timber and the non-timber benefits i.e. possess an even higher true economic value than the non-timber benefits alone.

Another Government decision (at the time of writing) also compels a conservative approach. China does not support the use of forest-based carbon offsets in carbon accounting. Therefore, the value of these carbon fixation services is currently zero.

Thirdly, as each researcher has been independent in the choice of theory and method, the model has been assumed to be additive. But possible cases of double-counting and interaction among components have been noted in section 2. Also we know from the second bullet point above that timber and non-timber values are deemed interactive; why should we assume that all ecological and social values are not interactive?

6.22 Final Report

The ITTO Manual for Project Monitoring, Review and Evaluation contains a model project completion report. Two stages could be involved in preparing this report. The first would use the ITTO Manual as a template, but the project team could present it as a paper (entitled just as a “report”, not a “completion report”) for the final workshop (ignoring sections 6 c) & d) in order to give all attendees as much information about the project as possible. After the workshop, this preliminary report could be up-dated and up-graded to cover the experiences of the final workshop, then presented as a completion report to ITTO.

More detailed points about the executive summary section of this report are:

- Emphasise the shift in objective priorities to the national accounting system under section 2, both for the development and for the specific objectives
- Include a wider and deeper range of target beneficiaries under section 3 than that stated in the project document, as in addition to government agencies, academia, and other international organizations, it could be argued that local people with forest rights of any kind should also benefit from better forest valuation. Moreover, the ITTO gain is more strictly that of the ITTO producer member countries and the secondary criterion of the project’s success will be technology transfer of the national accounting approach. A draft package for this purpose could be prepared before the final workshop and elaborated during the workshop through consultation with other country representatives for final delivery to these countries after the workshop.

There is, however, a genuine gain to the ITTO as an agency encouraging sustainable forest management. The project can be followed by others of the same type elsewhere. This was explained by James T. Gasana, Technical Adviser to the Swiss ITTC Delegation, speaking at the 2001 Beijing Symposium “...with this project ITTO has *for the first time* financed an operation that aims at providing a methodology and data to take into account environmental functions for the relevant decision-making processes” (writer’s italics).

- Make a plain statement under section 4 about the importance of ranking easier goals ahead of more difficult ones in project design, in this case national accounting ahead of complex theory and method for valuing non-marketed outputs. A development objective should also be short and simple, rather than clustering together many subsidiary aims, because forestry is after all only one sector of the economy, and it is enough if any forestry project can assay to make a modest contribution to the grand development objectives of modern economies.

Lay stress on the support of the Government for creating and sustaining the standard procedures for collection of data needed to value tropical forests in the national accounts. After the initial example of Hainan, Yunnan should probably follow. Encourage national authorities to consider similar valuation techniques for

all other forests in China, to achieve a final goal of complete accounting for all forests in the National Accounts.

- Make a general recommendation under section 5 or as an operational lesson note under section 4 that a small “think-tank” is needed to guide Project Directors in controlling academic staff to operate as a team on complex research projects. As academic and research people naturally have independent thought patterns reinforced during their education, it can be difficult to harness them to work towards a common goal. The role of this small guidance group is not actually to discuss and debate the merits of different methodologies and lines of research but rather to ensure that each is assigned a role that contributes to the common goal and that all are designed for mutual support. The group has to be open-minded enough to cope with possible reduction in their own personal contributions during the collaboration process.
- As the project’s total budget is less than US\$500,000, the remainder of the completion report comprises only the results, the synthesis of the analysis, and the conclusion and recommendations. With the wisdom of hindsight it can now be seen that the work on the theory and methodology of tropical forest environmental accounting was akin to the labours of Hercules, and the project team should be able to congratulate themselves on partial realisation of this goal, but to state candidly here that the original proposal was over-ambitious. Probably the final result could not have been avoided, and the important feature is to stress that other outputs will have been fully achieved, and the partial success of the theory and methodology objective is still an achievement.

GPS has been rather unsuccessful because of difficulty of delineating forest areas. Especially in Hainan tropical and sub-tropical are inter-mixed by altitude, even local forest officers unable to separate on photos. But, although GPS has been a costly exercise with limited results, the project cannot be blamed for this, as it could not have been completely foreseen, although it might have been suspected. From a scientific viewpoint, it was necessary to make the effort, and the result is still valuable because it guides future investigators along the most profitable routes.

6.3 China & Forest Valuation

The general comments on forest valuation show that the existing situation in Chinese law needs consideration as it affects any market-based approach. The State ownership of land eliminates any notion founded on “arm’s length transactions” or “willing buyer/willing seller” but does not detract from the axiom of opportunity cost for the State could always remove the forest and replace it with another land use if it so chose. Furthermore, the sale of trees is also subject to regulatory distortions, even in the case where an economic agent has planted the trees, regulators control the licensing of the permit to fell the trees. Clearly this is a serious deterrent to planting trees by private individuals, and a legal change amending the State’s role to one of approving forest management plans would have a beneficial result. Finally, the continued influence of the Ricardian theory of value which reduces the role of all factors of production to labour

alone makes it difficult to fairly value natural forest, which becomes merely the most perfect example of the factor “land” in classical economics i.e. it has zero or even negative value until subject to change by labour.

There are several other important points that require emphasis:

- We have noted a presumption of the project document that the logging ban removes a low value or damaging use of the forest and permits a spectrum of valuable environmental and social services to flow instead. But we have to remember that if there is no change in the usage system i.e. industry continues to demand the same magnitude of input of raw materials, these logs will have to be imported after a domestic logging ban. In other words, the ecological benefits of the forest will relate solely to domestic accounts; the natural resource base of the exporting country may be eroded and its national accounts, if environmental effects are included, may show a negative effect equal and opposite to that of the domestic gain. Many ecological benefits are ascribed a global value, carbon-sequestration, for example, so the global effects of unsustainable or even illegal logging in an exporting country would become an equal and opposite negative entry with a net (global) effect of zero.

Unfortunately this is not merely a theoretical speculation, as China’s plywood industry continued to expand after the logging ban, and indeed to increase its own exports. The imports to fuel this increase seem to originate largely in Russia, from the vast taiga forests of *Larix dahurica* and other conifers in the Far East and Siberia. These are the planet’s last most extensive tract of natural forest and it could be argued that they could sustain decades of unsustainable logging, but the principle made here is not compromised – if the usage system can continue to find alternative sources after a domestic logging ban, we have to be careful about unreserved attribution of global benefits from eco-services of domestic forests.

- Forests subject to logging bans are not free of costs. In fact, they can be very expensive to manage, as they require protection from fire, animal and human damage, and foresters cannot perform these functions without the infrastructure of roading to access forest areas, equipment, and of course their own salaries, together with overheads and other fixed costs. Forests cannot be valued fairly without the inclusion of management costs involved in producing various eco-goods and services.
- Forests are not normally classified as wasting assets by accountants. That is, they do not depreciate like machinery. Nevertheless, their productivity is still subject to the law of entropy and energy, hence money, must be expended in preserving their condition. We know from the geological record that forests come and go, and any decision to maintain a certain ecosystem will force expenditures, especially if there are endangered species, whose struggle against the pressures of evolution have to be assisted by human efforts to protect habitats, create artificial breeding programmes for animals, etc. Again, costs cannot be ignored in valuations.

- Economic and political circumstances may change, despite commitments to protect forest *in situ*. This comment is particularly pertinent in the case of plantation forests, which may be established in particular locations to absorb available land and labour, but some years later their location may be undesirable due to distance from processing plants, for example. A case in point occurred in Chile, where the government offered generous incentives to plant “marginal” land in the hills with trees, but it was found that some companies preferred to buy more expensive agricultural land close to their mills and to plant this with trees because the cheaper transport costs and better growth outweighed the loss of the government grant and the extra cost of the land. So even a National Park or Forest Reserve protected by legislation in perpetuity cannot be assumed to have no opportunity cost. Circumstances change.

6.4 Project Assumptions

The ITTO Manual on Project Formulation prescribes the use of logical framework matrices to describe a project’s elements (objectives, outputs, activities etc.), and for each of these elements, objectively verifiable indicators, the means of verifying these and important assumptions. These logical framework worksheets are subject to the scrutiny of ITTO’s Expert Panel on Technical Appraisal of Project Proposals at least once, and generally, after revision, one or two more times.

The idea of stating the “important assumptions” is to demonstrate that the Executing Agency has a clear picture of what may go wrong with the project if certain conditions are not met, but in practice, it seems little attention is paid to this column in discussing project proposals, as the assumptions stated are commonly only for minor matters, or at the worst are just truisms, tautologies or self-fulfilling prophecies. However, as we have seen, there are very real and deep assumptions underlying the project and it is these *covert* assumptions that are addressed here rather than the *overt* assumptions in the logical framework matrix of the project document, the latter being generally unexceptionable.

1. Tropical forest ecological and social services are set below their true value before the project and will be set at their true value after the project.
2. All tropical forest ecological and social services are positive for all economic agents affected by their change.
3. Tropical forest timber values cannot be simultaneously obtained with tropical forest ecological and social services (= sustainable forest management for multiple uses is sub-optimal).
4. The total value of tropical forest ecological and social services can be obtained by simply summing the calculated amounts for each individual service i.e. there is no interaction or trade-off.
5. Each method for calculating any component of the tropical forest ecological and social services is commensurate with any other method e.g. ‘2’ on one scale is the same quantity as ‘2’ on another – no method is biased towards higher or lower values.

6. Discoveries of value at one project site can be inducted to another in the same province.
7. Land under the forest has no opportunity cost as the State has conserved its role in perpetuity.
8. Methods for valuing tropical forest ecological and social services can be considered in complete isolation from those for valuing tropical forest plantations.
9. Green accounting for tropical forests can be introduced without reference to other sectors of the economy that might not welcome it e.g. mining.
10. Tropical forests can be assigned values for their ecological goods and services that require no deduction for the costs of management and protection.

Fortunately, most of these assumptions can readily be addressed in the remainder of the project. (1) is probably valid for the *ex ante* situation, but there is a risk of over-valuation for the *ex-post* situation. (2) can easily be re-thought, and (3) probably remains valid as an administrative fiat, a fixed Government decision. (4) needs serious attention and so does (5). (6) is quite acceptable, as it accords with scientific method, which proceeds from induction of theories derived in a limited experimental situation to testing in a wider situation, tentatively moving to a universal law if no exceptions are found. (7) requires some thought and (8) some work. (9) appears to be holding – surprisingly. (10) has not been assumed by all studies, but the costs of future management should be incorporated in all results.

6.5 Final International Workshop

In a sense, everything depends on the final workshop. Progress has generally matched the implementation plan, apart from the theory and methodology study, but to reach a successful conclusion it will be necessary not to “lose the plot”.

The workshop objectives as stated in the workplan for the final workshop are threefold and the first one is actually itself a composite of four sub-objectives:

- Discussion on the tropical forest environmental valuation technology that the project has introduced
- Discussion on the green policy system, including ways and means to correct externalities
- Discussion on bringing these environmental values into the national accounting system
- Introduction to Hainan case study

These activities are assigned to the first day. In accordance with the advice offered earlier in this review, the project team is urged to re-prioritise the first day’s activities as follows:

- National accounting system
- Hainan case study
- Green policy system

The second day should be as suggested in the workplan an opportunity for overseas speakers to introduce their experiences on tropical or indeed any forest in their

national accounting system (not, except as necessary, on the theory). Lessons learned can be discussed.

The third day should desirably be devoted to a field trip and if the workshop is held in Hainan this should be to Jiangfengling, while participants still have in their minds the description they heard on the first day.

The final day should begin with formalising the self-help package for other ITTO producer countries to work on introducing tropical forest environmental values into the national accounts. Perhaps a small working group willing to work in the evenings could already have advanced this matter. Then the floor could be open for a return to the general discussion on the unsolved problems of theory and method, but allowing time for the final conclusions of the workshop to be agreed and printed before the end of the day in a form for distribution to the media.

The budget for the workshop is rather tight and at the time of writing a decision is awaited on whether to hold the workshop in Beijing or Haikou. This decision is in the hands of higher authorities, not of the project team. China is a huge country and Haikou is 3 hours 40 minutes by air from Beijing, so the situation is very similar to that of ITTO itself, which can hold one ITTC Session a year in Yokohama next to its headquarters, much more cheaply and conveniently than another in a far distant tropical location. However, there are other good reasons for one session overseas. Obviously Beijing would be cheaper and more convenient for the same reasons - the project team are nearby and CAF has its own facilities to demonstrate models. Nevertheless the present consultant favours Haikou (or even Sanya) as a workshop location because of his recommendation for emphasis on the national accounting system, the strong support of the Haikou Statistics Office, and the proximity of the project site with the boost that a field trip always gives to any seminar. It is true that Jiangfengling is still distant, so even the possibility of Sanya as a location should be considered, as it is closer to the project site, and international connections to Hong Kong are good, with ample hotel and conference facilities.

The first symposium raised the perennial problem of insufficient speakers due to travel costs. The system of supporting producer country delegates is traditional to ITTO and used again for the final workshop. But the sad fact is that most consumer country delegates are not able to travel either without employer support or some form of sponsorship. Most academic staff are happy to lecture without fees but cannot afford to bear the expense of travel and accommodation. As the problem was raised at the first symposium, it is rather naïve to suppose the situation will have corrected itself.

6.6 New Problems

The main new problem that will continue to tax academic and administrative minds after the project is the method of combining the various forest goods and services in a credible production function which can be solved. This is still a major task.

7. Conclusions

Reviewers normally measure a project's success by measuring the degree to which it has achieved its development and specific objectives. The conventional progress reporting required by the ITTO Manual for Project Monitoring, Review and Evaluation may not convey the full picture in a case like the present project where the success of the whole project hangs in the balance of the last 20%. It assumes a linear trajectory where every 20% segment is of equal value. But in the case of PD 39/98 Rev.2 (M) success lies in the very last activities and indeed in some actions that might take place after the close of the project.

To date a great deal of work has been expended on the theory and method of accounting for tropical forest environmental values; however, no-one has yet succeeded in writing a fully integrated account of methods for valuing non-marketed environmental services in general because of their great variety. This specific objective is over-ambitious and indeed events have proven this characteristic in the difficulty of meeting the deadline for publication of Output 1.2 in the Project Document (the research report on the theory and method of tropical forest environmental accounting) to the point where, although the full draft report is complete, the Project Director felt obliged to delay publication, a wise decision if the reader accepts the comment made above on this specific objective.

Nevertheless, the project can still succeed, can still achieve the expected impacts if the other more manageable specific objective is given higher priority, that is, to prepare a plan for bringing tropical forest environmental accounting in line with national economic accounting. It may be enquired how this can be done without a widely agreed set of theories and methods to do so. In other words, it could be argued that the theory is more fundamental than the practice.

This is true, but observation of members of the United Nations shows that for decades prior to the development of the UNSNA in the 'sixties, nations had prepared and published their national accounts. The fact is that national accounts can be prepared on existing agreed principles and then, as new theories and methods of data collection and analysis evolve and achieve acceptance, they can be modified to incorporate new approaches. If the project concentrates on the more limited target of incorporating tropical forest environmental values into the provincial accounts of Hainan Province, it will benefit from the strong support afforded by the provincial Statistical Bureau, and later the experiment can be repeated in Yunnan, ultimately reaching the national accounts when the central Government deems the technique mature enough for general use, in particular to evaluate the effects of forest policies.

There is a second criterion of success, which is the adoption of the project's achievements in the field of national accounting by ITTO producer member countries. The vehicle for accomplishing this will be the final workshop, when visiting ITTO producer country contributors will have access to a technology transfer package, in

addition to the opportunity of learning from the project team, and the various publications of the project.

Meanwhile, work on developing the theory and method may proceed and, as they evolve and are accepted, these methods may supplant the earlier ones used to start the process. This setting of priorities does not undervalue the research on theory and method but gives more time to perfect and test the underlying ideas and harnesses them to a very practical and important task. The project team reported some mild disappointment that more papers at the first international symposium were not devoted specifically to tropical forest environmental accounting. The final workshop must concentrate on tropical forest values in the national accounts.

8. Recommendations

- For the remainder of the project, the area of study should be reduced and priorities among the specific objectives should be re-arranged in the following order:
 1. The plan for bringing tropical forest environment accounting into line with the national economic accounting system and proposed environmental policies.
 2. Research report on case studies, with attention to detail in the case of Hainan.
 3. Research report on environmental policies (kept separate and subordinate to the first priority objective)
 4. Completion of work on a theory and methodological system of accounting for the tropical forest environment. Publication of this document should be delayed until just before the actual workshop, to encourage contributors to concentrate on practical experiences of forest representation in the national accounts. Its early release might elicit a repeat of some of the diverse theoretical studies of the first international symposium, and detract from the preferred focus of the final workshop on national income accounting by allowing academic debate to range too widely over issues that cannot be solved in the limited space of four days.
 5. The publication of the workshop proceedings is of course of the utmost importance and only ranks last here because it has to appear last chronologically.

(The current stock and value accounting of China's tropical forest environment resources is considered complete, although the area in the Tibet Autonomous Region still requires an intensive survey – a task, and an important one, for another small project).
- The theme of the final workshop should focus on securing papers about the Hainan provincial forest accounts, the national accounts of PR China and on overseas methods of representing forests in the national accounts, in accordance with the priorities set above. The Project Director should be permitted to exercise strict control over the themes of prospective papers to ensure this criterion is met.

- A small team of close advisers should be formed to assist the Project Director to work closely with the Hainan collaborators (Forestry Bureau and Statistical Bureau) in order to advance the trial run of the provincial level plan (Output 2.3.2 in the original project document). A strong effort is needed to run the plan, at least in Hainan, and not to be content with “asking them (Hainan Province) to provide opinions on trial run feasibility” (output 2.3.4 of the original project document). The team must be composed of project members who are willing to work for this team goal, which may mean that their own personal research contribution may not be immediately utilised, but held for implementation at a later stage. The team needs to operate like a “think-tank”. This means it must be willing to entertain and consider all possible interpretations of data, including those that suggest negative values for some forest products and services. It must be rigorously objective in its conclusions.
- The ITTO Manual for Project Monitoring, Review and Evaluation contains a model project completion report. Using this template, the project team should prepare a paper for the final workshop ignoring sections 6 c) & d) in order to give all attendees as much information about the project as possible. After the workshop, this preliminary report can be up-dated and up-graded to cover the experiences of the final workshop.
- If possible, and if funds allow, the external advisory team should be augmented with a national economist with experience of national income accounting. Desirably, his or her curriculum vitae should demonstrate mainstream macroeconomics expertise rather than natural resource economics. This stipulation is because a link person is needed between the more scientific approach of the project team and the practical requirement of the national accounts i.e. an “economist” rather than a “scientist”.
- For the final workshop, the project team should compile a technology transfer package for the ITTO producer country contributors. This should take the form of a sequence of questions which should guide the reader through to a solution as closely as possible adapted to the needs of his or her country’ forest sector.

GLOSSARY OF TERMS

N.B. Not all terms defined here have generally accepted interpretations; where the writer has considered it essential to define terms afresh in order to avoid confusion, such terms are marked with an asterisk *. Many definitions are abbreviated compared to the extensive explanations found in dictionaries of economics.

Carbon Sequestration: Removal of carbon dioxide from the atmosphere during photosynthesis and fixation of the element carbon into organic plant compounds such as lignin (wood) and cellulose.

Capital Asset Pricing Model: A valuation method for different financial assets where value is inversely proportional to the degree of conformity with the market average trend.

Conservatism: Precept of accountancy and financial investment analysis that directs the use of the lowest likely return and the highest likely cost in the analysis of any economic process e.g. after manufacturing, inventories are valued at unit cost of production, NOT at unit sale price.

Consumer surplus: The difference between the price a consumer pays for a product or service and their true personal valuation of it (what they would have been prepared to pay rather than go without it).

Contingent Valuation: A survey method that involves creating a hypothetical market and then trying to determine consumers' willingness to pay from direct questions (yes/no or by degrees) or through variations such as bidding games.

Double-counting: Evaluating a cost or benefit twice in a valuation, usually unconsciously, by measuring it in two different forms, and then adding the results.

*Forest Economic Value Accounting**: Assessment of the economic value of forests, irrespective of their style of management at any epoch and also of whether products are tangible or intangible, in order to permit forest owners and users to make fair comparisons of values, costs and benefits with non-forest assets in their portfolios or their bundle of user-rights. Results must always (*ex hypothesi*) be monetized.

*Forest Resource Accounting**: Management technique for integrating forest information at all levels and regular intervals to track changes in status of major physical and biological parameters in order to support implementation of a policy of sustainable forest management. Results rarely monetized.

Fuzzy Set Theory: An attempt to quantify precisely elements that are intrinsically imprecise by weighting their membership of a set in degrees from full membership to non-membership. See description of method to analyse water conservation role of forests.

GIS: Geographic Information System

GPS: Global Positioning System

“Grain-for-green”: A PR China Government compensation scheme that grants 150kg of rice per 0.068 hectare per annum for 5-8 years to farmers in return for retiring land from rice production and establishing trees instead.

Mu: Commonly used Chinese unit of area (usually for arable agriculture). About 0.068ha.

Public Good Forest Products: Forest products whose consumers are not in rivalry with each other nor able to exclude each other from consumption. Where forest management is supported by taxation, consumers also cannot reject the option demand for these forest products, although they can reject physical consumption of some of them, like forest recreation. Markets for such products usually are imperfect, or do not or cannot exist.

Tropical Forest: Forest occurring south of Nanling Mountain and the southern slope of the Yunnan Plateau, including forest in southern parts of Guangdong and Guangxi, southeast Fujian, and even central and north Taiwan Province. This definition is largely botanical and allows transitional seasonal tropical forest to be distinguished from subtropical evergreen broadleaved forest, for example. Alternative definitions based on meteorological data, and not followed by the project team, could have led to the definition of much forest south of the Tropic of Cancer in China as subtropical. Reference Ren Mei'e and Zeng Shaoxuan (1991) “Discussion on China’s Tropical Region” *Geographic Science* 11(2):101-107

Value: In use, the marginal utility to an owner of consuming one more unit of a good or service; in exchange, the marginal cost to a producer of producing one more unit of a good or service. If the latter equals the former, value and price are synonymous.

Valuation: The process of assessing value. (v.i.)

Willingness-to-pay: Total willingness-to-pay is the area under a demand curve for some good or service between two specified points, typically an *ex-ante* situation usually the free market and an *ex-post* situation usually after price has been manipulated in some way. Mean willingness-to-pay will be more than the *ex ante* price and less than the *ex-post* price if consumption has increased.

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Obviously the published work of academic project staff has been a most important source of information. In this review, all have been attributed to the "project team", rather than to the individuals who wrote the papers. Their contribution is still acknowledged.

Numerous others academics and officials, whom it has not been possible to mention by name, contributed to the missions. However, neither these nor any of the persons mentioned above are responsible for any errors, omissions, or duplications that may appear in this review. These are solely the writer's own.

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ANNEX

TERMS OF REFERENCE

Review and comment on the methodologies adopted by the various research teams working on elements of the project and provide advice and suggestions on the format and structure of the final report.

Comment on any likely difficulties in achieving the desired outputs arising from differences in approach and methodologies used by the various research teams and how such difficulties could be minimised.

In an overall assessment of progress, address the following:

- Do the project assumptions still remain valid?
- Has progress so far matched the implementation plan, if not what can be done to restore or improve the plan? If this is not possible what else should be done?
- Is it likely that the expected impacts will be achieved, if not what should be done?
- Has the project identified new problems, which need to be examined in designing further work?

Provide advice and guidance on steps that are considered necessary to bring the project to a successful conclusion.

Provide advice and guidance to ITTO on the selection of speakers and reporting format for speakers for the proposed international workshop.

Attend the international workshop to provide an overview paper which will review the methodologies and approaches taken during implementation and offer suggestions on lessons learned and recommendations for further work.

[extract from Document CEM(XXXI)/5]