IS NATURAL FOREST MANAGEMENT A VIABLE LAND USE OPTION IN A COLONISATION ZONE IN BOLIVIA?

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Executive Summary

This study assesses the comparative advantage of land use options faced by small farmers in a colonisation zone, including the management of small forest blocks by community and farmer groups, and develops a methodology that enables such groups to calculate their log production costs and negotiate better log prices with the local forest industry. It forms part of the wider DFID Forestry Research Programme study 'The Economic Analysis of Stakeholder Incentives in Participatory Forest Management'. The fieldwork was carried out in two periods in May and July 1999.

The 1994 Popular Participation law and the new Forestry and Land Reform laws approved in 1996 have created the opportunity for small colonist farmers to manage up to 3 million hectares of lowland tropical forests. Both the Centre for Tropical Agricultural Research (CIAT) and the Research and Promotion Centre for the Peasantry (CIPCA) have started to promote forest management as an option for diversifying farm incomes, and as an escape route from the forest fallow crisis faced by these farmers on the agricultural frontier. But the lack of information about the expected costs and benefits to community and small farmer forest management inhibits the extension efforts of local NGOs. The Superintendencia Forestal (SF) is concerned whether the new Forestry law and regulations will provide sufficient incentives to community groups and farmers.

The research was carried out with four communities in the El Choré colonisation zone in the Santa Cruz Department of Eastern Bolivia. In these communities small farmer forestry groups have been helped by CIPCA to prepare forest management plans. The SF has approved these plans, but at the time of the study only the 'El Recreo' community had commenced logging. Working with key informants identified by the forestry groups, the research team estimated the cost and income flows from the main land uses options in the area – namely rice production (manual and mechanised), small-scale cattle production, and natural forest management. PRA-style activities were held in the communities to gauge local perceptions with regard to the sources of cash incomes and the benefits derived from on-farm forests, as well as to better understand changing factor scarcities. A workshop was organised in order to estimate the costs of forest management (including transaction costs), using a methodology that it is hoped will prove to be replicable in other communities.

During the spontaneous settlement in El Choré, colonist farmers were allocated 50-hectare blocks of natural forest, much of which has been cleared in order to grow food crops (for subsistence and sale) such as rice and maize, and undertake extensive cattle production. However, farmers confront low levels of fertility and high weed infestation in their cultivated plots, whilst overgrazing and poor management often results in the abandonment of pastures. The main constraints to farmers are perceived by themselves to be labour and cash, and a lack of viable options for diversifying on-farm household livelihoods. With the closing of the agricultural frontier, farmers are increasingly faced with a lack of new land to clear. In spite of these difficulties colonist settlement persists, together with increasing land accumulation and social differentiation.

Making comparisons between present land uses proved difficult first because of the variability within activities in farming systems, and second because while farmers will try to maximise returns to their scarcest factors of production, successive activities have specific and often different objectives. Households aim to achieve subsistence food production (both rice and maize) and meet cash requirements through sales of rice using the minimum amount of labour. Having met these objectives, resources will be switched to other activities. The area for manual rice production rarely exceeds two hectares because of labour constraints.

Gross margin analysis suggests that the returns to family labour are slightly higher than wage labour rates. . Mechanised rice production is limited to a small number of farmers. Returns to family labour are higher than in manual rice production, but for many farmers the high levels of risks have proved a disincentive. Mechanised production requires more inputs, and timeliness in mechanised operations. Extensive cattle production is viewed as probably the most viable activity in the reserve. On an annual basis returns to family labour may be low, but the possibility of capital accumulation (from the herd, fencing and pasture improvement) provides the main incentive to households. Farmers have received considerable institutional support: the large majority of colonists have started to build their herds through a range of credit-in-kind schemes, backed by animal health and other extension advice. Normally, households can build up a herd of up to 10 cattle within ten years.

Up to 20% of farm blocks are still covered in natural forest, and often these blocks form larger contiguous areas. Forest management offers an alternative income source to households when they join forestry groups; however, illegal logging remains attractive due to short-term cash returns. Calculations made with members of these groups show that for a 10 hectare forest block the cost of the management plan and initial logging totals Bs. 1.52 – 2.52 per "*pulgada cruzeña*" (PC) - the local timber measure - at the log landing (equivalent to US$10-18 per m3). The El Recreo community has sold logs for a price of Bs. 3.5 per PC for soft timber (US$ 24 per m3) and Bs. 4.5 per PC for construction timber (US$ 31 per m3) at the log landing. The net income from logging is equivalent to Bs. 2.28 per PC (US$ 16 per m3). But local market prices are volatile, and net income is very sensitive to log prices.

A financial cost-benefit analysis shows that the net present value (NPV) is positive for a range of discount rates and a 20-year felling cycle. For example, using a 15% discount rate the NPV is Bs. 769 (US$ 134) per hectare, and with a 25% discount rate the NPV falls to Bs. 423 (US $74) per hectare. Again, profitability is sensitive to log prices, the estimates of standing commercial volume and assumptions about forest growth. In the absence of any financial support to community forestry, real increases in market prices are crucial to forest management profitability. The low profitability of forest management is a concern., even though many farmers are partly motivated by non-economic factors. The approval of the forest management plan represents a significant step in formalising individual land title. Farmers believe that a farm with a forest management plan will have a higher market value, but there have been no cases of such sales. Concurrently, there is a degree of opposition within the farmers' unions since it is felt by union leaders that they will lose control over land transfers, and it is suggested that some union leaders linked to illegal logging operations perceive forest management as a threat.

The case study was primarily undertaken to test the usefulness of a number of economic tools in analysing stakeholder incentives in forest management. The choice of tools was determined by the objectives of the study, and the disciplines and experience of the research team. CIAT has considerable institutional experience in agricultural economics, and the use of conventional economic tools such as gross margin analysis, which can also be easily understood by non-economists. To evaluate land use options key informants were selected with the CIPCA-supported forestry groups, and focus group meetings were held with community members. Both CIAT and CIPCA promote participatory principles in their work, and support community groups. Rapid appraisal and participatory methods were, therefore, the most appropriate way to collect data and take back the analysis and results to groups. However, neither CIAT nor CIPCA has much experience in participatory economic approaches, or in assessing the financial profitability of forest management.

Unfortunately, the fieldwork was affected both by heavy rains and a strike by farmers blockading Santa Cruz. Generally, it proved difficult to organise community group meetings because of the dispersed nature of households, and the inclement weather. This and lack of skilled facilitators undermined attempts to carry out 'best practice' PRA. Nonetheless, the study was able to estimate the returns to land use options, and provide some preliminary data on the financial profitability of small-farmer forest management. A simple methodology was developed that enables forestry groups to calculate the costs of log production, including management and transaction costs. There was not sufficient time to return to these groups to discuss the results of the financial analysis of present agricultural systems and contrast and compare these with the option of forest management. More time will be needed for CIPCA and other NGOs to assist forestry groups to prepare *ex-ante* estimates of expected costs and benefits as part of forest management planning exercises, and to monitor actual costs and benefits. The study showed that the ability of the forestry groups to do these calculations should not be underestimated. When colonist farmers have their own estimates of production costs they will be in a stronger position to negotiate log prices with local sawmills.

Recent legislative and institutional reforms have been prompted in part by the recognition that forest management has not been an option for indigenous groups and small farmers. However, the present low profitability of forest management is a constraint to its adoption by them. Profitability depends largely on the local market prices for logs. Without the improved control of illegal logging there is likely to be downward pressure on prices in the long-term. Illegal logging is in part linked to unresolved tenancy issues and the status of the reserve, which causes uncertainty amongst colonist farmers. The SF and INRA have been slow to resolve the legal interpretation of land use in the El Choré colonisation zone. With forest resources owned by the state but exploited by local communities, logging companies and sawmills, there is a need to minimise conflicts of interest between these groups. The ability of the municipal forestry units to administer forests with different stakeholders and co-ordinate more closely to monitor the transport of logs and processing of logs by local sawmills remains to be seen.

CIPCA’s commendable technical work on field data collection and farmer training needs to be matched by developing within the groups the managerial skills to implement management plans and ensure an equitable distribution of the costs and benefits amongst group members. CIPCA and other NGOs should also encourage networking between groups and between municipal governments. Some of the revenue received by the municipal governments from forest taxation should be used to support such information and dissemination activities.

CIAT should produce standard volumetric tables and dendrology and develop simple field procedures for the collection of inventory data by colonist farmers. CIAT needs to seek long-term research funds to continue to maintain, measure, and analyse results from its permanent sample plots, and feed this information back to forest managers (CIPCA and other NGOs), municipal forestry units, and the SF.

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Acronyms

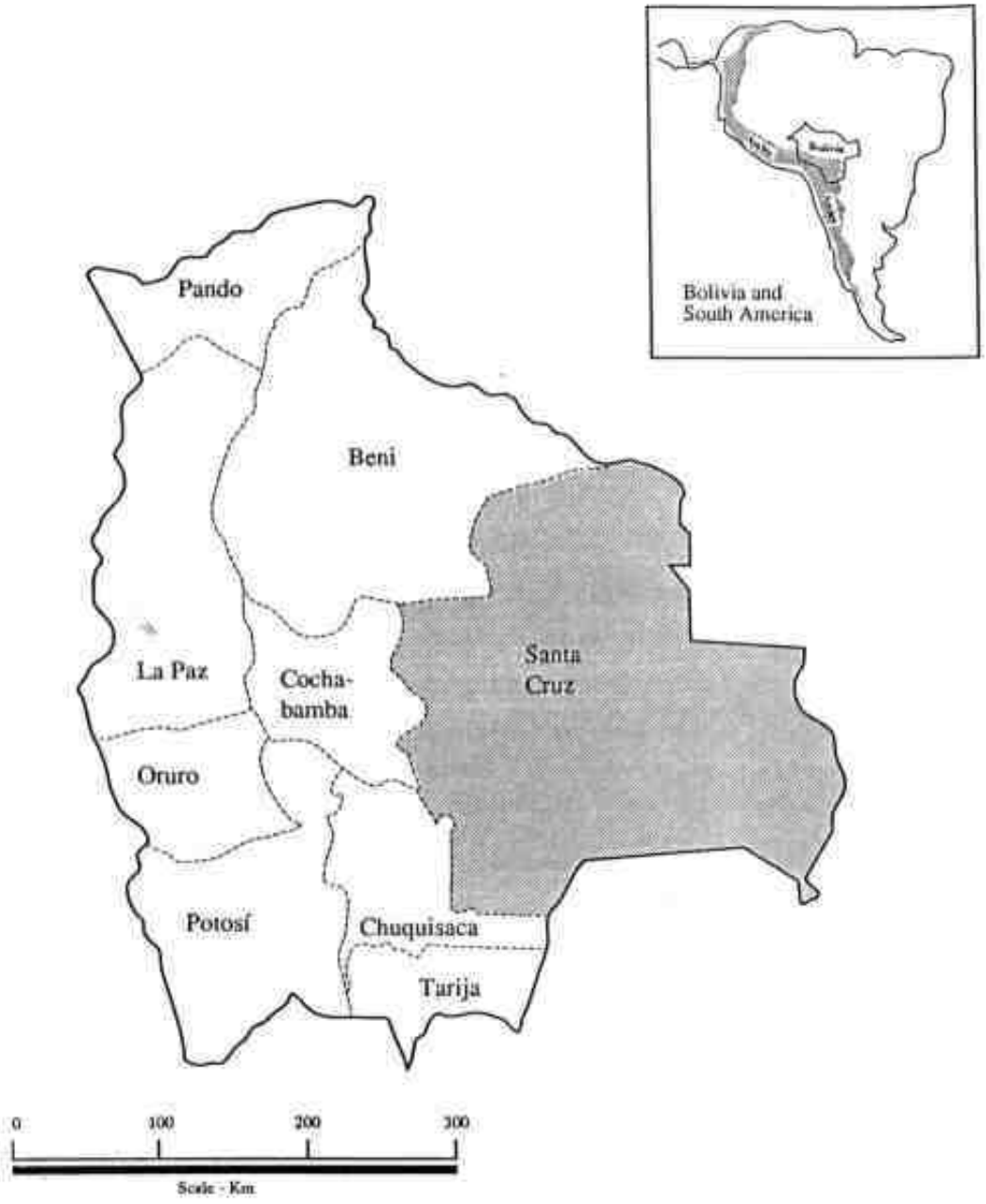
ASL	*Agrupaciones Sociales del Lugar* Local Community Groups
AU	Animal Unit
BOLFOR	*Programa de Manejo Sostenible de Bosques* Bolivian Sustainable Forest Management Project
CBA	Cost-benefit analysis
CDF	*Centro de Desarrollo Forestal* Centre for Forestry Development
CEFOR	*Certificados de Origen* Certificate of Origin (for transport of logs)
CIAT	*Centro de Investigación Agrícola Tropical* Centre for Tropical Agricultural Research
CIPCA	*Centro de Investigación y Promoción del Campesinado* Research and Promotion Centre for the Peasantry
INRA	*Instituto Nacional de Reforma Agraria* National Agrarian Reform Institute
MDSP	*Ministerio de Desarrollo Sostenible y Planificación* Ministry of Sustainable Development and Planning
NPV	Net Present Value
NTFP	Non-timber forest product
PC	*pulgada cruzeña* Timber measure for Santa Cruz area
SF	*Superintendencia Forestal* Forestry Superintendency
TCO	*Tierras Comunitarias de Origen* designated indigenous lands

Glossary and equivalents

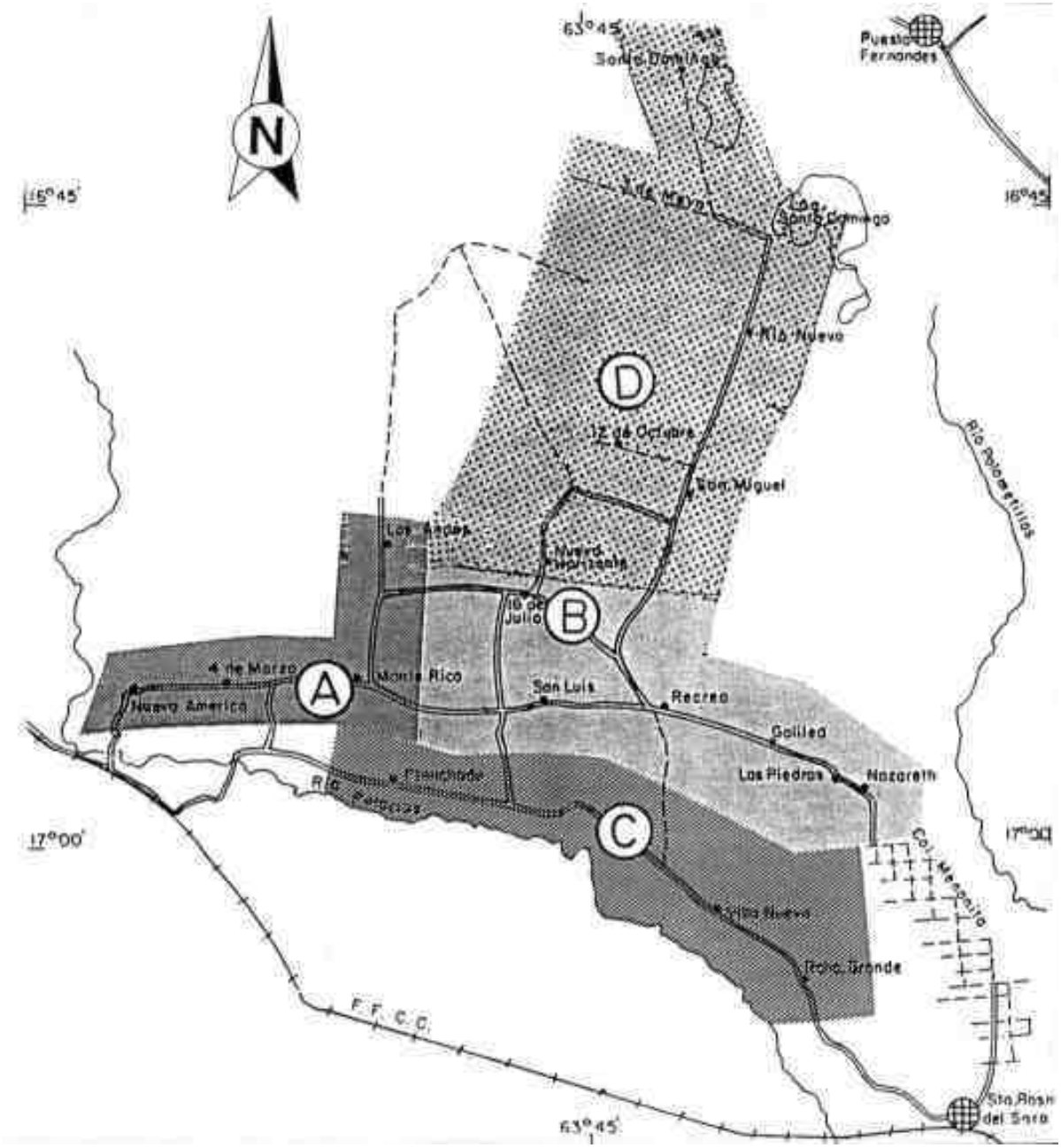
fanega	unit of measure (approximately 184 kg)
pulgada cruzeña	1 m3 = 40 PC; 1 PC = 10.6 board feet = 0.025 m3

The exchange rate at the time of the study was Bolivianos (Bs) 9.32 per pound sterling and Bs. 5.75 per US dollar.

Map 1: Eastern Bolivia

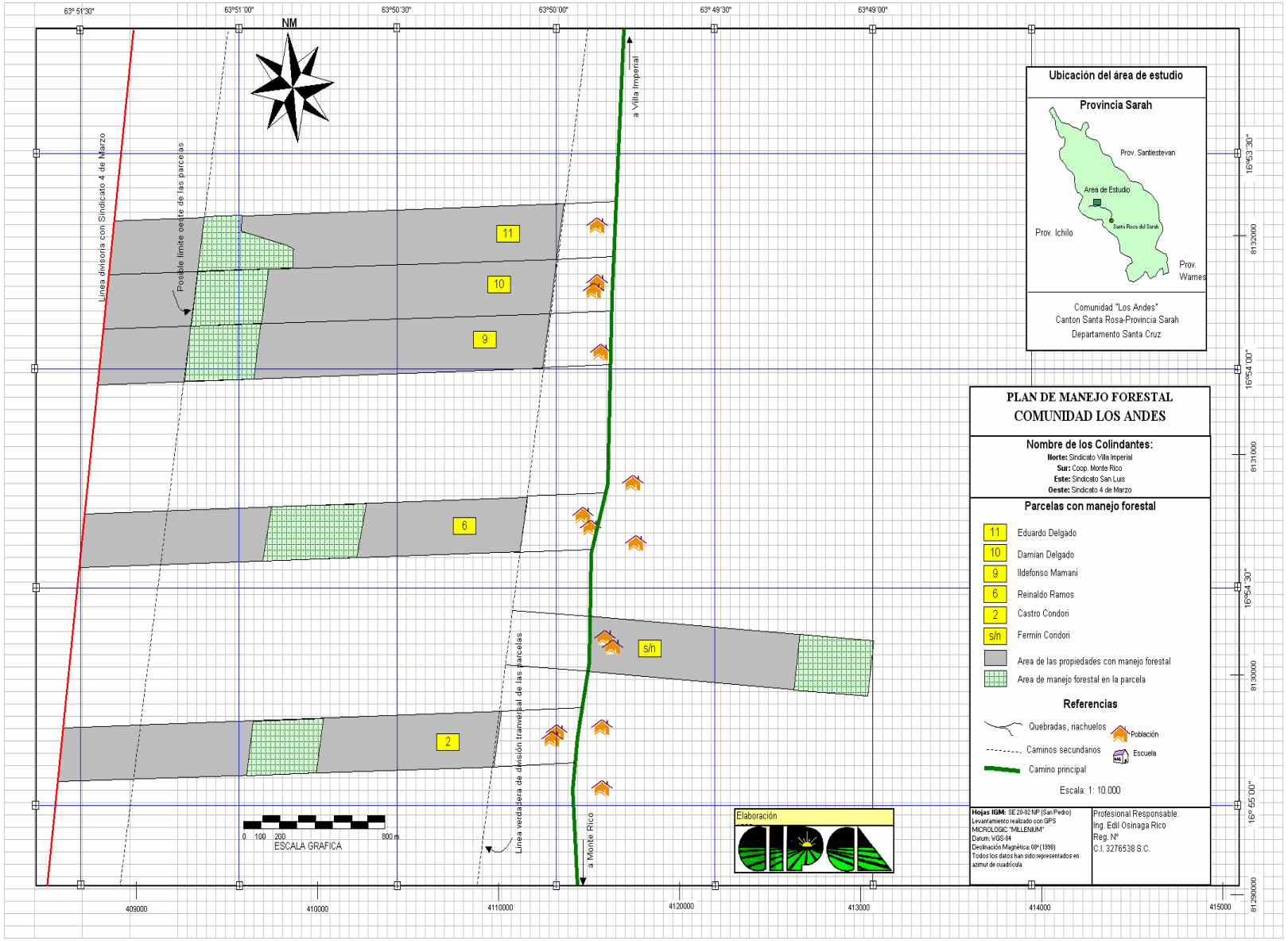


Map 2: Communities of El Choré



CIPCA 1991

Map 3: Part of the Los Andes Forest Management Plan



MAIN REPORT

1. INTRODUCTION

1.1 Background

This case study forms part of a wider research study entitled 'The Economic Analysis of Stakeholder Incentives in Participatory Forest Management (PFM)' financed by the Forestry Research Programme (FRP) of the UK Department for International Development (DFID) and implemented by the Overseas Development Institute (ODI). The study attempts to improve donor and project understanding of the economic incentives faced by different stakeholders, and in particular local forest users. The main objective of the research study is to develop a set of tools or methodological 'toolbox' for the economic analysis of PFM for use by donors and project managers throughout the project cycle. Case studies have also been carried out in Zimbabwe, Ghana, Nepal and Mexico as part of the research programme.

In the Bolivian case study the economic incentives of the different land use options available to colonist farmers are evaluated. Natural forest management is a new activity for these farmers, and accordingly a particular emphasis was given to developing a replicable methodology by which the members of forestry or 'silvicultural groups' could estimate the costs and benefits of community forestry (CF).

It is estimated that at present there are 48 million ha of tropical forest in the Bolivian lowlands: 48% of the total is located in the Department of Santa Cruz. About 12.8 million ha are within the country's 37 protected areas, few of which are effectively administered. The pressures to clear forestland have been unrelenting over the past decades in eastern Bolivia. Factors contributing to deforestation in the area include: land scarcity in the densely populated Andean highlands, the cocaine trade, and government-sponsored colonisation schemes in the tropical lowlands, which have lead to population movement. Also the growth of urban centres and the opening of international markets have encouraged land intensification and the opening of new land to alternative agricultural uses. Small farmer shifting agriculture is also a factor in deforestation (Pacheco, 1998).

Typically, colonist farmers have received land parcels of up to 50 hectares, and are loosely organised in farmers' unions. 'Slash and burn' techniques on forest land (either of the remnant forest cover or secondary regrowth) in order to produce food crops such as rice (manual and mechanised) and maize, and small-scale but extensive cattle production have contributed to deforestation. At the same time, the falling productivity of these smallholder agricultural systems has induced what is known as the secondary regrowth, or forest fallow (*barbecho*) crisis (Maxwell & Pozo, 1981). Farmers confront low levels of fertility and high weed infestation in their cultivated plots, whilst overgrazing and poor pasture management have resulted in the abandonment of pastures. As well as labour shortages, farmers are increasingly faced with a lack of land, and a lack of viable options for diversifying on-farm household livelihoods. Many abandon their farms due to this. However, other colonist farmers often replace them; commentators have noted this persistence of colonist settlement, together with increasing land accumulation and social differentiation amongst farmers on the agricultural frontier (Thiele, 1993).

Local research institutions and NGOs such as the Centre for Tropical Agricultural Research

(CIAT) and the Research and Promotion Centre for the Peasantry (CIPCA)[1] respectively have sought 'escape routes' from this crisis. Recently the focus has been on agroforestry, silvi-pastoral, and farm forestry systems. The legislative programme that started in 1994 and which includes the 1996 Forestry law, has started a process of decentralisation and popular participation, and created an opportunity for small farmers and community groups in the lowland tropics to collectively manage the remnant forest blocks on their land. A previous lack of research in small farmer forest management has been corrected by CIAT and CIPCA. The latter have been promoting forestry groups and forest management amongst colonist farmers. However, there have been few studies on the returns to farmers offered by the forest management option.

Box 1: The changing forest policy and institutional framework: new incentives for forest management?

The new forestry legislation was approved in 1996 following a wide consultative process. The new law forms part of a wider legislative reform programme introduced in the period 1993-97, which included the new Environment (*Ley de Medio Ambiente*), Land Reform *(Ley de Tierras*), Administrative Decentralisation *(Ley de Decentralización Administrativa*), and Popular Participation laws (*Ley de Participación Popular*). The latter created 311 municipal governments and widened their earlier urban jurisdiction to include all municipal territory. Together these legislative changes provide for a wider administrative participation in planning and control functions (particularly at a departmental and municipal level), and more popular participation in forest management and protected area decision-making (Pavez & Bojanic). The main features of the forestry legislation include:

- The creation of a new regulatory body, the Forest Superintendence (SF) within the Ministry of Sustainable Development and Planning (MDSP). The SF is responsible for awarding concessions and forest permits, approving management plans, and ensuring the payment and distribution of forest taxes. Also the SF oversees the operations of the municipal forest units

- A new distribution of forest tax revenues, between the prefecture of each Department (35% of the logging tax, and 25% of forestland clearance tax); municipal government (25% of the logging tax, and 25% of forestland clearance tax); the National Fund for Forest Development (10% of the logging tax plus 50% forestland clearance tax and the balance of the fines and auctions); and the SF (30% of the logging tax). Control of these municipal tax revenues is supervised in part by local grass-root bodies.

- Indigenous people have been guaranteed exclusive rights to logging in designated areas, known as *tierras communitarias de origen* (TCOs). The area logged each year rather than the total forest area is subject to a forest licence payment. No authorisation is required for traditional and domestic use of forests products if use is for subsistence purposes, either for rural population in the areas they occupy or for indigenous people within their forest TCOs.

- The responsibility for formulating and undertaking public forest research and extension has been delegated to the prefectures in each Department.

- Municipal governments have to delimit and administer public forests through local community groups - known as *agrupaciones sociales del lugar* (ASLs) - support the ASLs to prepare

[1] Founded in 1971, CIPCA aims to strengthen peasant farmer and indigenous institutions and organisations, support communities to secure land rights, and achieve sustainable rural development. More recently CIPCA has provided support to municipal governments. CIPCA's programme in El Choré started in 1981, and since 1991 it has been promoting alternative agricultural production systems (including forestry and agroforestry).

management plans, and monitor them. To undertake these tasks, the law created municipal forestry units (*Unidades Forestales Municipales*).

The impact of the 1996 forest law has been mixed. In 1998, two years after the introduction of the new Forestry law, only 86 concessions are in operation in an area of 5.7 million ha or 11.8% of the total forested land area. This represents a decline of almost 75% of the area dedicated to concessions previous to the new legislation (i.e., 22 million ha under forest concessions and some 180 companies). Previously, timber harvesting was based upon the simple extraction of logs legalised by a payment according to volume. Now, in order to harvest any forest product, an approved management plan is required. However, few of the forest concessions are logging under the new system. Because their concession agreements were drawn up the previous regime, logging can continue using exceptional permits (*planes de excepción*).

Many of the fundamental difficulties faced by the forest sector remain unchanged. Logging intensity is low because of the high transport costs, particularly with secondary species. Approximately 80% of the volume harvested is derived from 14 species, but harvesting is normally restricted to five principal species: mara (*Swietenia macrophilla*), cedro (*Cedrela* spp.), ochoo (*Hura crepitans*), palo maría (*Calophillum* sp.), and roble (*Amburana cearensis*) (CNF, 1998). Domestic markets are limited, and there is little investment in the sector and a shortage of modern technology in timber transformation.

The oversupply of 'informal' timber continues to exert downward pressure on timber and forest product prices. Recent short-term log price increases are attributable to the reduction in concession volumes, and uncertainty in the forest industry. This is prompting illegal logging and land clearance. Also the withdrawal of many forest concessions has left large areas of forestland unprotected from land use change.

There is an increasing polemic about the new forest royalty (*patente forestal*) and the regulations accompanying the forest law (published six months after the law). Transaction costs for forest management and the forest industries are perceived to be high. But the discussions between the SF, local municipal government, and the forest industry are marked by the absence of any agreed financial information about profitability in the forest sector.

Municipal governments with substantial public forest resources are probably those most likely to be dominated by the informal forest sector (loggers and sawmills) and only at best disinterested in opening a new space for indigenous groups, or colonist farmers. Although a total of Bs.12 million ($US2.14 million) was received by municipalities with forest resources, by mid-1999 only 15 municipal forest (production) reserves had been created, and 10 ASLs approved by the MDSP. A key limitation of the new decentralised approach remains the lack of clearly delimited municipal forest areas, and the difficulties faced by the Land Reform agency (INRA) in resolving tenancy and access issues. The institutional and technical capacity of municipal governments to tackle forest management issues is also likely to be limited in the foreseeable future (Kaimowitz et al., 1999), although a number of bilateral projects like BOLFOR (the Bolivian Sustainable Forest Management Project) and NGOs are providing assistance, including CIPCA in Santa Rosa.

The economic analysis of land use options is an important tool for designing effective project and policy interventions to alleviate poverty. Also, a greater awareness and transparency of the benefits and costs of forest management can contribute to improved and informed decision-making by stakeholders (policy-makers, forest owners, the forest industry, etc.). For colonist farmers, for example, a better quantitative assessment of product flows and benefits from their forests can be used as to negotiate improved log prices with local sawmills and loggers, and so encourage more farmers to adopt forest management. It is estimated that in the tropical lowlands some 3 - 6 million hectares may be farmed by small-scale colonists and

indigenous groups, and perhaps half of this area is natural forest.

1.2 Study area

The fieldwork was carried out in a colonisation zone on the southern boundary of the El Choré Forest Reserve, Sara Province, Santa Cruz (Map 1). This permanent forest production reserve was created in 1966 (covering an area of 1.08 million hectares) as public land designated for timber concessions. The reserve comprises of subtropical humid and semi-humid deciduous forest (as defined by the Holdridge system), and falls within the Amazon basin. Neither the Centre for Forestry Development (CDF) nor its successor the SF has been able to exert effective control over logging activities or land clearance in the reserve. The opening of logging and petroleum roads and the construction of the railway to Beni were factors that contributed to spontaneous colonisation from the late 1960s. The principal settlement occurred in the early 1970s, and this often resulted in conflict (and often violent clashes) between the colonists and forest authorities. The El Choré colonisation zone is one of several colonisation zones located to the north of the city of Santa Cruz and according to the Santa Cruz land use plan may be exploited for agro-forestry purposes. The titling of farmers' plots is being carried out by INRA, and the division between the colonisation zone and forest reserve is being redefined.

Approximately 1,000 families live along the southern boundary of the reserve and its buffer zone; about 40% of the population originate from the highland departments of Chuquisca, Potosí and Cochabamba (CORDECRUZ et al, 1992; CIPCA, 1997). Cultural differences are reflected in social and economic attitudes.[2] Colonists are located in communities along previous forest or petroleum tracks (Map 2), with regular plots of up to 50 hectares (normally approximately 250 metres wide and 2,000 metres long or 200 metres by 2,500). Over time the area of remnant forest has fallen, but still represents up to 65% of the total land area (CIPCA, 1992).

The 1996 Forest Law and its regulations have provided a new institutional base for forest management with the creation of the SF. New technical norms for forest management planning have been introduced, and the municipal authorities, and local community groups are new actors in the management of the national forest estate. Essentially, the law is providing the opportunity for new interest groups to engage in forest management in contrast to logging or clearing land illegally. Three forms of forest exploitation are allowed:

- with a forest management plan, on private land, and designated indigenous lands, known as *Tierras Comunitarias de Origen* (TCOs);
- with a forest management plan, on state land with a forest concession held by a private company or an ASL;
- with a land clearance permit.

The new access to public forests for organised groups and the technical support to be provided by local municipal authorities are the most notable features with regard to the study

[2] The El Recreo community is *Guarani* in origin, and since arriving in 1979 in El Choré the community members have continued to practice agriculture collectively, and more recently begun to formally manage their single forest block. The majority of the members of other communities are '*collas*' who tend to work independently. The 'silvicultural groups' formed amongst the latter are, therefore, different.

area.[3] In the mid-1990s, CIPCA initiated a community and small farmer forest management project in El Choré forest reserve. This was the first attempt to introduce participatory forest management with colonists in Bolivia. The pilot project has been working with four communities (with a total of 40 beneficiary families) to bring 600 ha under management and to provide technical assistance to the local municipal technical unit (CIPCA, 1997; Johnson, 1997).

However, there are a number of unresolved issues. The status of the El Choré reserve and colonisation zone has created uncertainty with regard to tenancy. The SF has technically approved the CIPCA-supported management plans, but the lack of formal land titles remains a stumbling block[4]. All the CIPCA-supported management plans are for forests on private property. Also the ability or willingness of the municipalities to provide effective support remains unproven.

To date one CIPCA-assisted community has an SF-approved forest management plan and logging has commenced. This has enabled the community to negotiate improved log prices with a local sawmill owner (the price is considerably higher then the price for illegally extracted logs in the area). CIPCA has assisted other groups of farmers in three other communities (*San Luis*, *Los Andes* and *4 de Marzo*) to prepare forest management plans, which have also been approved technically by the SF (Map 3). The ability of the community members to negotiate reasonable prices for their logs depends on having adequate knowledge of costs, including transaction costs. The study aimed to develop a replicable methodology for community-level calculation of timber costs of production.

1.3 Objectives

There were two specific research objectives for this case study:

- to undertake a study of on-farm land use options in a colonisation zone, including the financial analysis of forest management of on-farm small forest blocks;

- to develop a replicable participatory economic methodology by which forest management members can calculate the returns to community forestry, to improve understanding of their costs and benefits, and negotiate better log prices with the local forest industry.

It is expected that the research will enable secondary stakeholders (most obviously CIPCA, CIAT, SF and other projects) to better understand the socio-economic constraints to profitable smallholder and community forestry.

1.4 Report structure

[3] Indigenous peoples have exclusive right to harvest in the TCOs. To date some 5 million ha of productive forests out of an estimated total of 14.5 million hectares are managed in this way (Pacheco, 1998).

[4] According to the Forest law, to qualify as an ASL a group or community must (a) have a minimum 5-years of residence in the zone; (b) have at least 20 members; and (c) be a legal entity (*personería jurídica*). Furthermore, group members must have a National Agrarian Reform Institute (INRA) land title in order for the SF to approve their management plan.

This report is divided into five sections. Section two considers the methodological approach of the study, and section three presents the results of the economic analysis undertaken. Sections four and five contain a discussion of the results and a number of conclusions respectively, from both a methodological and development viewpoint. The appendices provide a description and the economic calculations for the different land use options, the methodology used to calculate forest management costs and benefits by forestry groups, and log and timber price data.

2. STUDY METHODOLOGY

2.1 Introduction

The study attempted to follow the Economic Stakeholder Analysis (ESA) approach (Davies & Richards, 1998) by focusing on the decision-making processes of the main stakeholders and the trade-offs faced by them. But the researchers also tried to use the approach and its tools to directly support and benefit the target group – those farmers who are preparing management plans for their small forest blocks – through the development of a methodology to estimate forest management and production costs.

Accordingly, the research team employed a variety of approaches to assemble data and prepare activity budgets that reflected local practices and farming systems. Prior to the commencement of the fieldwork, primary data on local log and timber markets were collected. Information and literature were collated on the changing forest policy and institutional framework, and how this was affecting colonist farmer perceptions of the viability of forest management, and secondary data sought on farming systems in the study area and similar colonization zones. In the field semi-structured and informal discussions were held with key informants. Concomitantly, in order to feed into the preparation of enterprise budgets, focus group discussions were held with members of silvicultural groups in three communities, and PRA-type tools used to elicit perceptions of trends in the scarcity of their factor of production. Gross margin analysis was used to calculate the returns to the factors of production used in crop and livestock production, and cost-benefit analysis (CBA) techniques were used to assess the profitability of livestock and forest management. Results of the forest management analysis were taken back to a meeting of the forestry groups, and a methodology to assist these groups in calculating their own production costs developed. [5]

2.2 Selection of communities and key informants

The fieldwork was carried out with the forestry groups formed by CIPCA in the El Choré colonisation zone. Discussions on forest management were held with four groups. From these groups the farmers themselves selected a number of key informants, with whom discussions took place on other land use options. Visits were made to forest blocks and agricultural fields with key informants. Key informants identified inputs and outputs, and their costs and prices, for different land uses in order to construct enterprise budgets for the gross margin and cost-benefit analysis.

[5] At the conclusion of the fieldwork, a short presentation of the preliminary results of the study and other observations on experiences of communal forest management was given to the Social Forestry Network in Santa Cruz.

There are few women members in these forestry groups (see Box 2). Those that are members are typically widows or their husbands work off-farm on a semi-permanent basis, and consequently women only participated indirectly as key informants or in the focus groups as wives or partners.

Box 2: Women, forests and social exclusion

Women colonists are active in most agricultural activities with the exception of land clearing. Often they are responsible for small animals and small-scale cattle production, and occasionally local commercial activities such as dairy product marketing. In some areas the introduction of mechanised agriculture, which depends more on hired labour, and the more generalised use of hired labour has meant that food preparation for labourers has become an additional household task for women. Involvement in public activities (farmer unions, or NGOs) is normally low and still often token. Social mobility for the majority of women is therefore severely restricted. Many non-timber forest products have been domesticated and found around homes, agricultural plots, and orchards (Torres, 1999). Women tend to be reluctant to enter forests and at present are effectively excluded from natural forest management. Nonetheless, it was noticeable that a number of women did attend the study's PRA activities and the forest management meeting, which indicates that perhaps CIPCA's and other local NGOs' programmes are having an impact and creating new social spaces for women.

At the community-level another set of key informants were union leaders. Colonist farmers in communities in El Choré and other colonization zones are organised in farmers' unions (*sindicatos*). The unions are responsible for land allocation to households, representing the community with state agencies (for example with regard to the provision of public services) and organising community activities such as road maintenance. A number of unions make up a '*subcentral'*, which in turn are grouped into a '*central'*. In El Choré four 'subcentrales' (*4 de Marzo, Galilea*, *Villa Nueva* and *Nuevo Amanecer*) make up the *Central Unica de Trabajadores Campesinos del Norte de Santa Rosa* (CUTCNSR). The '*centrals'* are in turn grouped into Federations. The unions have been important instigators for social infrastructure and social support mechanisms, although latterly they are struggling to retain effective control or influence over land use and distribution and to maintain popular support. In part this is the result of the new administrative decentralisation and popular participation laws.
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Other key informants included officials of the SF (both in Santa Rosa and Santa Cruz), the local municipal government, and the forest industry in Santa Rosa. Subject matter specialists in CIAT directed the study team to relevant literature and reviewed the draft enterprise budgets.

2.3 Secondary data collection

Prior to the fieldwork, a search was made of secondary data sources in CIAT and CIPCA for information on the El Choré study area, as well as wider data and reports on land use change on the Bolivian agricultural frontier. The examination of crop budgets and farming systems data compiled by various CIAT research programmes complemented the production data provided by key informants. Other research and census data (CORDECRUZ et al, 1992) were used to broaden the researchers' understanding of the socio-economic development of the study area, and in particular the impact of technological and institutional changes on incentive frameworks. Time series data on crop and input prices were sought to discern market trends (CAO, various years). Given the amount of survey data available, and the staff

and time constraints of research team, it was decided not to carry out a sample survey of households as part of the fieldwork.

Historic data on log and timber prices were also analysed and compared with the market survey carried out by the study team of current prices along local marketing and processing chains. The SF in Santa Rosa collected data from eight sawmill and haulage businesses, whilst CIAT and CIPCA staff contacted farmer union leaders, silvicultural group members, and sawmill owners. There is little quantitative data on non-timber forest products (NTFPs), although Torres (1999) provides a detailed description of their use in one community group in El Choré.

2.4 Participatory research activities with key informant and stakeholder groups

Participatory activities with stakeholder groups were informal. Farmer households are located along logging and petroleum roads in a 'piano key' or ribbon development fashion rather than clustered in villages. This regular but dispersed nature made organising community meetings at short notice difficult. Farmer unions' meeting take place on a periodic and fixed date, and members are obliged to work on community projects. The research coincided with the onset of the rains and land clearing operations, and consequently not all farmers had the energy or inclination to attend the evening meetings. Another factor was that the farmers' unions are themselves also split between those who are involved in the CIPCA-supported forestry groups and those who are at best disinterested or wary of the possible implications for the farmer unions. Leaders of these unions have reportedly close relations with local sawmills who have helped build or improve roads, etc., in return for access and forest clearance. If colonist farmers gain individual land title, the unions' traditional role to allocate usufruct amongst their members will be lost.

Therefore, the PRA-type activities were not held with a necessarily representative sample of the wider communities in which they were held. The research team spent two to three days in each of communities. During the day the team split up according to their disciplines, with economists accompanying subject matter specialists on farm visits. On one evening in each community, community and forestry group members and their families were invited to meetings held in the early evening, and their time compensated to some extent by showing videos of popular Bolivian films (there is no electricity supply in the area). [6]

A number of PRA-type exercises were carried out to broaden the researchers' understanding of trends in livelihood strategies. Farmers were asked to rank and score income sources, the relative importance of forest products and services, and the scarcity of their factors of production (labour, land, and capital or cash). Local perceptions on sustainability were also discussed. It was not possible to carry out all of these exercises in each community meeting. The main benefit of the meetings was the wider discussions about the incentives for forest management.

[6] A farmer blockage of Santa Cruz caused the cancellation of one field visit, and heavy rains and flooding curtailed another.

2.5 Reporting back to forestry groups

The intention of the study team was to share the results of the study to the forestry groups. Unfortunately, the delays experienced by the research team only allowed one activity to be held with members of the forest management groups, in which the groups were assisted to calculate for themselves the costs and returns to forest management. Some 20 farmers attended the meeting (there are 23 farmers in the four CIPCA-supported silvicultural groups, and 10 families in the El Recreo community). Low levels of numeracy are always an issue in such exercises, but the approach called for only basic computational skills, and at least initially it was intended as much as a pedagogical exercise amongst and between group members and their (CIPCA) forester.[7] Following a logical sequence, the groups arrived at a cost for logs sold either in the log landing or at the sawmill gate, which could then be compared against prevailing local market prices for logs. The exercise took about three hours.

3. RESULTS

3.1 Participatory exercises

A number of PRA-type exercises were undertaken with the groups. They did not prove successful in terms of generating good quantitative information, but did provoke a wider discussion with regard to local perceptions on the changing factor scarcities and the importance of forest resources in household livelihoods.

Participants were asked to first rank their cash income sources in the past 12 months, and then score them using 50 counters. This exercise was then repeated in order to look at the importance of forest products.

Table 1. Ranking and scoring of (a) household cash income & (b) forest benefits

(a)	Cash	Counters	(%)	(b) Forest benefits	Counters	(%)

[7] CIPCA had prepared a draft manual to calculate costs and operating margins (CIPCA, 1999), but this had not been applied in the field and consequently was rather abstract. It was felt that by letting the groups share experiences and carry out the calculations themselves, a more robust methodology could be developed.

income					
Annual crops	11	22	Logs	20	40
Cattle	9	18	'Nature'	12	24
Logs	8	16	Fencing posts	5	10
Pigs	5	10	Fuelwood	5	10
Sheep	5	10	Wild animals	2	4
Chickens	5	10	Construction material	2	4
Fruit	4	8	Medicinal plants	2	4
Wage labour	2	4	Fruit	2	4
	50	100%		50	100%

The results suggest a degree of cash income diversification in the colonisation zone. Annual crops are important both for subsistence and cash sales. The sale of cattle and logs (from authorised land clearing rather than forest management) by men provide large and discrete cash amounts. A large proportion of this is usually reinvested in productive activities, whilst small stock are marketed by women to cover domestic needs and smooth household cash flows. Income from wage labour tends to be low within these forestry groups.

Logs are the main forest product sold. Other timber and non-timber products tend to be used for subsistence purposes. Since nearly all members of the forestry groups have relatively large remnant forest blocks, and extensive areas of forest fallow, there is a thin market for fence posts and fuelwood within the communities, and poor access and high transport costs preclude their sale outside the communities. There was a long discussion about the 'natural attributes' of forests. The participants decided that this included water and clean air. Bush meat is an important source of protein, and hunting a popular activity for men. But much more time is needed than previously to hunt.

Whilst there was unanimous agreement that cash was the main limiting factor for households, participants were split over the subsequent ranking of family labour and land. One group was asked how they would spend a credit of Bs.1000. There was unanimous agreement the money would be used to purchase cattle. Some sustainability issues were discussed (see Table 2). Participants were asked to distribute counters to show trends. The past and future were defined as equal (15-20 year) periods from the present, i.e. representing the earliest time when at least a few of the colonist farmers settled in El Choré.[8]

Table 2. Sustainability Trends

	Past	Present	Future
Forest 'size'	20	10	10-20?
Cattle population	0	10	20
Rice yield	15-20	10	5

The participants tended to define natural forest size on their farms in terms of log volume. This has halved in the past 15 years, since both the size of the remaining forest area has fallen and as larger trees have been logged. The future is seen as uncertain: forest management is

[8] According to CORDECRUZ (1992), in 1990 only 34% of farms were occupied by colonists who arrived prior to 1981.

seen to be an option worth exploring while there is institutional support, and this may result in improved quality of logs and the incorporation of secondary forest. Others thought that more profitable cattle production would limit any forest size increase as the cattle population continues to rise. None of the participants had brought cattle to the area when they arrived; all had acquired cattle through various credit-in-kind programmes. None of the farmers thought that rice yields could be sustained without purchased inputs, and all were wary of mechanized rice production given the indebtedness that this had caused in the earlier schemes in the area. Family livelihood considerations are, therefore, significant: the need for quick returns determines most families' perspectives, although for others longer-term capital accumulation through livestock is a part of their strategy.

3.2 Gross margin analysis of crop and livestock production

Three of the principal enterprises undertaken by colonist farmers in the El Choré are:

- manual basic grain production
- mechanised rice production
- small-scale cattle production

Because farmers practice shifting agriculture, only clearing small areas of forest and secondary forest regrowth each year, relatively large proportion of their farms remain under forest cover. When conditions permit some farmers are able to introduce mechanised rice production, again on small areas of land. Almost all colonist households have cattle and other small livestock, and farmers seek on- and off-farm employment. However, these land use options are not mutually exclusive. Rather farmers attempt to balance production and consumption objectives, determined by factors such as household size and composition, family labour availability, wealth, market access, and the availability of institutional support. Having met basic livelihood objectives, households will invest in alternative activities that yield higher returns to their scarcest resources.

To compare these returns gross margin estimates were made of these three enterprises. The gross margin calculations used the prices and variable costs faced by farmers. The quantities of outputs and inputs were obtained from key informants. Visits were made to 3-4 farmers for each production system, and discussions held in their fields. Crops and cattle sold were valued at farm-gate market prices, while outputs consumed by the household were valued according to their local purchase price. Purchased variable inputs were valued at farm-gate costs. Constant prices were used for all variable costs and outputs. Casual hired labour was valued at the daily agricultural wage.

Because cattle stocks pass from one year to another, it is necessary to distinguish between the closing valuation of stocks (including any sales of cattle or products during the year) and their opening valuation (including any purchases) when estimating enterprise gross output. Typically, cattle graze on natural pastures, and farmers slowly establish improved pasture. Gross margins per hectare relate to the area of improved pasture and not total grazing area. Fencing costs are considered a variable cost since they are incurred only as the area of improved pasture increases.

Calculations were made of annual gross margin per hectare, per day of family labour and per capital (cash costs of purchased variable inputs). Table 3 presents a summary of the principal

food crop production systems, and Table 4 summarises the returns to cattle production. Details of the enterprise budgets are presented in Appendix 1.

Table 3. Summary of Financial Analysis of Food Crop Production Systems (Bs)

	Manual Rice Production			**Mechanised Rice Production**				
Description	*Manual production of rice and maize in secondary forest regrowth (1-2 ha per annum)*			*5 years continuous mechanised production of rice (up to 5ha)*				
Objective	*Meet food and cash security requirements of household*			*Increase farm income through commercial rice production*				
Markets	*Sale of surplus rice to intermediaries at farm-gate, maize for own-consumption*			*Sales of rice to intermediaries normally at farm-gate*				
Year	**1**	**2**	**7**	**1**	**2**	**3**	**4**	**5**
Gross margin / ha	2,312	1,472	1,789	1,478	1,788	1,432	1,076	702
Gross margin / day family labour	59	50	54	53	119	95	72	47
Gross margin / cash	2.5	2.0	2.1	0.5	0.9	0.7	0.6	0.4
Sensitivity analysis:								
Gross margin / day family labour								
10% increase in input prices	58	49	53	43	106	82	59	35
20% increase in input prices	58	48	52	33	92	69	46	23
Gross margin / cash								
10% increase in input prices	2.4	1.8	2.0	0.4	0.7	0.6	0.4	0.3
20% increase in input prices	2.3	1.7	1.9	0.3	0.6	0.4	0.3	0.2
Gross margin / day family labour								
10% decrease in output prices	51	42	46	38	94	73	52	30
20% decrease in output prices	43	35	38	23	68	50	31	13
Gross margin / cash								
10% decrease in output prices	2.2	1.7	1.8	0.4	0.7	0.5	0.4	0.2
20% decrease in outputs prices	1.8	1.4	1.5	0.2	0.5	0.4	0.2	0.1

Table 4. Summary of Financial Analysis of Cattle Herd Development (Bs)

Description	*Development of cattle herd, totalling 10 cattle in 10 years, and gradual investments in improved pasture and fencing*											
Objective	*Farm income diversification, land capitalisation*											
Markets	*Sale of young bull calves and heifers to intermediaries, repayment–in-kind to NGO; sale in community of cheese*											
Year		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
Gross margin / ha		954	352	541	446	-110	323	-361	961	354	642	410
Gross margin / AU		954	271	301	178	-33	98	-129	235	63	93	203
Gross margin / day family labour		14	6	9	7	-2	5	-5	12	4	7	6
Gross margin / cash		11.3	9.1	9.7	6.1	-0.5	3.5	-4.5	7.8	1.1	3.6	4.7
Sensitivity analysis:												
NPV at discount rate (Bs/ ha)	10%	2,644		(Bs/AU)	1,783							
	15%	2,230			1,565							
	20%	1,927			1,401							
	25%	1,699			1,273							

Manual rice and maize production results in higher returns to family labour than its opportunity cost (Bs.30 per day for agricultural wage labourers). Mechanised rice production provides higher returns to family labour, and a plot can be in production for up to five years before yields fall to levels below those for manual production However, the additional cash input costs are high, as is the need for timeliness in mechanised operations. Many farmers are wary of the experience of unsuccessful mechanisation schemes. Sensitivity analysis indicates that returns to family labour and cash are robust to increases and decreases in input and output prices respectively for both manual and mechanised rice production (Table 3).

The majority of farmers consider cattle as the most attractive way to accumulate capital. Access to credit-in-kind schemes and extension support provided by Heifer Project and CIPCA has been the key feature of cattle development in El Choré, and has reduced transaction costs and risks. Table 4 shows that the returns to family labour are low, as is the opportunity cost of younger children and women's labour. Households are aware that within 10 years a small herd can be developed. Farmers are prepared to invest any gains from annual crop production in herd development (cattle and land). Sensitivity analysis for a range of discount rates shows that net present value (NPV) per hectare or animal unit remain high for the 10-year production period.

3.3 Cost-benefit analysis of forest management

Cost-benefit analysis was undertaken for forest management (and livestock) in order to assess financial returns to systems in which an initial investment is made and benefits are realised over a number of years. Costs and benefits are discounted in order to estimate the Net Present Value (NPV). Because there is likely to be a wide variation in rates of time preference rates between farmers, the NPVs are calculated for a range of discount rates. Full details of the costs and benefits are provided in Appendix 2. Table 5 shows a summary of the results of the expected profitability of forest management, both for the initial logging of the forest and the net present value of the felling cycle for a range of discount rates.

Table 5. Financial Analysis of Forest Management (Bs/ha)

Description	*Colonist farmer management of small on-farm remnant forest blocks (10 hectares)*				
Objective	*Farm income diversification, land capitalization*				
Markets	*Sales of standing timber or logs at local sawmill gate*				
Discount rate	**0%**	**10%**	**15%**	**20%**	**25%**
Net income of initial harvest (Bs/ha)	605				
NPV (felling cycle)		1,084	769	563	423
Sensitivity analysis:					
NPV (20% log price decrease)		857	610	443	328
NPV (excluding growth assumptions)		512	385	328	230

Source: Table A2.9 (Appendix 2).

A net income of Bs. 605 per ha from the initial harvest – or Bs. 6,050 per household with a 10-hectare forest block – appears to be a significant incentive to a member of a forestry

group. Returns to family labour are approximately Bs.24 per day. However, the financial profitability of forest management over the 20-year felling cycle is sensitive to log prices and assumptions about forest growth.

3.4 Forest management costs and returns

The third approach used by the study team was to assist the forestry groups to calculate themselves the costs of management planning, logging, and marketing for a typical 10-hectare forest block. The research team had already worked with key informants from each group to discuss their experiences of forest management. In this meeting a number of members from each of the groups discussed the parameters and costs of management planning and logging activities, and prevailing log prices. All four groups had prepared management plans with CIPCA, and one group had a contract with a local sawmill for their logs. The groups estimated a cost for logs sold either in the log landing or at the sawmill gate, based upon the following steps:

1. Cost of preparing management plan (10 ha forest block):
    - Farmers' time (opportunity cost) in data collection, and seeking approval of plan;
    - Costs of CIPCA (from the CIPCA forester who participated in the exercise);
    - Costs of consumables.

2. Logging costs up to the log landing:
    - Farmers' time (opportunity cost) in felling, delimbing, preparing skidding paths, cross cutting and loading logs;
    - Costs of consumables and, where applicable, equipment hire.

3. Transport and marketing costs up to the sawmill gate:
    - Farmers' time (opportunity cost) in meetings and negotiations;
    - Costs of transporting logs to sawmill, including the transaction costs involved in obtaining log transport certificates (CEFORs).

The cost analysis was limited to the initial logging. This avoided the difficulties of calculating and interpreting present values for future cost and benefit flows, and reflected the importance of the initial decision to invest in a management plan.

There are a number of permutations for selling logs: as standing timber, in the log landing (or roadside), loaded on trucks, and at the sawmill gate. Some sawmills will also process logs for a fee. In the exercise the groups examined the difference between selling the logs in the log landing and at a sawmill, and with or without a skidder. A summary of the average costs of production is shown in Table 6 (see Tables A3.1 – A3.9 in Appendix 3 which give full details of the calculations). These costs do not include a margin for profits. The results are expressed in terms of the *pulgada cruzeña* because this is the local unit of measure.

Table 6. Costs of logs from a managed forest (10 hectares)

	Total Cost (Bs)	Cost per *pulgada*	Total Cost (Bs)	Cost per *pulgada*
	Excluding skidder costs		**Including skidder costs**	
Total cost of management plan	2,695	1.04	2,695	1.04
Logging costs	1,260	0.48	3,860	1.48
Total costs to log landing	3,955	1.52	6,555	2.52
Transport and marketing costs to sawmill gate	6,800	2.61	6,800	2.61
Other costs (taxes, CEFORs)	1,062	0.41	1,062	0.41
Total cost at sawmill gate	11,817	4.54	14,417	5.54

The differences in costs per *pulgada* show clearly the cost of hiring a skidder (Bs. 1/*pulgada*). For many small farmers or groups, the difficulties of hiring a skidder make this option an unlikely proposition; many will prefer to sell their logs at a lower price which includes skidding costs.

For a representative 10-hectare block with a commercial volume of 65m^3 to be felled in the initial logging, the margin at the log landing and sawmill is determined by the difference between the costs and the value of the sum of soft and construction timber. Market prices have been volatile since the introduction of the new forestry regime; however, in 1999 the El Recreo community has sold their logs at the log landing for a price of Bs. 3.5 per *pulgada* (soft timber) and Bs. 4.5 per *pulgada* (construction timber). With 1,820 *pulgadas* of soft timber and 780 *pulgadas* of construction timber, the margin is Bs. 5,925, which is equivalent to Bs. 2.28 per *pulgada* (or US$100 per hectare)[1]. These results are sensitive to changes in log prices: for example, an across-the-board Bs. 1 fall in price would halve net income from the initial logging. Given that it is probable that labour costs are less variable than non-labour costs, and that owners of logging machinery and sawmill operators may be in a stronger position to negotiate than farmers, downward pressure on prices can be expected.

The importance of the exercise was to demonstrate an approach that enables farmers to estimate their production costs and compare these with log market prices, and to illustrate the breakdown of costs (including transaction costs). Greater transparency in cost formation should assist farmers to negotiate reasonable prices for their logs and seek cost-effectiveness in forest management. It is hoped that CIPCA will support and encourage groups to repeat the exercise prior to negotiations with local forest industries.

Farmers can also compare the cash return from the first logging to two other alternatives: the clearing of high forest (*monte alto*) for subsistence agricultural production or land speculation, and illegal logging. In all three cases the farmer fells and delimbs the trees, and the buyer drags out the logs. The first option is increasingly rare, as farmers find it easier to manage secondary forest regrowth, but is nonetheless permitted by the SF (for areas greater than 5 ha a tax of US$15 per ha is paid). In 1999 a 5 ha block of forest was cleared in the *4 de marzo* community. 14 trees were felled and 24 commercial logs extracted with a total volume of 1,490 *pulgadas* (37.3 m3) and gross value of Bs. 3,312. The net income to the farmer was estimated to be approximately US$ 95-100 per ha. This is similar to the return to the return to the initial logging described above. The extracted volume per hectare tends slightly higher

[1] (1820@3.5+780@4.5) = Bs. 9,880-Bs. 3,955 = Bs. 5,925

and the log price lower with land conversion compared with a felling as part of a forest management plan. In an illegal logging a higher volume is normally extracted but the informal log market price may be as much as a half less than the market price.

In the absence of non-market incentives, real increases in market prices are crucial to forest management profitability. There is some evidence that price increases have taken place in the period 1995-1999: however, the survey data is not conclusive.

- The market for logs derived from managed forests is thin (the majority of logs are sourced from legal land clearing operations and illegal logging operations), and the sawmill/haulage companies' costs can vary according to the volume of commercial timber, and whether or not access roads or other works are required. Farmers bemoan low standing timber prices, but the farm-gate price includes these costs.
- The interpretation of standing timber prices is difficult because of estimating commercial volume for different species. Also, there are too few examples of logs being sold with Certificates of Origin (CEFOR) to ascertain the extent of any price premiums that this may attract.[2]
- Generally, the survey suggests that the nominal price of logs at the sawmill gate in Santa Rosa has increased, and the highest price ranges from Bs. 6.0–7.0 per *pulgada* (Table 7). Santa Cruz timber prices are often cited in dollar. In dollar (real) terms these prices have not increased noticeably, however in Santa Cruz prices are more sensitive to factors such as board lengths and quality. It is unclear if present Santa Rosa prices are exceptional given the uncertain supply of logs following the closure of many concessions. The volume of informal timber in the market seems to be the most likely factor in determining future log prices.

Table 7. Sawmill prices, Santa Rosa, 1995 and 1999

	Log prices	**Sawn timber**

[2] This may be a factor in the case of El Recreo. In other instances it has been suggested that once obtained CEFORs could be re-used by sawmill owners for the transport of illegal logs.

	1995	1999		1995	1999
Species	Bs/Pt	Bs/Pt	Bs/pulg	Bs/Pt	Bs/Pt
Ajunau	0.40			2.30	
Almendrillo	0.40			2.00	
Bibosi		0.57	6.0		1.90
Cedro	0.46			2.20	
Curupau		0.66	7.0		2.70
Cuta	0.40			2.30	
Jichituriqui	0.36	0.66	7.0	2.10	2.70
Mápojo	0.28				2.50
Mara	1.30			3.50	
Murure		0.66	7.0		2.40
Ochoo	0.28	0.57	6.0	0.80	1.80
Palo Maria	0.42	0.66	7.0		2.80
Paquio	0.35	0.66	7.0	1.10	2.50
Picana	0.33			2.10	
Roble	0.80			2.20	
Tajibo	0.30			2.00	
Tarara	0.30			2.20	
Verdolago	0.42	0.66	7.0	2.00	2.40
Yesquero	0.36	0.66	7.0	1.50	2.20
Guayabochi		0.64	6.8		2.50
Copaibo		0.66	7.0		
Coquino		0.66	7.0		2.50

Source: Table A4.1 and A4.2 (Appendix 4).

3.5 Returns to forest management and present land uses in El Choré

While farmers will try to maximise returns to their scarcest factors of production (cash and family labour), comparisons between distinct activities with specific and often quite different objectives are difficult. Table 8 presents the estimated returns to land use options in the El Choré colonisation zone, and is summarised from Tables 3,4 and 5 above. Farmers balance production and consumption objectives. They seek first to achieve a high degree of food security and meet cash requirements through manual rice production and wage employment, whilst minimising risk. The allocation of family resources is likely to be affected by factors such as family size and the family dependency ratios. Having met these objectives, resources will be switched to other activities, according to the availability of additional household land, labour and capital. Mechanised rice production is an option for a limited number of farmers because of the shortage of adequate land located near roadsides, whilst cattle herd development is more ubiquitous. The latter provides a low risk means to accumulate capital and raise land values, and is the preferred choice of colonist farmers.

Table 8. Summary of financial performance of alternative land uses

	Annual average			Annual returns (Bs)			
Enterprise	**Area**	**Family**	**Cash**	**Per ha**	**Per**	**Per input**	**Per AU**

	or AU	labour days	(Bs)		family day	cash	
Manual rice	>2 ha	34	834	1,857	54	2.2	
Mechanised rice	>5 ha	18	2,112	1,295	77	0.6	
Cattle	>3 AU	77	730	410	6	4.7	251
Cattle				NPV (Bs)			
15% discount rate				2,230			1,565
20% discount rate				1,927			1,401
Forest management	10+ ha						
15% discount rate				769			
20% discount rate				563			

Comparing the returns to limiting factors such as cash and family labour for different enterprises shows that there is a relationship between factor scarcities and returns: there are lower returns to cash in mechanised rice than manual rice production, and higher returns to family labour from mechanised rice, compared with cattle ranching. Returns to land tend to be lower for extensive land use systems such as ranching and forest management.

Increasingly households lack of family labour as children attend schools and young people migrate, and this can be reason for intensifying production. Farmers in the El Choré study area have tended not to adopt introduced agroforestry or silvipastoral systems. There are examples of cover crops in fallows, and perennial crops such as citrus fruit and the regeneration of timber trees in pastures, but on a very small-scale and amongst few farmers. Multi-strata systems hare not been adopted. Some authors have suggested that farmers are more likely to adopt diversified systems because they require low inputs of capital and absorb family labour (e.g., Thiele, 1990). However, many farmers with relatively abundant land resources are reluctant to adopt labour-intensive approaches such as minimum tillage technologies, or to establish perennial tree crops which seem complex to manage, and appear to promise low initial returns to labour and cash inputs. Uncertainty with regard to future markets for perennial fruits and construction timbers is a disincentive to adoption of these systems.

Forest management could be a significant option for some colonist farmers. Profitability is low over the 20-year felling cycle, but incentives include income diversification (and high net cash benefits of the initial logging) and the possibility of formalising tenancy and increasing land values. The main constraints include uncertainty with regard to future timber prices and to continuing institutional support (CIPCA or other NGOs). The four forestry groups did not finance the cost of their management plans; this cost was effectively subsidised by CIPCA (but included in the cost calculations). Future groups will probably have to invest in their management planning costs or negotiate a log price net of these costs with local forest industries.

4. METHODOLOGICAL DISCUSSION

4.1 Quantifying farmers' perspectives

The stakeholder meetings in the communities proved disappointing in terms of obtaining good quantitative data for economic analysis. Organising the meetings at relatively short notice among dispersed farmers at the onset of land preparation activities contributed to a low turnout, but the lack of experienced facilitators was a limiting factor in achieving 'best practice' PRA. The meetings did provide an opportunity for community members to discuss the progress in obtaining approval for their forest management plans (admittedly this was probably the main reason why they attended the meetings), but farmers also explained that uncertainty about markets and continued institutional support were the major factors limiting their ability to improve their livelihoods.

Both CIAT and CIPCA have and continue to work in these communities. This facilitated the fieldwork with key informants and the confidence of the forestry group members to speak frankly in the workshop. The calculation of the costs of production of forest management planning and logging was successful. The participants were able complete the simple calculations needed to determine production costs, including transaction costs. The members of the forestry group recognised the value of the cost estimates, and the need for this information in order to negotiate log prices with local sawmills. The exercise demonstrated the commitment of the forestry groups to both CIPCA's forestry programme and CIAT's on-going research efforts.

But the workshop also showed an awareness of the uncertainty within the forestry groups with regard to the costs and benefits of forest management, and in particular the distribution of these costs and benefits amongst group members. The workshop discussions also showed that there are differences between the groups in terms of their understanding of the details of new forestry regime, and their confidence to manage the process of forest management. The ability of the groups to tackle such issues and more generally improve their managerial capacity will be a major challenge to CIPCA. Above all the workshop demonstrated that taking back the results of the economic analysis is a useful approach that informs discussions about the practice of forest management, and the institutional constraints facing farmers.

4.2 Key informants and gross margin analysis

In the study area colonist farm household livelihood strategies attempt to balance family labour availability across various on- and off-farm activities to ensure sufficient subsistence goods and cash incomes, whilst minimising risk. Estimates made of the returns to scarce resources in annual crop and livestock production appear robust and reflect farmer perspectives. An individual enterprise gross margin provides an approximate measure of returns to scarce resources, and is useful when assessing returns to different enterprises or production techniques.

Gross margin analysis is relatively simple in terms of data needs and calculations compared with other approaches, for example, linear programming and whole-farm budgeting, and its results are more amenable to discussions with farmers, extensionists, and other non-economists. Nonetheless, gross margin calculations can become complex in enterprises characterised by a wide range of combinations of inputs and outputs in any particular production period and across time.

- Building representative herd development models, for example, proved time-

consuming because of the variation in cattle numbers and size of improved pasture from one year to another. In these circumstances the potential for errors in data collection and analysis increases. Attempts to model agroforestry and silvipastoral systems were frustrated because of the lack of consistent quantitative data on yields and input levels on the small number of examples found. However, the lack of good quantitative data is a common problem: the calculations of the financial profitability of forest management depend on the estimates of the commercial volumes of timber, and there is a suspicion that these volumes may be unintentionally over-estimated.

- Comparing the results of gross margin analysis is difficult when the cost structures of enterprises are different. Although only variable costs are included, the relative importance of purchased inputs and hired labour will tend to increase as enterprises become more market-orientated. When the objective of an activity is to accumulate capital, for example in land or cattle, fixed costs such as depreciation become significant in economic analysis.[3]

- The gross margin results need careful interpretation, especially when there is a high degree of economic differentiation among farmers, and when activities are undertaken by farmers faced with changing factor scarcities.

- Non-market costs and benefits can also be important in farmer decision-making. These are likely to be important in forest fallow systems, which for example provide seasonal grazing for cattle, fuelwood, NTFPs and permit the regeneration of degraded areas, and remnant forest blocks where farmers protect water sources.

The selection of key informants is fundamental, but perhaps equally important is taking data and results back to wider groups of target farmers in order to initiate a process of discussions. A particular economic tool or set of tools may provide insights or a 'snap-shot' of current returns to scarce resources, but tend not to reflect the dynamic of farmer decision-making. Similarly, there is likely to be a relationship between managerial capacity and knowledge of farmers and the significance of transaction costs. Transaction costs for sustainable forest management are high because it is a knowledge-intensive activity, which requires a high degree of co-ordination amongst farmers, foresters (in this case, CIPCA), loggers, and the SF.

The difficulty in not 'missing a moving target' (Richards, 1997) has never been harder for those designing projects or support programmes. However, participatory economic analysis and dissemination with communities or target groups can improve the understanding of farmer objectives, how these objectives are met, and how decisions are made about allocating household resource to both on and off the farm activities.

5. CONCLUSIONS

5.1 Methodology development

The methodological approach of the study was determined by its objectives, the disciplines

[3] This was perhaps not such a problem in the gross margin calculations for either mechanised rice as farmers hire services rather than own machinery, or for the cattle herd development since fencing represents a low proportion of costs and needs to be regularly replaced and so may be treated as a variable cost.

and experience of the research team, and the time available for fieldwork. Previously there has been little information available on the profitability of small farmer and community management of small forest blocks. CIAT has considerable institutional experience in agricultural economics, and the use of conventional economic tools such as gross margin analysis, but the Forestry Programme has been constrained from including economics in its recent work. Both CIAT and CIPCA promote participatory principles in their field activities, and support community groups. Rapid appraisal and participatory methods were, therefore, the most appropriate way to collect data and take back the analysis and results to groups, and to contribute to capacity building for a number of stakeholders.

The study was able to evaluate the current land use options faced by colonist farmers in El Choré through field visits and informal interviews with key informants, the majority of whom are members of CIPCA-supported forestry groups. Focus group meetings were held with community members to develop a methodology for the groups to calculate their own production costs.

The study was quite successful in calculating returns to alternative land use options, including forest management by small farmers and community groups on small forest blocks. The methodology developed for such groups to estimates the costs of production of logs (including training and other transaction costs in order to prepare and have approved a management plan) will need discussion and wider testing but provides a reasonable basis. These preliminary calculations are important, not only to improve negotiations between forest groups and local sawmills, but also to inform the SF and local municipal forestry units of the constraints to profitability.

Unfortunately the study team was unable to repeat this exercise with the calculations made for the returns to the main land uses. The PRA-type meetings did not provide much useful quantitative material, in part because they were not well organised and coincided with the start of the agricultural year, and in part because of the more pressing need of the communities to discuss progress with their management plans with CIPCA staff. The study did show that interpreting comparisons between present land uses is difficult because of the wide variation in inputs and outputs within activities, and because while farmers will try to maximise returns to their scarcest factors of production, successive activities have specific and often different objectives. Comparing and contrasting the results would have helped verify or triangulate them beyond the narrow group of key informants, and would probably have drawn attention to a wider set of factors that affects household decision-making including the non-economic constraints to income diversification.

5.2 Implications of low profitability of forest management

The low profitability of forest management for colonist farmers is a concern. Recent forest sector legislation and other reforms have been prompted in part by the recognition that thitherto forest management has not been an option for indigenous groups and small farmers. CIPCA's programme in El Choré is one of the first attempts to introduce participatory forest management with colonist farmers in Bolivia.

In El Choré profitability depends largely on the local market prices for logs. Although apparently high and volatile at present, unless there is improved control of illegal logging

there is likely to be downward pressure on these prices in the long-term. Illegal logging is in part linked to unresolved tenancy issues and the status of the colonisation zone. The SF and INRA have been slow to resolve the legal interpretation of land use in the El Choré reserve and colonisation zone. The 1996 Forestry law has given an important role to municipal governments to administer forests managed by local community groups, but much will depend upon the effectiveness of these municipal forestry units. It remains to be seen how the SF and the municipal governments co-ordinate more closely to monitor the transport of logs and processing of logs by local sawmills.

Information on forest management planning and logging costs is also relevant to the forestry programmes of CIAT and CIPCA. CIPCA's commendable technical work on field data collection and farmer training has not been matched by developing within the groups the skills to develop the practices and rules for the implementation of the plans (including the equitable distribution of costs and benefits amongst group members). There is a need to estimate ex-ante the expected costs and benefits for each forest management plan, and then to monitor the costs and income flows of forest management. Assisting small farmer groups to collect and analyse this information and develop their own indicators would be a useful step forward in identifying management cost savings, and the significance of transaction costs. The methodology used in the study needs to be repeated and refined.

CIAT are testing a number of agroforestry initiatives and need to reintroduce economic tools in their evaluations of new technologies. Both CIAT and CIPCA should also encourage networking between groups and between municipal forestry units, and providing information on the profitability of forest management and the constraints faced by small farmer groups should be a major contribution. Some of the revenue received by the municipal governments from forest taxation should be used to support such information and dissemination activities.

CIAT and other researchers should respond to the uncertainty about volume estimates in management plans by producing standard volumetric tables and dendrology guides. Together they should repeat a sample of the stock surveys with the forestry groups and check tree identification and volume estimates. Concomitantly, CIPCA and CIAT should attempt to develop simple field procedures for the collection of inventory data by colonist farmers (and measure the costs of alternative inventory designs). The opportunity costs of not improving management planning will be reflected in the increased risk of dysgenic selection. As the actual volumes harvested prove less than the planned volumes, the temptation to re-enter forest stands and extract greater volumes during the felling cycle will increase. The over-harvesting of the most valuable species and most desirable stems will result in a lower productivity of the stand as aggressive shade tolerant species (which tend to be of poor form and lower commercial value) dominate the stand. CIAT needs to seek long-term research funds to continue to maintain, measure, and analyse results from its permanent sample plots.

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APPENDIX 1: DETAILED CALCULATIONS OF RETURNS TO ALTERNATIVE LAND USE OPTIONS

A1.1 INTRODUCTION

In this appendix the returns to the land uses practised by colonist farmers in El Choré are presented. The data were collected from key informants during visits to their farms, and the main parameters compared with secondary sources. Originally the intention of the study was to prepare a comparative analysis of the main land use systems practised by colonist farmers, namely:

- slash and burn and livestock – the 'traditional' or base case;
- slash and burn, livestock and agroforestry;
- slash and burn followed by mechanised rice production, and livestock;
- slash and burn, livestock and forest management (with and without a community sawmill);
- slash and burn, followed by mechanised rice production, livestock and forest management (with and without a community sawmill).

However, when the fieldwork commenced, a number of problems were encountered. First, it became clear that very few farmers had introduced agroforestry as part of their farming systems and that these agroforestry systems were small scale and piecemeal. Likewise, few farmers carry out mechanised rice production as its adoption is limited due to topographical and market constraints; and the mobile sawmill that had been introduced earlier into the area by CIPCA soon ran into financial difficulties and was no longer in operation.

Data collection and analysis focused on slash and burn agriculture, both manual and mechanised, livestock production and forest management. Clearly, the analysis is based upon a small sample of colonist farmers, the study's key informants, and enterprise gross margins are likely to be highly variable.

A1.2 GROSS MARGINS FROM MANUAL BASIC GRAIN PRODUCTION

Rice is both the principal subsistence and cash crop. Forest or secondary regrowth is cleared and rice with maize planted for two cropping seasons. Plot sizes rarely exceed 2 ha, because of labour constraints. The farmer will then 'abandon' the plot for 5 years before returning for a third crop. Crop production requires relatively little cash inputs, although there is a greater reliance on chemical inputs than previously, in part due to greater weed infestation and in part due to labour shortages. Non-household labour is used for land clearing, weeding, and harvesting. Reciprocal labour arrangements are still common but on a payment basis, and most colonist farmers both employ wage-labourers and are wage-labourers themselves. Yields fall in the second year (and would collapse if a third crop was planted) and recover to some extent in the third season (year 7). Some rice and all the maize is retained for family consumption.

Table A1.1 shows that gross margins are high and that returns to family labour are slightly higher than the market rate for wage labourers (Bs. 30 per day). Returns to cash are also high, and hence a proportion of this cash can be used to finance on-farm and off-farm investments.

Table A1.1: Gross Margins from Manual Basic Grain Production (Bs/ha)

			Year 1	Year 2	Year 7
Production parameters	Unit	Unit cost			
Rice	fanega		15	10.0	12
Maize	qq		7.5	7.5	7.5
Inputs					
Seed (rice)	kg/ha		16.2	16.2	16.2
Seed (maize)	kg/ha		1	1	1
Herbicide (Tordon)	lit/ha			1	1
Insecticide (Nuvacron)	lit/ha		0.5	0.5	0.5
Transport	fanega		12	7	9
Threshing	fanega		15	10	12
Hired labour					
Land preparation:					
- clearing			6	6	5
-feeling			4		1.5
Weeding				2.5	2.5
Harvesting:			10	7	8
Total hired labour days			20	16	17
Gross income					
Rice	fanega	200	3000	2000	2400
Maize	qq	30	225	225	225
Gross income			3225	2225	2625
Variable costs					
1. Inputs					
Seed (rice)	kg/ha	1.5	24.3	24.3	24.3
Seed (maize)	kg/ha	5	5	5	5
Herbicide (Tordon)	lit/ha	70	0	70	70
Insecticide (Nuvacron)	lit/ha	70	35	35	35
Transport	fanega	12	144	84	108
Threshing		7	105	70	84
Total input costs			313.3	288.3	326.3
2. Hired labour	day	30	600	465	510
Total variable costs			913	753	836
Gross margin / ha			2312	1472	1789
Gross margin / family labour			59	50	54
Gross margin / cash			2.5	2.0	2.1

Table A1.2: Family labour inputs (manual rice)

Family labour inputs (days)	**Year 1**	**Year 2**	**Year 7**
Land preparation:			
- clearing	6	6	5
-feeling	4		1.5
-burning	1	1	1
-weeding		1	1
-gather & re-burn	3	2	2
Planting (rice)	3	3	3
Planting (maize)	1	1	1
Weeding	5	2.5	2.5
Application insecticide	1	1	1
Application herbicide		2	2
Harvesting:	10	7	8
Construction of storage ('galpon')	2	1	2
Pathway to 'galpon'	2	1	2
Threshing and post-harvest tasks	1	1	1
Total family labour days	39	30	33

A1.3 GROSS MARGINS FROM MECHANISED RICE PRODUCTION

Mechanised rice production is presently carried out on a continuous basis for 5 years until the plot is abandoned. Plots that are mechanised are larger than areas cultivated manually (up to 5 ha), but only a small proportion of farmers are able to mechanise because of the topography of their parcels or lack of road access. Some mechanised plots have been abandoned because of soil compaction and weeds. Rice yields can be high, and farmers will tend to cultivate until yields fall to manual production levels or weeds become too prevalent (and when returns to family labour fall sharply (see Table A1.3). Many farmers in El Choré have found that mechanised production has resulted in debts because of difficulties in financing credits. Experience has shown mechanisation to be a high-risk option.

Table A1.3: Gross Margins from Mechanised Rice Production (Bs/ha)

Production parameters	Unit	Unit cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Rice	fanega		20	18.0	16	14	12
Winter soya	ha		1	1.0	1	1	0.5
Inputs							
Seed (rice)	kg/ha		80	80	80	80	75
Herbicide (Propanil)	lit/ha		7.5	12	12	12	10
Herbicide (Tordon)	lit/ha		0.5	0.5	0.5	0.5	
Insecticide (Arrivo)	lit/ha		0.1	0.1	0.1	0.1	0.2
Insecticide (Nuvacron)	lit/ha		1	1	1	1	1
Mechanisation services							
Ploughing	ha		2	2.0	2	2	2
Harrowing	ha		2	2.0	2	2	2
Seed bed harrowing	ha		1	1.0	1	1	1
Threshing	fanega		20	18	16	14	12
Transport	fanega		20	18	16	14	12
Hired labour							
Land preparation							
- clearing			2				
-burning			1				
Destumping			24				
Weeding			2	2	2	2	2
Harvesting			8	8	8	8	8
Total hired labour days			37	10	10	10	10

Gross income (Bs)	Unit	Unit cost	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**

Rice	Bs/fanega	200	4000	3600	3200	2800	2400
Winter soya	Bs/ha	230	230	230	230	230	115
Gross income			4230	3830	3430	3030	2515
Variable costs							
1. Inputs							
Seed (rice)	kg/ha	3	240	240	240	240	225
Herbicide (Propanil)	kg/ha	32	240	384	384	384	320
Herbicide (Tordon)	lit/ha	70	35	35	35	35	0
Insecticide (Arrivo)	lit/ha	168	16.8	16.8	16.8	16.8	33.6
Insecticide (Nuvacron)	fanega	70	70	70	70	70	70
Total input costs			601.8	745.8	745.8	745.8	648.6
2. Mechanisation services							
Ploughing	ha	120	240	240	240	240	240
Harowing	ha	120	240	240	240	240	240
Seed bed harrowing	ha	120	120	120	120	120	120
Threshing	fanega	10	200	180	160	140	120
Transport	fanega	12	240	216	192	168	144
Total mechanisation			1040	996	952	908	864
2. Hired labour	day	30	1110	300	300	300	300
Total variable costs			2752	2042	1998	1954	1813
Gross margin / ha			**1478**	**1788**	**1432**	**1076**	**702**
Gross margin / day family labour			**53**	**119**	**95**	**72**	**47**
Gross margin / cash			0.5	0.9	0.7	0.6	0.4

Table A1.4: Family labour inputs (mechanised rice)

Family labour	Year 1	Year 2	Year 3	Year 4	Year 5
Land preparation					
- clearing	1				
- burning	1				
Destumping	6				
Burning of logs	3				
Manual planting	5	5	5	5	5
Weeding	1	1	1	1	1
Application herbicide	2	2	2	2	2
Application insecticide	2	2	2	2	2
Harvesting	2	2	2	2	2
Threshing	2	2	2	2	2
Construction of storage ('galpon')	2	1	1	1	1
Track to 'galpon'	1				
Total family labour days	28	15	15	15	15

A1.4 RETURNS TO CATTLE PRODUCTION

Colonist cattle production in the study area has been supported in the past by the Heifer Project and to a lesser extent CIPCA. The majority of colonists with cattle started their herds from their membership of these credit-in-kind schemes. Farmers use land that will no longer be used for crop production. A herd development model was drawn up with each of the key informants, most of whom started with one adult cow but after 10 years had a herd of 10 cattle. This classifies them as small-sized cattle owners. It was found that farmers were prepared to invest in at least one cow in this period.

Table A1.5 shows a typical herd development. The herd inventory shows the composition of the herd in each year and includes births. Individual animals move through the age classes until they are sold or die. Deaths, purchases, and sales of animals are shown. Mortality rates are low because of the individual care given to animals. The total number of animals, animal units and area of improved pasture established by the farmer is also shown.

In the first years cash inputs are low, but gradually family labour is replaced by capital (e.g. fencing, improved pasture). Labour inputs are low and mainly family labour is used – often children – so the opportunity cost of family labour is low. Women are important decision-makers in livestock activities, although in other colonist settlements and with larger herds men tend to regain managerial and marketing control. Cattle are dual purpose, but milk and dairy sales or gifts are not significant until the family has three adult cows.

Cattle are perceived to be one of the most profitable activities available in the

colonisation zones, and are an important element in livelihood strategies. Returns to family labour may be low, and cash flows are marginal (see Table A1.6), but capital accumulation in terms of herd size, fencing and improved pasture is a significant incentive. Input and livestock prices tend to be discussed in US dollar terms by farmers. For comparison purposes, the summary results are reported in *bolivianos* in table A1.7.

Table A1.5: Herd Development Model

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
1. Herd structure & births	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Breeding cows	1	1	1	2	3	3	2	3	4	5
Bulls										
1-2 year heifer			1	1				1	1	1
1-2 year bull calves							1		1	1
0-1 year female calves		1	1				1	1	1	2
0-1 year male calves					1	1		1	1	1
2. Deaths							1			1
Purchases	1									
Breeding cows								1		
Bulls										
1-2 year heifer										
1-2 year bull calves										
0-1 year female calves										
0-1 year male calves										
3. Sales										
Breeding cows										
Bulls								1		
1-2 year heifer										
1-2 year bull calves						1				
0-1 year female calves										
0-1 year male calves										
Number of animals in herd	1	2	3	3	4	4	4	6	8	10
Total Animal Units	1	1.3	1.8	2.5	3.3	3.3	2.8	4.1	5.6	6.9
Area of improved pasture	1	1	1	1	2	2	2	2	3	3

Table A1.6: Gross Margin Analysis of Colonist Family Herd (US$)

Labour and input parameters	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
Grass Seeds (3kg/ha)	3				3				3	
Annual labour inputs:										
Caring for animals	60	60	60	60	60	60	75	75	75	90
Fencing					3				3	
Clearing secondary growth	10				10				10	
Establishing pasture	3				3				3	
Weeding and maintenance	5	3	5	5	5	5	5	10	5	5
Total Labour days	78	63	65	65	81	65	80	85	96	95
Total hired labour days	9	2	3	3	9	3	3	5	9	3
Gross income (US$)										
Closing valuation (year end)	250	350	500	650	850	850	750	1100	1500	1850
+sales during year	0	0	0	0	0	150	0	250	0	0
-opening valuation (at start of year)	0	250	350	500	650	850	850	750	1100	1500
+ purchase during year	0	0	0	0	0	0	0	250	0	0
+ sale of dairy products	0	0	0	0	0	54	54	108	108	162
Total gross income	250	100	150	150	200	204	-46	458	508	512
Variable costs (US$)										
1. Inputs										
Cost of seeds (US$4.5/kg)	14	0	0	0	14	0	0	0	14	0
Fencing posts(126 per ha)					47				47	
Support posts (14/ha)					8				17	
Barbed wire (rolls) (3.5/ha)					44				66	
Vaccinations + Antiparasites	2	3	4	5	7	7	6	8	11	14
Antiparasites (external)	15	20	27	38	50	50	42	62	84	104
Mineral salts (10kg/yr/AU)	5	7	9	13	17	17	14	21	28	35
Salt blocks (0,4qq/yr/AU)	2	2	3	5	6	6	5	7	10	12

Total Input Costs	37	31	43	60	191	79	67	98	276	164
Total hired labour cost	47	8	13	13	47	13	13	26	47	13
Total variable costs	84	39	56	73	238	92	80	124	323	177
Gross margin / ha	166	61	94	78	-19	56	-63	167	62	112
Gross margin / AU	166	47	52	31	-6	17	-22	41	11	16
Gross margin / day family labour	2	1	2	1	0	1	-1	2	1	1
Gross margin / cash	2.0	1.6	1.7	1.1	-0.1	0.6	-0.8	1.4	0.2	0.6
NPV at discount rate (10%)	460									
(15%)	388									
(20%)	335									
(25%)	295									

Note: breeding cows = 1 AU; bulls = 1.5 AU; 1-2 yr heifer + bull calves = 0.5 AU; 0-1 yr calves = 0.3 AU

Table A1.7: Summary Results of Gross Margin Analysis (Bs)

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
Gross margin / ha	954	352	541	446	-110	323	-361	961	354	642
Gross margin / au	954	271	301	178	-33	98	-129	235	63	93
Gross margin / family labour	14	6	9	7	-2	5	-5	12	4	7
Gross margin / cash	11.3	9.1	9.7	6.1	-0.5	3.5	-4.5	7.8	1.1	3.6
	per ha			*Per au*						
NPV at discount rate (10%)	2,644			1,783						
(15%)	2,236			1,565						
(20%)	1,927			1,401						
(25%)	1,699			1,273						

APPENDIX 2: CALCULATION OF FOREST MANAGEMENT COSTS AND BENEFITS

A2.1 INTRODUCTION

The preparation of a forest management plan is a prerequisite for the extraction of forest products. The forest management plans prepared by CIPCA in conjunction with the forest groups in El Choré follow the format prescribed by the SF (1997). The CIPCA approach is to prepare forest management plans in a participatory fashion through the training of community or group members in the technical aspects of planning and logging, and to encourage collaboration between groups and forest industries, and the local municipal government.

The plan must describe the management unit (the productive forest), and this may be comprised of various small blocks such as the forest remnants found on small farms in the El Choré colonisation zones. The undertaking of a commercial census is the main activity of forest planning, and has to be supervised by a qualified and registered forester (who is legally responsible for the management plan). Pre-harvest forest inventories are optional. The technical norms specify that the census or stock survey must include the mapping, marking of trees (stock survey number) and measuring of all commercial stems greater than the minimum permitted diameter for that particular species. The stock survey must also include information on stems classified as prohibited for logging or in danger of extinction. It is only a recommendation that lower diameter classes are included in the stock survey.

The management plan comprises two parts: a general plan (*Plan General de Manejo*) and the operational plans (*Planes Operativos*). The former is a descriptive account of the ownership, history and location of the forest, legal considerations (including in the case of community or group management a declaration of community support), and an account of the (biophysical) condition of the forest. It also contains the objectives of the management regime and silvicultural system chosen. This will include a description and justification of the felling cycle and intensity, and hence the annual allowable cut and harvesting schedule. The plan will also discuss the pre-and post-harvest activities, and the measures to be adopted to mitigate the effects of logging and extraction. The plan should be revised at least every five years.

The operational plans detail the specific objectives and activities (harvesting or silvicultural) to be carried out in each harvest area based upon the general plan, including the specification of equipment or machinery to be used in logging. The forest tax must also be calculated. The preparation and execution of operation plans is the responsibility of a professional forester.

Since 1966 private companies holding concessions selectively but heavily logged the forests of El Choré. However, inventory data indicates that approximately 15 to 25 m^3 per ha of harvestable volume remains. The first management plan was prepared with CIPCA's assistance in 1997 for the El Recreo community, and approved by the SF in 1998 together

with the logging plan for the first harvest. In other communities CIPCA invited farmers to form silvicultural groups, in order to prepare a management plan, and four plans have been prepared and submitted to the SF. The difference between the plans is due to land tenancy and forest size:

- In El Recreo, land tenancy is communal and the forest block has a size of 300 ha (the total land area of the community is 800 ha), which has been divided into 10 compartments to be logged over a cycle of 20 years.

- In the other communities each farmer has a land plot of 50 ha, and within this remnant forest blocks of between 10-25 ha: within the 20 year cutting cycle, fifth part of the number of harvestable trees will be logged every four years.

A2.2 FOREST MANAGEMENT ACTIVITIES AND COSTS

The costs of management planning were estimated through discussions with the silvicultural groups and the CIPCA forester. There were some minor variations in planning costs between the groups due to the experience of group members and economies of scale. Neither CIPCA nor the silvicultural groups have kept detailed registers of management costs. The steps taken to produce the plan for the forest blocks of the silvicultural group are the following:

- Members of the group work together with the CIPCA forester to map each forest block, and carry out a stock survey of trees with a minimum diameter at breast height of 50cm. This requires the cutting of parameter and other survey lines for the block. A 10-hectare block will have 675 m of boundary and 2,150 m of stock survey lines (see Table A2.1).

- Trees are marked and numbered, and trees classified according to their condition and marketability. In El Recreo the group measured 205 trees in a 20-hectare block (see Table A2.1).

- Training in these activities and low impact logging techniques is given collectively to the group. The CIPCA forester undertakes the preparation of the map and data analysis in Santa Cruz (see Table A2.2 and Table A2.3) (CIPCA equipment depreciation costs).

Table A2.1: Fieldwork Costs (10-hectare forest block)

	Unit	Quantity	Unit cost (Bs)	Total cost (Bs)	Observations
1.1 Field personnel					
Opening boundary lines	Person-day	3	30	90	
Opening survey lines	Person-day	3	30	90	
Stock survey	Person-day	6	45	270	
		12		450	
1.2 Inputs					
Tape	unit	1	1	1	
Rope (measuring)	unit	2	0.4	1	
Pencils	unit	4	1.5	6	
Paper	unit	8	5	40	
Spray paint	unit	4	15	60	
Notebooks	unit	2	16	32	
Sub total + contingencies	10%			153.8	
Total Fieldwork (management plan)				604	
Cost per ha				60.38	

Boundary measurement 675m; survey lines 2,150m (10-hectare block)

Table A2.2: CIPCA Personnel and Overhead Costs

	Unit	Quantity	Cost (US$)	Cost (Bs)	Total Cost (Bs)	Observations
Training courses / meetings	Person-day	4	46	264.5	1,058.0	
CIPCA overhead costs	Person-day	4	16	92.0	368.0	
Fuel	Visit	4		300.0	1,200.0	
Sub total + contingencies	10%				2,888.6	
					62.0	
					46.6	
2.Fieldwork supervision						
Stock survey	Person-day	10	46	264.5	2,645.0	
CIPCA overhead costs	Person-day	10	16	92.0	920.0	
Fuel	Visit	2		300.0	600.0	
Sub total + contingencies	10%				4,632.7	
3. Report preparation	Person-day	10	46	264.5	2,645.0	
Data analysis	Person-day	1	70	402.5	402.5	
CIPCA overhead costs	Person-day	11	16	92.0	1,012.0	
Sub total + contingencies	10%				4,465.5	
4. Equipment depreciation					489.6	
Total					9,587.8	
Ha per management plan					62	
Total per ha					155	

Table A2.3: CIPCA Forest Management Equipment Costs

	Quantity	Cost (US$)	Cost (Bs)	Total Cost (Bs)	Residual value	Economic life (years)	Depreciation (Bs)	Observations
		(US$)	(Bs)					
50m tape (rope)	2	65	374	748	75	1	673	
10m tape	6	2	12	69	7	1	62	
Compass Suntoo	2	230	1,323	2,645	265	5	476	
Clinometer Suntoo	1	260	1,495	1,495	150	5	269	
Diametric tape 10m	1	99.5	572	572	57	1	515	
Flexometer, 5m	4	7	40	161	16	1	145	
Flashlight	1	35	201	201	20	2	91	
4 person tent	2	121	696	1,392	139	2.5	501	
GPS system	1	998	5,739	5,739	574	4	1,291	
GPS antenna	1	275	1,581	1,581	158	4	356	
Chainsaw	1	1500	8,625	8,625	863	2	3,881	
Axe	5		75	375	38	5	68	
Machete	10		50	500	50	1	450	
Total (annual)							8,777	
Total							490	
The CIPCA equipment is used in the preparation of several management plans and the chain saw is used for other activities. An arbitrary 10% of total annual depreciation costs (excluding the chain saw) are assigned to any particular 10-ha forest block.								

The farmer of each block and other members of the group subsequently verify tree selection for the first harvest in the field. Prior to logging, skidding trails are opened and climbers cut. If necessary, access roads and rudimentary bridges, etc., are planned (although these structures would be constructed with loggers). Generally roads and log landings are not necessary given the relatively small size of the forest blocks and location of farm plots on access roads (which were originally built by logging and oil exploration companies).

The logging costs are based on actual data from El Recreo. The group aims to fell about 8-10 stems per day. Trees are felled but not delimbed until the contractor carries out log skidding, and trunks are cross-cut immediately prior to loading in the log landing. In both instances this is to avoid damage from rotting or pests. The group contributes labour to these activities (Table A2.4). All the groups express their determination to be actively involved in logging operations in this way.

Other costs include the preparation of subsequent logging plans (*planes operativos de aprovechamiento*). There is some uncertainty as to whether these need to be prepared annually or simply for each logging (Table A2.5).

To date CIPCA has not only prepared the formal management plans but also undertaken many of the administrative activities necessary for the approval of the plan. CIPCA has provided much of the equipment for the stock survey, including compasses, tapes whilst other non-specialised items such as axes and chainsaws, which are available for rent within these communities. This has been justifiable given that the pilot nature of the CIPCA initiative, and the uncertainty over the interpretation of the forest law and its regulations with regard to colonist farmer forest management. Preliminary estimates of transaction costs are based on the experiences of El Recreo and discussions with the SF office in Santa Rosa (see Table A2.6)[1]

[1] There are some differences between the cost data presented here and the groups' cost estimates. For example, activities after the initial logging are not included in the latter. Also CIPCA's overhead costs and the depreciation of equipment costs are summed and included in the CIPCA daily rate.

Table A2.4: Felling Activities (Group Members' Costs)

	Unit	Quantity	Unit Cost (Bs)	Total cost (Bs)	Observations
1. Tree felling					
Chainsaw operator	Person-day	1.5	35	52.5	@8-10 trees / day
Assistants	Person-day	7.5	25	187.5	
Opening skidding trails					
Assistants	Person-day	2	25	50	
Delimbing trunks and preparing rodeo					
Chainsaw operator	Person-day	0.5	35	17.5	
Assistants	Person-day	2	25	50	
Cross cutting and loading trunks on lorries/trailers					
Chainsaw operator	Person-day	0.5	35	17.5	
Assistants	Person-day	4	25	100	
2. Inputs					
Fuel (chainsaw)	Lit / day	3	2.8	25	
Oil & grease (chainsaw)	Lit /day	3	13	39	
Paint	Lit	0.25	50	13	
Total (felling and loading logs)				552	
				55.17	Per ha.

Table A2.5: Preparation of Logging Operating Plans

	Unit	Quantity	Cost (US$)	Cost (Bs)	Total cost (Bs)	Observations
1. Preparation of POA						
Field data collection	Person-day	0.5	46	250.7	125.4	@10-20 ha per person-day
Field data collection	Person-day	2		25.0	50.0	
Preparation of report	Person-day	0.5	46	250.7	125.4	
CIPCA overhead costs	Person-day	3	16		261.6	
Fuel	Visit	0.25		300.0	75.0	
Sub total + contingencies	10%				701.0	
					10.0	Ha per forest block
					70.1	Per ha.
2. POA follow-up						
Field data collection	Person-day	0.3	46	250.7	75.2	@10-20 ha per person-day
Field data collection	Person-day	2		25.0	50.0	
Preparation of report	Person-day					
CIPCA overhead costs	Person-day	0.3	46	250.7	75.2	
Fuel	Visit	0.25		300.0	75.0	
Sub total + contingencies	10%				552.4	
					10.0	Ha per forest block
					55.2	Per ha.
Total					125.3	Per ha.

Table A2.6: Transaction Costs

	Unit	Quantity	Cost (Bs)	Total cost (Bs)	Observations
Negotiations with local loggers, sawmill, transporters	Person-day	4	35.0	140.0	
Delivery of CEFORs	Person-day	4	35.0	140.0	Multi-purpose visits
Bus costs (return to Santa Rosa)	journey	2	35.0	70.0	
Total				350.0	
				35	Per ha

A2.3 INCOME FROM TIMBER PRODUCTION

The expected income from timber sales depends on the assumptions regarding harvestable commercial volume during the felling cycle. CIPCA have adopted a polycyclic forest management system with a low logging intensity and, if proven necessary, post-harvest silvicultural treatments. However, the approach is controversial since it entails numerous entries in the forest block during a single felling cycle. The volume to be harvested is determined by the initial logging of over-mature and mature stems, and then, in subsequent entries, a falling proportion of the commercial volume. The idea is to ensure a flow of timber and hence cash receipts through the 20 year felling cycle. CIPCA aim at an initial harvest of between 25-35% of total commercial volume, followed by four additional entries within the felling cycle, each extracting a further 10-25% of the total volume estimated at the time of the preparation of the plan (Table A2.7). It is assumed that the expected incremental growth of both standing harvestable stems and those in the lower diameter classes will compensate for the difference between the initial and following harvests. CIPCA have yet to define the basis for any post-harvest silvicultural treatment that can be adequately undertaken by colonist farmers and there is an absence of research to support such interventions.

Table A2.7: Harvestable Volume of Forest Block

Year	Harvest	Number of commercial trees	Commercial volume (m3)	(Adjusted) commercial volume (m3)
0	1	15	63	63
4	2	23	57	70
8	3	22	42	68
12	4	21	36	69
16	5	16	21	50
Total		97	219	320

CIPCA adjust the estimate of standing volume to take into account growth, recruitment, and mortality. However, these rates are estimates that are not based on local research results (such as logging damage and regeneration studies). The stock survey generally shows that the standing volume comprises 70% softwoods (Table A2.8).

Table A2.8: Total Timber Income for a Forest Block (undiscounted)

Year	Harvest	(Adjusted) commercial volume (m3)/ha	Value of soft woods Bs/ha	Value of hard woods Bs/ha	Total income Bs/ha
0	1	6.3	617.4	340.2	957.6
4	2	7.0	686	378	1064
8	3	6.8	666.4	367.2	1033.6
12	4	6.9	676.2	372.6	1048.8
16	5	5.0	490	270	760
Total			617.4	340.2	957.6

Soft woods represent 70% of harvestable volume; @Bs. 3.5 per *pulgada* cruzeña
Hardwoods @ Bs. 4.5 per *pulgada* cruzeña.

The discounted costs and benefits of the management of small forest blocks is shown in Table A2.9 for a range of discount rates. With a 15% discount rate and a 20-year felling cycle, and the base case assumptions, the NPV for the felling cycle is US$134 per hectare (US$ 1,340 per 10-hectare forest block or per household). The management of small forest blocks is profitable (NPV>0).

Table A2.9: Discounted Costs and Benefits of Forest Management (Bs/ha)

			Discount rate				
Activity	**Cost**	**Year**	**0%**	**10%**	**15%**	**20%**	**25%**
A. Planning				**Discounted costs (Bs)**			
Stock survey etc.	60	-1	60	66	69	72	75
Preparation of Plan	155	-1	155	170	178	186	193
Annual operating plans	55	20	1,105	470	346	269	218
B. Logging							
Initial logging	90	0	90	90	90	90	90
Harvest 2	90	4	90	62	52	43	37
Harvest 3	90	8	90	42	29	21	15
Harvest 4	90	12	90	29	17	10	6
Harvest 5	90	16	90	20	10	5	3
C. Other costs							
Training (pre-planning)	47	-1	47	51	54	56	58
Taxes (initial logging)	1	0	1	1	1	1	1
Harvest 2	1	4	1	1	1	1	0
Harvest 3	1	8	1	1	0	0	0
Harvest 4	1	12	1	0	0	0	0
Harvest 5	1	16	1	0	0	0	0
Initial harvesting costs			**353**	**379**	**392**	**405**	**418**
Felling cycle			**1,470**	**624**	**455**	**349**	**280**
			Discount rate				
	Income	**Year**	**0%**	**10%**	**15%**	**20%**	**25%**
Initial logging		0		**Discounted benefits (Bs)**			
Soft timbers	617		617	617	617	617	617
Hard timbers	340		340	340	340	340	340
			958	958	958	958	958
Logging (first felling cycle							
Harvest 2	1,064	4	1,064	727	608	513	436
Harvest 3	1,034	8	1,034	482	338	240	173
Harvest 4	1,049	12	1,049	334	196	118	72
Harvest 5	760	16	760	165	81	41	21
Total discounted benefits			**3,906**	**1,708**	**1,223**	**912**	**703**
Net income (initial logging)	Bs/ha		605	578	565	552	539
Net Present Value (felling cycle)			2,436	1,084	769	563	423
Net income (initial logging)	US$/ha		105	101	98	96	94
Net Present Value			424	189	134	98	74

Sensitivity analysis shows however that these results are very susceptible to reduced timber prices and yields. Table A2.10 illustrates the effects of (a) a drop in log prices (Bs. 3 / *pulgada* for soft timbers and Bs. 4 / *pulgada* for construction or hard timbers), and (b) eliminating the growth, recruitment and mortality assumptions.

Table A2.10: Sensitivity Analysis (NPVs, Bs/ha)

	Discount rate				
	0%	**10%**	**15%**	**20%**	**25%**
Net Present Value (base case) (Bs/ha)	2,436	1,084	769	563	423
(a) NPV (fall in log prices)		857	610	443	328
(b) NPV (excluding growth assumptions)		512	385	328	230

A2.4 OBSERVATIONS

The difficulty with the CIPCA approach is that it is an uneasy combination of planning and field procedures adopted from large-scale concessions and participatory approaches. This tension is also inherent in the split between forests with greater or less than 200 ha and the regulations that govern their management according to the forestry law. In particular the reliance upon a stock survey has its drawbacks, as this does not appear to be providing reliable harvest volume data for management decision-making either for the initial felling cycle or subsequent cycles to ensure the longer–term productive potential of the stand.

These limitations are exacerbated by the highly heterogeneous nature of even adjacent forest blocks (due to the numerous unplanned logging that has occurred on them). Prescriptions for one block cannot be assumed valid for all the blocks within a management plan. Essentially, not enough is known about stand distribution in these blocks, and arguably CIPCA management plans are exaggerating expected commercial volumes (given the difficulties in measuring the height of the trees). CIPCA have started, correctly, to train colonist farmers in simple technical inventory and data collection techniques. However, current practise presents some real dilemmas, for example the lack of data collection control by the CIPCA forester, and subsequent over-estimation of stand volume. Inventory data would provide information of a stand's floristic and structural composition, and help determine the felling cycle and harvestable volumes. However, to gather pre-harvest inventory data implies greater planning costs (in data collection, processing and control).

The objective of the stock survey is to select harvestable stems and locate these for harvesting operations; however, since the stock survey only considers a portion of the forest stand, the relative lack of information requires a conservative yield allocation and simple harvesting. The repeated re-entry into the forest breaks is one of the 'golden rules' of good forest management given that logging damage to the remnant stand can be expected to be high.

In the short term there is a pressing need for CIAT and other researchers to produce standard volumetric tables and dendrology guides (since it cannot be assumed that tree identification by colonist farmers is adequate). CIPCA and CIAT should attempt to develop simple field procedures for the collection of inventory data by colonist farmers (and measure the costs of alternative inventory designs).

The opportunity costs of not improving management planning will be reflected in the increased risk of dysgenic selection. As the actual volumes harvested prove less than the planned volumes, the temptation to re-enter stands and extract greater volumes during the felling cycle will increase. The over-harvesting of the most valuable species and most desirable stems will result in a lower productivity of the stand as aggressive shade tolerant species (which tend to be of poor form and lower commercial value) dominate the stand.

APPENDIX 3: A METHODOLOGY FOR FARMER CALCULATION OF FOREST MANAGEMENT COSTS AND RETURNS

A3.1 INTRODUCTION

The following tables are copied from the exercise carried out in the field with representatives of the four forest management groups. This was only the first attempt to use this approach, and more discussion will be needed to improve the methodology.

The tables were prepared from the earlier discussions with key informants, and numbered so that the farmers followed the sequence of activities in the calculations of the cost estimates. Nine tables needed to be completed by the farmer forest groups:

Table	Description
Table A3.1	Time spent by farmers in the preparation of the management plan
Table A3.2	CIPCA's field costs
Table A3.3	Inputs and equipment hire
Table A3.4	Summary of management plan costs, (from tables A3.1, A3.2 and A3.3)
Table A3.5	Labour costs in logging operations
Table A3.6	Inputs and equipment hire costs (logging)
Table A3.7	Summary of logging costs (from tables A3.5 and A3.6)
Table A3.8	Transport and marketing costs
Table A3.9	Summary table (from tables A3.4, A3.7 and A3.8)

COST OF MANAGEMENT PLAN					
Table A3.1: GROUP TIME SPENT IN FOREST BLOCK					
ACTIVITY	Number of people	Number of days	Total person-days	Cost per person-day (Bs)	Total (Bs)
	A	B	C=A x B	D	E=C x D
Boundaries	*4*	*1*	*4*	*30*	*120*
Survey lines	*4*	*1*	*5-6*	*30*	*150*
	3	*2*			
Location and numbering of trees					
Tree spotter	*2*	*1*	*3*	*40*	*120*
Record keeper	*1*	*1*			
Red tape procedures for MP approval	*4*	*1*	*4*	*30*	*120*
TOTAL			*16*		*510*

COST OF MANAGEMENT PLAN					
Table A3.2: CIPCA COSTS per forest block					
ACTIVITY	Number of people	Number of days	Total person-days	Cost per person-day (Bs)	Total (Bs)
	A	B	C=A x B	D	E=C x D
Training	*1*	*3*	*3*	*350*	*1,050*
Supervision of census	*1*	*1*	*1*	*350*	*350*
Preparation of document, maps etc. (office)	*1*	*2*	*2*	*350*	*700*
TOTAL					*2,100*

COST OF MANAGEMENT PLAN					
Table A3.3: INPUTS AND EQUIPMENT HIRE					
ITEM	Number of units	Unit cost	Total cost (Bs)		
	A	B	C=A x B		
Paint	*4 cans spray*	*15*	60		
Notebooks etc.			15		
Tape	*1.5 m*	*2.5*	3.75		
Markers	*2*	*2*	4		
Tape	*2 x 25 m*	*0.5*	2.5		
TOTAL			*85*		

COST OF MANAGEMENT PLAN					
Table A3.4: SUMMARY					
				Bs	
1	TIME SPENT IN FOREST BLOCK			*510*	
2	CIPCA COSTS			*2,100*	
3	INPUTS AND EQUIPMENT HIRE			*85*	
	TOTAL			*2,695*	

LOGGING COSTS TO LOG LANDING					
Table A3.5: GROUP LABOUR COSTS					
ACTIVITY	Number of people	Number of days	Total person-days	Cost per person-day (Bs)	Total (Bs)
	A	B	C=A x B	D	E=C x D
Fell trees					
Chainsaw operator	***1***	***3***	***3***	***50***	***150***
Assistants	***2***	***3***	***6***	***30***	***180***
Open skidding tracks					
Compass operator	***1***	***1***	***1***	***30***	***30***
Labourers	***2***	***1***	***2***	***30***	***60***
Delimbing					
Chainsaw operator	***1***	***1***	***1***	***50***	***50***
Assistants	***1***	***1***	***1***	***30***	***30***
Skidding to landing	***1***	***(1-2)***	***1***	***30***	***30***
Cross cutting					
Chainsaw operator	***1***	***1***	***1***	***50***	***50***
Assistants	***1***	***1***	***1***	***30***	***30***
Loading logs	***2***	***3***	***6***	***30***	***180***
TOTAL					***760***

LOGGING COSTS TO THE LOG LANDING					
Table A3.6: INPUTS AND EQUIPMENT HIRE					
ITEM	Number of units	Unit cost	Total cost (Bs)		
	A	B	C=A x B		
Felling	*3 person-days*	*100*	*300*		
Delimbing	*1 person-days*	*100*	*100*		
Cross cutting	*1 person-days*	*100*	*100*		
Skidding*	*2,600 pulg*	*Bs1 / pulg*	*2,600*		
TOTAL			*3,100*		

*a direct payment or discounted from sales price

LOGGING COSTS					
Table A3.7: SUMMARY					
			with skidder	*without skidder*	
5	COST OF LABOUR (farmers)		*760*	*760*	
6	COST OF INPUTS		*500*	*500*	
	EQUIPMENT HIRE		*2,600*	*0*	
TOTAL			*3,860*	*1,260*	

COSTS OF TRANSPORT AND MARKETING FROM LOG LANDING TO SAWMILL					
Table A3.8: COSTS OF TRANSPORT AND MARKETING					
ACTIVITY	Number of units	Unit cost	Total cost (Bs)		
	A	B	C=A x B		
Group meetings	*6 x 0.5*	*30*	*90*		
Negotiations with buyers	*4*	*30*	*120*		
Negotiations with transporters	*1*	*30*	*30*		
Transport costs	*2,600 pulg*	*2.5*	*6,500*	*to Santa Rosa sawmill*	
Other misc. costs					
Application for CEFOR	*2*	*30*	*60*		
TOTAL			*6,800*		

MANAGEMENT PLAN, LOGGING AND MARKETING COSTS						
Table A3.9a: SUMMARY – ***without skidder***						
	Cost	Volume logs		Total Volume	Cost per *pulgada*	Market price
	Bs / forest block	"Soft" timber	"Construction" timber			
	A	B	C	D= B+C	E=A/D	
A. TOTAL COST OF MANAGEMENT PLAN (4)	***2,695***	***1,820***	***780***	***2,600***	***1.04***	
B. LOGGING COSTS (7)						
– without skidder	***1,260***			***2,600***	***0.48***	
C. TOTAL COSTO TO LOG LANDING (A+B)						
– without skidder	***3,955***			***2,600***	***1.52***	
D. TRANSPORT AND MARKETING COSTS TO SAWMILL (8)	***6,800***			***2,600***	***2.61***	
E. OTHER COSTS						
Taxes	***12***			***2,600***		
CEFORs	***1,050***			***2,600***		
Total	***1,062***			***2,600***	***0.41***	
F. TOTAL COST AT SAWMILL (C+D+E)						
– without skidder	***11,817***			***2,600***	***4.54***	

MANAGEMENT PLAN, LOGGING AND MARKETING COSTS						
Table A3.9b: SUMMARY – ***with skidder***						
	Cost	Volume logs		Total Volume	Cost per *pulgada*	Market price
	Bs / forest block	"Soft" timber	"Construction" timber			
	A	B	C	D= B+C	E=A/D	
A. TOTAL COST OF MANAGEMENT PLAN (4)	***2,695***	***1,820***	***780***	***2,600***	***1.04***	
B. LOGGING COSTS (7)						
– with skidder	***3,860***				***1.48***	
C. TOTAL COSTO TO LOG LANDING (A+B)						
– with skidder	***6,555***				***2.52***	
D. TRANSPORT AND MARKETING COSTS TO SAWMILL (8)	***6,800***				***2.61***	
E. OTHER COSTS						
Taxes	***12***					
CEFORs	***1,050***					
Total	***1,062***				***0.41***	
F. TOTAL COST AT SAWMILL (C+D+E)						
– with skidder	***14,417***				***5.54***	

APPENDIX 4: LOG AND TIMBER PRICES

Table A4.1: Log and Timber Prices in the Study Area in 1995

			log landing		Sawmill gate		
	Standing timber			**Log transport**	**Log**	**Sawn timber**	**Sawn timber**
Place	El Choré			El Choré-Santa Rosa	Sawmill, Santa Rosa	Sawmill, Santa Rosa	Santa Cruz
	Per tree	Bs / m3	Bs / m3		Bs/Pt	Bs/Pt	Bs/Pt
Ajunau	30			1.38 ton/km	0.40	2.30	3.25
Almendrillo	45			1.22 m3/km	0.40	2.00	3.27
Bibosi				0.28 PT/km			
Cedro	50				0.46	2.20	4.50
Cuchi							
Curupau							
Cuta	35				0.40	2.30	2.80
Jichituriqui	40				0.36	2.10	2.80
Mapojo					0.28		3.50
Mara	200				1.30	3.50	5.30
Momoqui							
Morado							
Murure							
Ochoo	30				0.28	0.80	1.10
Palo Maria	45				0.42		2.65
Paquio	37.5				0.35	1.10	3.30
Picana	25				0.33	2.10	3.00
Roble	70				0.80	2.20	4.25
Sirari							
Tajibo	45				0.30	2.00	2.90
Tarara	40				0.30	2.20	2.74
Verdolago	45				0.42	2.00	2.78
Yesquero	43				0.36	1.50	2.20

Fuente: BOLFOR.

Table A4.2: Log and Timber Prices in the Study Area in 1999

			Log landing		Sawmill gate		Sawmill gate
	Standing timber			**Log transport**	**Log**	**Sawn timber**	**Sawn timber**
	Per tree	Bs / m3	Bs / m3		Bs/Pt	Bs/Pt	Bs/Pt
Place	El Choré			El Choré-Santa Rosa	Sawmill, Santa Rosa	Sawmill, Santa Rosa	Santa Cruz
Ajunau							
Almendrillo							
Bibosi		40	120		0.57	1.90	
Cedro							
Cuchi							
Curupau		40	140		0.66	2.70	
Cuta							
Jichituriqui		48	140		0.66	2.70	
Mápojo	50					2.50	
Mara							
Momoqui							
Murure					0.66	2.40	
Ochoo		40	120		0.57	1.80	
Palo Maria		100	160		0.66	2.80	
Paquio		40			0.66	2.50	
Roble							
Sirari							
Verdolago					0.66	2.40	
Yesquero		40	140		0.66	2.20	
Guayabochi	50		160		0.64	2.50	
Copaibo	100		160		0.66		
Coquino	50		160		0.66	2.50	

Source: Superintendencia Forestal, Santa Rosa, survey data. Notes: Transport costs, El Choré (4 de Marzo y Los Andes – Santa Rosa: Bs 1.5-2.5 / *pulgada*; Santa Rosa – Santa Cruz: US$ 250 / 10-12,000 Pt.