RURAL DEVELOPMENT FORESTRY NETWORK

Chainsaws as a Tool for Conservation? A Comparison of Community-based Timber Production Enterprises in Papua New Guinea and Indonesia

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Summary

In this paper, we examine project experience in Papua New Guinea and Indonesia to frame the issues that need to be considered in the development of community-based timber production (CTP) enterprises, and in the light of the apparent paradox of how conservation objectives can be furthered by providing local communities with chainsaws, sawmills and timber-harvesting skills. We first define CTP enterprises in comparison to industrial logging and describe our two case study sites. We then examine some of the major technical, financial and economic, legal and political, social, and ecological factors affecting these enterprises. We conclude that it is challenging and requires substantial subsidies to develop viable enterprises let alone ecologically sustainable ones. We also find, however, that under certain conditions, CTP enterprises can provide community members with substantial economic and other benefits and thus give them the incentive to take the steps required to reduce internal and external threats to the forest resource. We end with a discussion of the applied research that needs to be carried out to develop more complete answers to the basic question of how these CTP enterprises can be used as a tool for conservation.

Introduction: Chainsaws as a Tool for Conservation?

There is a growing movement in the conservation and development community to link conservation to the sustainable use of biological resources. Increasingly, integrated conservation and development projects seek to meet the twin goals of

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promoting conservation and enhancing community economic development. They do so by assisting communities in developing commercial uses for the natural resources to which they have access. A common example of this type of project in forested regions of the tropics involves establishing non-timber forest product harvesting enterprises to fill a niche in local and international markets (Peters *et al.*, 1989; de Beer and McDermott, 1996).

Although these enterprises can have important impacts on a local scale (BCN, 1997a), they have a number of inherent ecological and socioeconomic limitations (Browder, 1992; Salafsky *et al.*, 1993). In particular, these non-timber forest product harvesting businesses generally prove to be based on a resource that is either of high commercial value, but low abundance (wildlife parts, aromatic resins) or of high abundance, but low commercial value (bamboo, fuelwood). Given these and other limiting conditions, it is difficult to establish enterprises that are simultaneously both economically and ecologically sustainable.

There is, however, at least one resource in most tropical forests that is both abundant and valuable in the marketplace – timber. The global timber market is currently a multi-billion dollar business, and demand is only likely to increase in the future. Papua New Guinea (PNG) alone has been estimated to have timber resources that are worth US$ 100 billion at current prices (Henderson, 1997). From an income generation perspective, it seems as though it would make sense for local communities to benefit from this wealth. But does this make sense from a conservation perspective? In particular, should conservation organisations invest in helping communities develop their timber resources? At face value, this question suggests a paradox – conservation organisations providing local communities with chainsaws, sawmills, and timber-harvesting skills to ‘save the rain forest’.

This paradox can only be resolved in the context of the threats being faced by the world’s forests. From a strict conservation perspective, community-based logging is obviously less desirable than having no logging at all. But in places where the forest is being threatened by large-scale industrial clear cuts or conversion to farms and plantations, small-scale community logging begins to make more sense. It is highly unlikely that the impact of a group of villagers with a chainsaw and portable sawmill will be comparable to that of even a small export logging operation with 20 chainsaws and 10 bulldozers. Furthermore, there is the hope that if local people can derive economic and other benefits from their forest, they will then have the

incentives for improved stewardship, protection, and sustainable use of its resources.

Although the idea of using community-based timber harvesting as a conservation tool sounds attractive in theory, it is largely untested in practice. Indeed, this idea is still relatively new – most existing efforts by conservation groups to establish community-based timber enterprises are now just getting underway. There is thus a critical need to learn about what works and what does not, as well as what additional information we need to know about these systems to make them more effective.

The Biodiversity Conservation Network (BCN) was established in 1992 to 1) support site-specific efforts to conserve biodiversity at sites across Asia and the Pacific, and 2) evaluate the effectiveness of enterprise-oriented approaches to community-based biodiversity conservation (BCN, 1997a; BCN, 1997b). With regard to this second goal, the BCN is testing a core hypothesis that if communities can economically benefit from the biological resources that they manage or control, they will take action to counter internal and external threats to these resources. All BCN funded projects contain one or more core enterprises that directly depend on the biodiversity of the project site. In addition, approximately 30 % of each grant is dedicated to collecting the social, biological, and enterprise data needed to measure the project's impact and enable BCN to test its core hypothesis.

In this paper, we draw on the two BCN-funded projects that we work with in PNG and Indonesia to frame the issues that need to be considered in the development of these types of enterprises in the context of timber production. After discussing nomenclature issues and describing the two case study sites, we compare the two locations to draw out the technical, financial and economic, legal and political, social, and ecological factors affecting these enterprises. We then use this information to discuss the specific questions:

- Can community-based timber production enterprises be technically, economically, socially, institutionally and ecologically sustainable?
- Can community-based timber production enterprises contribute to conservation?

We conclude with a discussion of the applied research that needs to be done by these and other projects to develop more complete answers to these questions.

Background Information

Terminology and definitions

In talking about community-based timber production, there are two terminology problems that arise. The first is 'What do we call these systems?' The obvious phrase to use would be 'community forestry'. Unfortunately, this term is already commonly used in conservation and development circles (FAO, 1978; Arnold, 1992; Peluso *et al.*, 1994). Along with its synonym 'social forestry', 'community forestry' generally refers not to timber harvesting *per se*, but rather to a wider form of use of, and social control over, forest areas. While community forestry projects can include timber harvesting, they more commonly involve a broader spectrum of activities including collection of fuelwood and construction materials, provision of food and environmental stability for food production, and the generation of income and employment through the collection and sale of timber and non-timber products (Arnold, 1992). Following Hartshorn (1995), we have thus chosen to use the term 'community-based timber production' (CTP). CTP is one part of the broader spectrum of community forestry activities.

The second problem is 'What do we call the opposite of community-based timber production?' Again following Hartshorn (1995), we have chosen to use the term 'industrial timber harvesting'. This usage is not meant to imply that community efforts do not involve industrial processes or have financially-oriented goals, but merely recognises that non-community-based efforts are primarily profit oriented and do not consider the broader ecosystem or socioeconomic impacts of their activities.

Determining precise definitions of CTP and industrial timber harvesting systems is difficult owing to the different ecological, social, economic, and institutional settings in which these systems are based. Furthermore, there are often grey areas between strictly community-based and strictly industrial timber production systems. Despite these difficulties, based on our review of CTP enterprises from around the world (Table 1, overleaf), there are at least five general characteristics that distinguish CTP systems from industrial ones:

- In CTP systems, resource rights are either owned by or assigned to local community members. In industrial timber harvesting systems, timber lands or the rights to harvest timber are held by companies whose owners often live far away from the actual site. In community-based systems, on the other hand, these rights are owned or held by local community members.

- In CTP systems, people harvesting the timber live near the site, depend on the forest for other goods and services, and place timber harvesting in the context of a larger land-use framework. In industrial timber harvesting systems, the people involved in logging efforts can live either near the forest or far away from it. In community-based systems, by contrast, timber is harvested by people who live near the forest. They generally depend on the forest not only for timber resources, but also for other products such as food and construction materials, and for its cultural and spiritual values.

- In CTP systems, harvesting is on a smaller scale and is less capital intensive. Industrial timber harvesting enterprises can employ a wide range of tools ranging from heavy machinery and mechanised skidders to hand tools and draft animals. As a rule, however, industrial timber production tends to be fairly large-scale and capital intensive and thus less reliant on human labour. In community-based systems, however, there tends to be a higher reliance on human labour and thus a lesser degree of reliance on machinery and other capital-intensive techniques.

- CTP enterprises seek to add-value to raw materials on or close to the harvesting site. Industrial timber harvesting enterprises generally harvest roundwood logs which are then transferred to large centralised processing mills that are located in cities or even abroad. Community-based systems, by contrast, seek to add-value to the raw materials locally by producing finished (e.g. furniture, toys, tools) or semi-finished (e.g. window frames, flooring, mouldings) products or processed lumber (i.e. wood that has been planed or sanded, dried, and sometimes chemically treated). This added value provides greater income to the local residents who own the enterprise.

Table 1 *Community-based timber harvesting efforts considered in this study*

Location	References
Papua New Guinea	
East New Britain	This study; Henderson, 1997
West and East New Britain	Salafsky, 1997
Lak, New Ireland	Orsak, 1996; McCallum & Sekhran, 1996
Lae, Morobe	Louman, 1996; van Helden, 1996
Kikori Basin, Gulf	WWF-US; Kikori Pacific Ltd. sources
Josephstaal Concession Madang	Ginn, 1997; TNC sources
Other Pacific countries	
Western Islands, Solomon Islands	Schep, 1996
Vanuatu	Wyatt, 1996
Asia	
West Kalimantan, Indonesia	This study
Eastern India	Poffenberger, 1994
Africa	
Masoala Peninsula, Madagascar	Kremen *et al.*, in press
North, Central and South America	
British Columbia, Canada	Poffenberger, 1996
Quintana Roo, Mexico	Bray *et al.*, 1993
Michochan, Mexico	Sanchez Pego, 1995
Central Selva, Peru	Benavides & Pariona, 1995; Hartshorn, 1995

- In CTP systems, capital is reinvested locally and there is a greater long-term incentive for sustainability. Industrial timber harvesting enterprises can easily move the capital for and profits from logging to other localities or sectors of the economy. These systems thus provide reduced incentives for a long-term sustainable harvest. Community-based systems, by contrast, generally invest their profits locally and thus have more of an incentive for maintaining forest stocks so as to provide employment and income for local residents over the long-term.

Description of the two project sites

The two project sites described in this paper are drawn from the 20 projects that are part of the Biodiversity Conservation Network (BCN).

East New Britain, PNG

The Gazelle Peninsula of East New Britain contains large tracts of lowland and upland tropical forests that are among the most threatened parts of PNG (Government of PNG, Department of Environment and Conservation, 1993). These forests contain a wide diversity of plants, birds, bats, and insects (Balun *et al.*, 1996).

The people of the Gazelle Peninsula live in small villages that contain members of one or more different clans. Each family typically controls small pieces of land near the village that are used on a rotating basis for shifting garden plots. Larger tracts of forest located farther away from the village are typically owned by all members of a certain clan and are used primarily as hunting grounds. Villages consisting of about 100 households control forest areas ranging between 5,000 and 20,000 hectares. These land rights are recognized by the PNG constitution, which assigns land and surface resource rights to the traditional land-owners.

Land ownership gives clans the ability to sell their timber rights to commercial interests. The forests of East New Britain are thus under massive threats from large, foreign-owned companies that are purchasing timber rights from local people at a fraction of their true commercial value. These large corporate interests typically pay less than US$ 5 for a cubic metre of timber that is later sold for a profit of over US$ 75 (Henderson, 1997). The companies typically strip the land of all salable timber, often in violation of existing forestry regulations, then move on to another clan and another forest tract (Henderson, 1997).

To combat the threat posed by this industrial timber harvesting, the Pacific Heritage Foundation (PHF) has been working since 1992 with residents of seven local communities to help them develop small-scale timber enterprises. These enterprises will enable the communities to develop their timber resource on a more ecologically sustainable and financially equitable basis (Henderson, 1997).

With BCN funding, PHF is working with six different small-scale community timber harvesting enterprises. Forest areas are surveyed by PHF staff and

community members. Each community enterprise has one or more chainsaws that are used to fell designated trees and remove their branches. The boles are then cut into 3 - 4 metre long sections that are moved into position using hand winches. They are then rough sawn into planks using a small portable ('walkabout') sawmill. These planks are carried by hand to a central transport site from which they are either sold to local markets or shipped by truck or barge to a central sawmill run by the project.

A typical walkabout sawmill can process about 0.5 - 1.2 cubic metres of timber per day, which works out to about 1 to 2 trees per week. Typical expenses per production of cubic metre of wood are listed in Table 2. In 1997, groups were selling wood for US$ 90 - 135 per cubic metre in local markets, with the higher prices being paid for higher quality woods. Benefits thus come to communities in the form of wages (around US$ 3 per day per person), profits (a couple of enterprises are putting thousands of dollars in clan bank accounts), and timber for house construction.

Table 2 *Estimated costs and revenues per cubic metre of wood harvested*

Item	**US$ / m^3**
Costs	
Labour	20
Transport	12
Royalty	6
Fuel / Oil	8
Maintenance / Parts	11
Loan for Equipment	25
Subtotal	82
Revenues	132
Net Revenue	50

In addition to the strictly business activities, the project is developing long-term biological monitoring techniques to examine sustainability. PHF staff work with the

community-run enterprises to assess the standing timber stocks, plan where timber harvesting should take place, and measure the ecological impact of timber harvesting on the forests.

West Kalimantan, Indonesia

Gunung Palung National Park in West Kalimantan contains 90,000 hectares of forest representing a wide range of habitats including mangrove, peat swamp, freshwater swamp, bench, hill, and cloud forests (MacKinnon and Warsito, 1982). These habitats contain a wide range of endangered species including orangutans, proboscis monkeys, gibbons, flying foxes, six species of hornbills, and dozens of other bird species.

The villages surrounding the Park are inhabited by Melayu and Chinese peoples along with a growing popu-lation of transmigrants from Java and Bali (Salafsky, 1994a). Village residents are primarily small-scale farmers, growing rice and other crops in irrigated and non-irrigated plots. Many villagers also own small forest garden plots outside the Park boundaries, which produce durian fruit and other products for commercial sale. Forested areas in and around the Park are owned by the Government and are zoned for different uses. Many of the parcels immediately bordering the Park have been classified as production forest. These parcels have been logged over the past few decades by concession holders who use mechanized equipment in the upland sites, and who hire community members to do hand logging in the swamp habitats. Additional threats to the forest come from expansion of agricultural plots, conversion of forest to plantations, and fires that spread from illegally logged sites during El Niño linked drought periods (Salafsky, 1994b).

This industrial logging has generally been conducted using unsustainable techniques. Sites are not regulated and indeed there is often illegal harvesting of timber and non-timber forest products from within the Park itself. In the upland areas where mechanised logging takes place, local people receive little or no benefits. In hand logging sites, participating villagers are generally mired in a debt peonage system in which they are given food and other supplies at high interest rates prior to setting out into the forest. They spend two to four weeks in the forest. After they sell the timber they have collected and have paid back their debts, there is little or no money left over. In either case, most of the profits are flowing to middlemen and concession holders.

To combat the threat posed by illegal industrial and hand logging, and to create a more equitable system of resource use, Harvard University's Laboratory of Tropical Forest Ecology (LTFE) has been working with Indonesia's Ministry of Forestry to create one of the first community-managed timber concessions in Indonesia. The community project, which is scheduled to begin in early 1998, will take over the management of an 8,000 hectare peat swamp forest site on the northwest border of the Park.

The project will be working with community members to set up one timber harvesting enterprise. This enterprise will annually harvest timber from 50 - 100 hectare strips (each strip will be about 125 metres wide), cutting 80 % of the trees greater than 40 cm diameter at breast height (dbh) in each strip. Felled trees will be cut into 4.2 metre sections, which will be hauled to the river using traditional sled and wooden rail techniques in conjunction with more modern winching and steel rail methods. Logs will then be rafted down to the village for processing at a central project mill using a band saw. Sawnwood will then be loaded on commercial ships for sale to domestic markets in Java, or processing into furniture for 'green marketing' in Europe.

Financial models based on planning data indicate that the CTP enterprise should be able to harvest around 1,300 cubic metres of timber per year. The enterprise anticipates being able to sell sawnwood for $US 105 - 270 per cubic metre, depending on the species, to a distributing agent in Java. This results in estimated revenues of $ 260,000 and profits of $ 30,000 that would be reinvested in the enterprise or used for community projects. Costs include wages of around $ 175,000 that would be paid to local community workers.

The project will draw on existing LTFE research at the site to monitor long-term effects on wildlife populations. In particular, the project will be able to compare seasonal population densities of orangutans and other key indicator species in the buffer zone with baseline levels in the Park itself.

Factors Affecting Community-based Timber Production Enterprises

Implementation of successful conservation projects through the establishment of community forestry enterprises requires that a number of technical, financial and economic, legal and political, social, and ecological factors be considered. For each factor, we list the challenges, describe experiences at the two case study sites and then summarise the major issues that emerge from the analysis.

Technical factors

Selection of appropriate technology

A major challenge early on in the PNG case study was selecting the appropriate sawmill for use by the enterprises. The terrain in the Gazelle Peninsula is very rough, and many so-called 'portable' sawmills proved to be very difficult to transport and set up in the field. The project tried several different sawmills, eventually settling on one particular model (Lewis Saw) that best suited local conditions. This model was also selected by another PNG-based project that reviewed available options according to the criteria outlined in Table 3 (Salafsky, 1997).

Table 3 *Criteria for selection of portable sawmill technology*

Criteria	Example
Portability	Weight of the heaviest component
Suitability for local terrain	Adaptability to steep sites and ability to cut timber on the ground
Ease of set up	Time and tools required, ability to do so without tools and bolts
Precision	Accuracy of cutting
Strength	Horsepower per blade
Ease of maintenance	Reliability and ease of obtaining parts
Cost	Capital and running costs
Safety	Presence of a shielded blade

Source: Salafsky, 1997

In the Indonesia case study, technology selection was also an issue, but for different reasons. There was consensus over what type of tools to use in the field since the project is adapting traditional hand logging practices, although steel, rather than wooden rail lines will be used to make the extraction of logs 2-6 km from the river rafting site financially viable. Issues developed, however, over the selection of the centralized processing mill. The Indonesian Forest Department required that the project should purchase an existing sawmill rather than buy a new one, since current Indonesian law forbids the import of anymore sawmills. The project could therefore not use the sawmill model that staff thought would most efficiently convert logs to sawnwood, and as a result, was forced to modify its initial financial projections to account for returns based on the less efficient mill. It is anticipated that success in training operators of the band sawmill will be very important, because financial viability of the enterprise is strongly influenced by the efficiency of converting log volume to sawnwood volume.

Maintenance and repairs

Another major problem that many enterprises in the PNG case study have run into is in obtaining the skills and parts necessary to repair equipment. At one site, where the manager is a trained mechanic, down time owing to equipment problems has been minimal. At most other sites, however, the enterprises have been side-lined for weeks or even months while attempting to repair broken mills. This is a common problem throughout PNG, where one study found that of the 700 or so mills in the country, fewer than 30 % were in operation, owing largely to the lack of technical expertise in maintenance and repair (FSP-PNG, 1995). Furthermore, it has been a logistical challenge to get broken chainsaws and mills back to the project base for repairs, and several pieces of equipment have 'gone missing' during transport and storage.

In the Indonesia case study, on the other hand, it is not anticipated that field maintenance and repair will be a significant problem since local community members have a long history of experience working with chainsaws, and other field equipment is limited to hand tools. It remains to be seen, however, whether keeping the used central sawmill running will pose a problem.

Transport

Perhaps the most persistent problem facing the enterprises in the PNG case study has been the transport of timber from the forest to the ponding site (the point where

timber is brought out of the forest), and then from the ponding site to the processing site and market, due to the difficult terrain and lack of infrastructure in the project area. The enterprises are currently carrying planks by hand from the forest to the ponding site at the nearest road or beach access point. This restricts timber harvesting activities to areas that are 500 m or less from these points. Groups now say that they want to develop roads and get trucks or skidders to ease the burden. This has many important economic and ecological implications, as discussed below. Groups are also finding it hard to transport their timber from the ponding site to the market. A few of the enterprises are located near road access and are using PHF-owned trucks, which may not be a sustainable means of getting future timber to the market. Other enterprises which do not have road access are shipping timber by barge, but this is also problematic as the shipping companies tend to be unreliable and it is difficult to load the barges in times of heavy surf.

In the Indonesia case study, transport of logs along the river poses a similar problem. Here, however, the problem is easier to solve, because the flat terrain of the proposed timber harvesting site will make it possible to combine the traditional wooden rail extraction system with portable steel rail lines to bring the logs to the river. Since the local community has been using a manual transport method for years, they will probably be willing to continue doing so. In addition, the presence of the river makes it possible and economical to raft the logs from the ponding site to the sawmill, and then to load sawnwood directly onto boats that will carry them to markets or secondary processing sites in Java.

Summary of technical issues that need to be considered in developing CTP enterprises

Selection of appropriate technology
- Is the technology being considered appropriate to the conditions at the site?
- Is it possible to adapt currently existing local technology to meet the needs of the enterprise? What levels of capital are required to do this adaptation?

Maintenance and repairs
- Can the technology be maintained in the field?
- Are parts and skills readily available?
- Are repair and maintenance skills easily transferable for new technologies?

Transport
- How will the timber be transported from the cutting site to the ponding site?
- How will timber be transported from the ponding site to the points of processing and sale?

Financial and economic factors

Developing steady and positive cash flows

A major challenge facing many of the enterprises in the PNG case study is simply keeping the business financially solvent. Many of the other factors described above and below conspire to drive these enterprises 'into the red'. At one site, the enterprise has trouble obtaining the spare parts to keep the mill running. At another site, the manager has trouble keeping accurate books, tracking costs, and obtaining cash payments for timber sales to local residents. And at a third site, there are difficulties transporting the timber to market. All of these problems mean that the enterprises often do not have the funds to meet their expenses and need to rely on subsidies from either outside funding sources or from employees working on credit. The managers of the enterprises are also often entering into a business for the first time and thus face considerable challenges in learning bookkeeping, banking, and other basic business skills.

In the Indonesia case study, the problems are likely to be much the same. Here, however, the larger scale of the community enterprise and the on-site presence of trained (and externally subsidised) managers may help alleviate some of these cash flow and management problems in the short-term. However, in the long-term, the enterprise will have to generate revenues to compensate for these subsidies.

Opportunity costs of labour and resources

Another major challenge faced by the enterprises in the PNG case study is the need to keep production costs down, especially given the relatively high cost of labour in the country. Owing to social dynamics, there is some pressure to have more people involved in the enterprise than might be justified on a pure financial efficiency criterion. In addition, since in PNG most people have access to land to grow basic subsistence foods, people do not feel compelled to do demanding physical labour like cutting or hauling timber. As a result, people often require relatively high salaries (at least by developing country standards) to create enough of an incentive to participate in the timber enterprise. Furthermore, most landowners currently have an alternative source of easy cash money: selling their timber rights to the large foreign timber companies. Thus people are asked to choose between working hard to earn their money (with payment only coming months or even years later) or simply signing over the land and resource rights to a large company to gain money upfront (albeit a fraction of the timber's overall value). This is a difficult decision, especially when combined with the fact that people have high implicit social discount rates that bias action towards the present.

In the Indonesia case study, the situation is slightly different. The LTFE project is also under pressure to hire more people than might be justified on a financial efficiency criterion – in this case the many people who otherwise would be engaged in uncontrolled, sometimes illegal logging. But, given the chronic levels of under-employment in the region, wages are lower and villagers tend to be more willing than in PNG to work hard for relatively less money. Furthermore, at this point, many of the households in villages around the Park have few employment alternatives other than subsistence farming (which does not provide quick cash and is also very labour intensive) and working in industrial logging camps in the debt peonage system described earlier. They do not have, however, the option of selling the timber since they do not control it. This lack of control increases the pressure to harvest the resources today before someone else does. In addition, as in PNG, the residents of West Kalimantan have high short-term social discount rates which means that people are biased towards quick returns.

Local versus overseas markets

Yet another major challenge for the enterprises in the PNG case study lies in marketing the timber. Initially, PHF and its community partners planned to market the timber overseas. Two of the sites obtained provisional certification from the

Forest Stewardship Council, which in theory enables them to sell the timber to the 'green market' for a premium price. In practice, however, there have been a number of problems in doing so. First, overseas buyers are looking for only the highest quality wood that is free of any defects and sawn to very specific dimensions. It is difficult for community-based sawmills to meet these standards. In most cases, the wood needs to be resawn by a central processing facility and, even then, only between 10 % and 20 % of the timber is suitable for export. Second, overseas buyers are generally looking for large orders – hundreds or even thousands of cubic metres of wood per shipment – which the community mills simply cannot meet. Third, it is very difficult to obtain premium prices for even certified wood – at best, it provides a 'hook' for selling wood at competitive prices. It is thus hard to justify the certification, which costs around US$ 12,000 every few years. The enterprises have thus decided that they are better off, at least in the initial phases of the project, concentrating on local markets in the communities themselves and in the provincial capital. Even so, PHF is serving as the primary buyer of the communities' sawnwood, and is, therefore, subsidising the enterprises by providing transport for the wood and by providing a guaranteed market, two conditions which are not sustainable in the long run.

In the Indonesia case study, the project also plans, at least initially, to concentrate on domestic markets. The project will begin by focusing on marketing sawnwood rather than incurring additional risks in buying equipment and training people in the communities for secondary processing (e.g. furniture, moulding) and in developing new markets for these products. Timber will be sawn to meet specific orders and then shipped to markets in Central and West Java. There has been some progress in identifying market links to Western Europe, where the demand for 'green' products is high – the project is hoping to begin these sales in the next couple of years. As in the PNG case, LTFE staff will have to take the lead in developing market linkages, at least in the near-term.

Summary of financial and economic issues that need to be considered in developing CTP enterprises

Developing steady and positive cash flows

- Can the enterprise show a profit and, if so, when?
- Can the enterprise maintain positive cash flows without subsidies from outside sources?
- Can the enterprise managers develop sufficient business skills?

Opportunity costs of labour and resources

- How do the opportunity costs of labour affect the enterprise in terms of local people's willingness to do heavy labour?
- What other opportunity costs do people face in terms of participating in the enterprise?
- How high is the social discount rate and does this affect people's willingness to participate in long-term timber projects?

Local versus overseas markets

- What markets are available to the proposed enterprise? What prices will the buyers pay?
- Are there ways of marketing products that are processed locally to capture added value benefits? Is the investment required to do so worthwhile?
- Does the enterprise have the capacity and quality control systems necessary to service international markets? Do the anticipated revenues from the international markets justify the increased expenses inherent in reaching them?
- Is there a 'price premium' or at least enhanced marketing opportunities available for certified woods either domestically or internationally? Do the anticipated revenues from 'green marketing' justify the cost of certification?

Legal and political factors

Legal ownership of timber rights

In PNG, the national constitution grants local clans the rights to land and above-ground natural resources. There are often problems when land is disputed between the members of different clans or sub-clans. Nonetheless, the rights clearly belong to the local people. Furthermore, the PHF project has taken advantage of forestry regulations that make it relatively easy for the landowners to form small logging enterprises that can produce up to 500 cubic metres per year.

In Indonesia, by contrast, the government holds all legal rights to the country's forests. While villagers are often given conditional access to some resources in the forest, they are not permitted to legally own trees or to cut, process, and sell timber.

Only the government can provide permits for these activities, and it usually assigns such rights to larger-scale, industrial concessionaires. This has presented both an opportunity and a major impediment to the LTFE project. On the one hand, the project potentially represents the first time the Indonesian government will give legal permission to a community entity to manage a concession, operate a sawmill, transport wood for sale, or market wood freely on the international or domestic market. On the other hand, the project team spent over two years trying to finalise a Memorandum of Understanding (MOU) with the government that would give the project permission to organize a community entity with legal access to the forest. Owing to the precedent-setting nature of this venture, both the government and the project may be taking unusual care in the development of this particular agreement. Nonetheless, the process has been a long and sometimes difficult one for project staff and the community members. And the project implementation phase will require additional investments from project staff and Ministry of Forestry officials to develop and revise regulations appropriate for CTP.

Political pressures

In PNG, although the government supports the needs of local community landowners in principle, in practice large industrial logging companies wield enormous power in the government. Corruption is endemic and there is often substantial political pressure to support the industrial logging efforts at the expense of community ones. The village enterprises have thus received little support from the government.

The situation is similar in Indonesia. Because the timber industry there is so large and lucrative, institutional, political and personal forces often conspire to work against more sustainable cutting methods and technologies, particularly where small-scale community forestry projects are concerned. There is, however, some evidence that these political pressures are easing a bit. In particular, some departments within the Ministry of Forestry seem genuinely interested in promoting more responsible use of timber resources. Several concessionaires have had their licenses revoked in the past year, and, in addition to the LTFE project in West Kalimantan, there are other community timber harvesting projects being initiated by concerned organisations in Sumatra and East and West Kalimantan. Still, much work remains to be done.

Summary of legal and political issues that need to be considered in developing CTP enterprises

Legal ownership of timber rights
- Who currently owns the legal rights to harvest timber resources?
- Is the enterprise able to get authorisation from relevant government agencies to harvest timber?

Political pressures
- What are the political realities that determine whether the enterprise will receive support from the government?
- Do established interests have the power to disrupt community efforts that they perceive as threatening?

Social factors

Competition between social factions

In the PNG case study, one of the major issues facing the project staff is the need to balance complex interactions within and between clan groups. All activities in the project sites take place in the context of a long history of interactions between members of different clans who, in the not too distant past, were often mortal enemies. Members of different clans tend to be very suspicious of one another and jealousies can quickly arise if it is perceived that one group is receiving preferential treatment from project staff. At the same time, it is difficult to get members of different groups to work together. Indeed, in some of the more successful enterprises, the business has been controlled by the members of one clan or sub-clan. In these cases, there has been less internal friction but more external friction – for example, sabotaging equipment by putting water in sawmill fuel tanks. In other sites where there were attempts to include representatives of several groups, there has been more internal friction, especially where there is no strong leader.

In the Indonesia case study there are similar problems, but between different social and economic factions of the community rather than between clans. The forest resources have traditionally been exploited by the poorest Melayu residents who have no alternative livelihood sources. Middle class Melayus and Javanese/Balinese transmigrants and Chinese have not traditionally used the forest resources. The wealthiest store owners from all three ethnic groups, however, have

benefited from the forest by bankrolling the current debt peonage harvesting system. Although the project is attempting to work with the poorer Melayu groups, these groups may face some competition from the wealthier residents.

Distribution of benefits

In the PNG case study, some of the biggest problems have come once the enterprise starts to make money. Financial success can often aggravate rifts within and between clans. For example, at one site, the project manager and a few of his close relatives have benefited whereas other community members have not, leading to heated arguments among clan members. At another site, however, the clan operating the sawmill has been very focused in obtaining the funds necessary to purchase back rights to their traditional lands that they sold to an outsider in the early part of the century. They have pooled their benefits from the project and are now completing the purchase of their ancestral lands.

In the Indonesia case study, the project will encounter similar difficulties. Once the MOU is signed, it will become a priority to establish an organised community entity. This group will hold the legal rights to harvest timber in the concession. It will also ensure that financial and other benefits of the project are a) not concentrated in the hands of a few individuals, and b) not so diffuse that anyone living in the villages around the project site can lay claim to the cash generated or the training offered. This entity will also be expected to minimise the 'magnet effect' by which 'outsiders' are attracted to the site to claim a share of the benefits or to usurp control and authority.

Summary of social issues that need to be considered in developing CTP enterprises

Competition between social factions

- How homogeneous is the community that is setting up the enterprise?
- Does it make more sense to try to work within or across current social structures?
- Who in the community will control the enterprise?

Distribution of benefits

- How will benefits from the enterprise be paid out? In cash as wages or dividends? As a lump sum for community projects?
- Who will be eligible to receive these benefits?
- Is it necessary to restrict access to the project benefits to avoid the magnet effect? Is this feasible?

Sustainability and conservation factors

Harvesting design and rotation times

In the PNG case study, the groups are using walkabout sawmill technology that in theory enables the groups to move around in the forest taking a tree here and a tree there, thus mimicking natural gap formation. In addition, sawing the timber *in situ* using walkabout sawmills minimises both the impact required to remove the wood from the forest and the nutrient loss from the soil. Finally, since the sites are geologically very young landscapes that are prone to landslide disturbance, they should be more adaptable to regeneration. In practice, however, groups have been hampered in their ability to selectively harvest trees by the need to be near road- or beach-heads necessary to transport the timber. Most groups are thus currently using their mills near settlements to clear-cut forests that would be felled anyway to produce subsistence gardens. Groups are also considering building roads to improve truck access to more remote sites. Construction of these roads would require groups to intensify their harvesting efforts to justify the expense of these roads. The one advantage the enterprises have, however, is that the large areas of forest land that they have to work with means they can have very long rotation times.

In the Indonesian case study, project staff have developed a harvesting strategy that involves cutting timber from thin, pre-delineated strips on a rotating cycle. These strips will be positioned perpendicular to the river. Project staff estimate that just 1 - 2 % of the forest should be significantly disturbed in any given year. The

traditional rail system will minimise impact on the soils and 'weedy' tree species will be used to construct the rails themselves. As a result, the strip cutting system should allow for natural regeneration of harvested species. This regeneration will be augmented by replanting of select wildlings including especially *Tetramerista glabra*, which is both a valuable timber tree and a keystone resource for orangutans and other large vertebrates. At projected extraction rates, communities will be able to harvest timber on a 60 - 100 year rotation cycle.

Interactions with wildlife

In the PNG forests, there are generally fewer large arboreal mammals such as primates, which implies that there will be less of an impact on animal populations as a result of small-scale timber harvesting. Furthermore, the individual clan members have good knowledge of the forest and value the wildlife as a food and/or aesthetic and spiritual resource more than 'outsiders', thus making them more willing to plan their timber harvesting actions to minimise disturbance to wildlife. For example, in one instance, community members took care not to cut down a large tree in which a hornbill pair was nesting until after the chicks were fledged. The group also left a buffer ring of a few trees around the nesting tree so as not to overly disturb the birds. However, this intimate knowledge of the environment can also just as easily have a deleterious effect on wildlife. In another community, for example, people deliberately went out of their way to cut down an emergent walnut tree in which large numbers of parrots traditionally roosted, citing as their incentive the need to keep the parrots from eating the cacao beans in their nearby plantations.

In the forests in West Kalimantan, there are more large arboreal animals and thus presumably a greater likelihood of disturbance. To limit this disturbance, the project plans to leave residual trees in strategic areas in the harvested strips that will enable arboreal animals to cross the logged areas. Furthermore, by enriching the forest with key species, the project hopes to provide important food and habitat to species like the orangutan.

Summary of sustainability and conservation issues that need to be considered in developing CTP enterprises

Harvesting design and rotation times

- What steps can be taken to improve the sustainability of timber harvesting? How easy is it to implement these steps in practice? Do they make economic sense?
- How does the harvest rate compare to the regrowth rate? What is the anticipated rotation time for regeneration of commercially viable species?

Interactions with wildlife

- What are the impacts of timber harvesting on wildlife?
- What indicator species can be tracked to monitor the effect of these impacts?
- What economically and practically feasible steps can be taken to mitigate these impacts?

Discussion

Based on the case studies outlined above and other examples of community-based timber production from around the world outlined in Table 1, we can start to address the three questions posed in the introduction to this paper.

Can CTP enterprises be technically, financially, politically, and socially sustainable?

At the most basic level, before we can worry about the impacts of community-based timber harvesting enterprises as a conservation tool, we first have to determine if they can simply work as enterprises. As described above, there is no doubt that these enterprises are beset by a vast array of challenges:

- organisational problems in getting a village to agree to embark on such an enterprise in the face of high opportunity costs;
- legal problems in obtaining government approval to access forest resources;
- training problems in developing the requisite skills of workers employed by the enterprise;
- technical problems in determining what equipment to purchase and how to keep it working;
- transport problems in getting the timber out of the forest;
- marketing problems in finding buyers who will accept limited quantities of the

product;
- social problems in keeping community members involved in the enterprise;
- political problems in dealing with economies that provide perverse incentives for activities of large companies against which the projects are competing;
- financial problems in keeping the enterprises solvent.

Even if all these problems are solved, the enterprises can be destroyed by success if there are disagreements as to what to do with the profits.

Solving these challenges requires work that is not directly related to conservation. But if the enterprises are not technically, financially, culturally, and institutionally sustainable, then there is no chance for them to contribute to conservation. And at this point, the evidence is at best mixed as to whether these enterprises can solve these problems, especially without support from outside organisations. In the PNG case study, although a few of the groups seem to be operating close to fully sustainable enterprises, others are stymied by the many problems that they face. And in the Indonesian case study, after more than two years of work, the project is still merely trying to work out an agreement with the government that will let the community get legal authorisation to harvest timber.

In a similar fashion, many of the CTP enterprises from around the world outlined in Table 1 have struggled to solve these basic problems. For example, the Yánesha Forest Cooperative Project in Central Selva, Peru, collapsed largely because the project was 1) dependent on outside support, 2) too complex for the local people to manage, 3) hindered in being able to transport timber to market, 4) unable to successfully find markets for its timber, and 5) subjected to the political and economic instabilities of the region (Benavides and Pariona, 1995; Hartshorn, 1995). Likewise, the Vanuatu Small-scale Sawmill Programme found that five out of eight walkabout sawmills were not functioning due to operational problems including other demands on sawmill operators' time, friction in the community, and local social conflicts (Wyatt, 1996).

Indeed, the challenges faced by these CTP businesses are common to all conservation-oriented enterprises. The Biodiversity Conservation Network (BCN) has found that few, if any, of the enterprises that it supports will be self-sustaining with no external subsidies after three years.

In the United States, which has a well developed infrastructure, a population that is experienced with a cash economy, and established markets, approximately one out of every seven newly formed businesses survives beyond five years. By contrast, BCN and its partners are sailing in uncharted waters, developing new businesses in remote areas with limited infrastructure and with people who are, in many cases, entering into a cash economy for the first time. These businesses must not only be financially self-sustainable, but ecologically and socially sustainable as well. These are serious challenges and we cannot expect that all projects will make it (BCN, 1997a).

Clearly, the answer to this first question concerning enterprise sustainability is that, at best, it will only be achieved in some cases and, at least in the initial phases of the enterprise, with some degree of subsidy.

Can community-based timber production be ecologically sustainable?

Assuming that viable CTP enterprises can be established, the next question is can they deliver on the elusive grail of ecological sustainability? Sustainability certainly seems to have escaped industrial loggers – in the early 1990s, it was estimated that less than 0.1 % of tropical logging is done on a sustained yield basis (Worldwatch Institute cited in Bray, 1991). Similarly, Hartshorn (1995) has stated that 'almost by definition, industrial harvesting of tropical timber is not sustainable'. Should we thus expect community-based timber harvesting enterprises to do any better?

Since community-based systems by definition use simpler and more labour-intensive technologies than industrial ones, we might assume that they will have less impact on the forest. And since communities that have control over the forest rights would, presumably, be interested in multiple harvests, they may be more inclined to practice sustainable forestry techniques such as directional felling, cutting lianas, maintaining seed trees, following through on replanting efforts, and cutting trees on sufficiently long rotation periods so as to guarantee future harvests. But local people have to have the knowledge and incentives to act in a sustainable fashion.

There are certainly tremendous challenges to overcome. In many cases, people may not know what steps are required to achieve sustainability. Or even if they have the knowledge, then despite the best plans and intentions, economics and human nature

conspire to make it tempting to take short cuts that decrease sustainability. In the words of one author describing a project in the Solomon Islands:

> 'Although the programme was about 'sustainable' forest management, there was a natural preference for 'convenient' forest management – for instance milling the nearest big tree and then the next nearest one'
>
> (Schep, 1996)

And finally, even if people are willing to take the extra steps to try to set up sustainable systems, there are still problems with monitoring impact in a cost-effective fashion to show that sustainability is occurring, especially within the relatively short time-frames over which these projects are funded and implemented (Margoluis and Salafsky, 1998).

So far the evidence from the projects is at best mixed as to whether these enterprises can attain sustainability without support from outside organisations. In the PNG case study only one group is actually moving its mill around the forest instead of clear cutting forests for agricultural gardens. And even this group is running into transportation problems that will force it to build a road to access timber supplies and thus limit their mobility. In the Indonesian case study, although the project has designed a seemingly sustainable timber harvesting scheme, it has not yet been tested and, in any event, is only made possible through substantial scientific and technical subsidies provided by the LTFE project team. And few if any of the other CTP projects we surveyed have fully documented sustainable harvesting systems.

The answer to this second question concerning the prospect of ecological sustainability is thus, that it can be achieved only in very limited cases and with substantial subsidy from outside sources.

Can CTP systems contribute to conservation?

Although the previous two questions are important from the perspective of long-term sustainability, in many ways they are less critical than the question of whether CTP enterprises can serve as a conservation tool. The greatest threat to the world's forests is not the loss of individual trees – it is the wholesale clearcutting of forest habitats for conversion into agricultural plantations, or worse still, into wastelands. At the very least, in areas where these major threats are imminent, we need to buy

time for these forests until longer-term solutions can be developed (van Helden, 1996).

Community-based timber harvesting is, by definition, practised by local people who own the rights (or at least legal, temporary access) to the timber resource. It is carried out on a smaller and less capital-intensive scale, and seeks to add value to the timber harvested and the products made from it. As a result these enterprises may be able both to persuade and empower the community to take the steps required to reduce internal and external threats to the forest resource. The hope is that communities can set up a system of adaptive management in which they can identify threats, respond to them, and then monitor the landscape to see if new ones develop (Margoluis and Salafsky, 1998).

In this regard, the evidence from the case studies seems promising so far. In the PNG case study, almost all of the villages working with the project have so far resisted the extreme pressure to sell their timber resources to the commercial logging companies. And in each of these villages, local community members point to the income that they receive from their sawmill as one of the key factors driving their decisions. In the Indonesia case study, the enterprise has not yet been implemented. But if it works as planned, it will contribute to conservation by providing 1) keystone swamp forest habitat to the animal populations in the National Park, 2) spatial buffering protection to an exposed flank of the Park that has suffered severely from fires during recurring El Niño linked drought periods, and 3) economic buffering to the Park by employing the same villagers who have been doing much of the illegal logging in the past (MacKinnon *et al.*, 1986).

In a similar fashion, the other projects we have examined from around the world indicate that CTP enterprises can reduce threats to forest. For example, a review of ecoforestry in Vanuatu concluded:

> ‘Small sawmilling is frequently the only way that local people have of generating reasonable levels of income from their forest resources, given currently existing markets. As such it can be an important interim measure, giving forest-owning communities the time and the money that they need to consider alternatives to large-scale logging.’ (Wyatt, 1996)

And on the other side of the world in Mexico, it was estimated that in 1990, 70 %

of current forest lands were held by communities or agrarian collectives (Bray, 1991).

So although CTP enterprises may require some subsidies and may or may not be ecologically sustainable, it does seem safe to say that these enterprises can indeed contribute to conservation by helping to meet large and immediate threats to the forest.

Conclusions

Based on our experiences in PNG and Indonesia and our understanding of other similar projects around the world, we are confident in stating that CTP enterprises should be an important component of the conservationist's tool kit. This is not to say that they are a perfect substitute for other strategies in the tool kit such as protected areas, policy reform, or conservation education. But they can be an important complement to these other tools if used in the appropriate situations.

In particular, it seems that CTP enterprises will be most useful as a conservation tool at sites where the forest is faced with massive threats from outside sources and where providing the community with sustained income seems likely to overcome the threat. In addition they are mostly likely to succeed if it is possible to implement them with some outside subsidy (at least in the short to mid term), especially in terms of logistical support and in marketing the timber.

To make CTP enterprises even more effective, we need to improve our understanding of these systems by trying them out and by experimenting with them. In particular, we envision five key research topics:

- What scale is most appropriate?
- What structure is most efficient?
- Do these enterprises make sense at small levels like the walkabout sawmills in PNG?
- Or should they be implemented on more intermediate scales such as in the Indonesia case study or the proposed TNC project in PNG (Ginn, 1997)?
- Should they be organised as a group of small businesses feeding into a centralised marketing unit or as stand-alone entities?

There is probably no one answer to any of these questions that will apply across all sites, but there may be important lessons we can learn about which scale and structure of CTP enterprises is most appropriate where.

What obstacles exist to making these enterprises work? What catalysts exist that can overcome these obstacles? In the section on factors affecting community-based timber production enterprises, we outlined a number of different issues that we have encountered in dealing with the enterprises at our case study sites. We believe that through our collective experience with these projects, we can develop general and yet non-trivial principles for dealing with these issues. For example, we might develop new cutting technologies, new ways of working with and providing requisite skills to community members, new financing mechanisms, new markets, new rotational cutting cycles, or new markets grappling with the opportunities and difficulties of eco-labelling, environmental price 'premiums' and 'green markets'.

What level and kind of subsidy will be required and for how long? It seems likely that some form of subsidy will be required at least to start most CTP enterprises. It would be helpful to know more specifically what this subsidy will entail under different conditions so that conservation projects can plan accordingly.

What are the trade-offs between short-term financial profitability and long-term ecological sustainability? The financial viability of a CTP enterprise is closely related to sustainability and conservation issues such as the ecological damage done to forest habitat during extraction, the proportion of the managed forest area disturbed annually, and the rotation cycle. It would thus be helpful to develop an understanding of the financial and conservation implications of different management options in different ecological and economic contexts, focusing in particular on identifying 'win-win' situations.

How do we monitor and assess the progress of these projects? Monitoring is vital to both documenting the impact of projects and learning how to improve them (Margoluis and Salafsky, 1998). We need to develop tools to help these projects define success and learn from their mistakes.

If we can answer these questions, we will be in an even better position to make decisions as to when and how to use chainsaws as a tool for conservation.

Acronyms

BCN	Biodiversity Conservation Network
BSP	Biodiversity Support Program
CTP	Community-Based Timber Production
LTFE	Harvard University Laboratory for Tropical Forest Ecology
GoI	Government of Indonesia
MOU	Memorandum of Understanding
PHF	Pacific Heritage Foundation
PNG	Papua New Guinea
TNC	The Nature Conservancy
USAID	United States Agency for International Development
WRI	World Resources Institute
WWF	World Wildlife Fund – US

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