DEFORESTATION AND WOOD USES IN THE ECUADOREAN ANDES

by Sven Wunder[1]

1. Introduction

This article is the result of an investigation carried out by the author,[2] within the framework of the Programme for Native Andean Forests (PROBONA) in Ecuador. PROBONA is a programme for the conservation and sustainable use of native forests in the Andes,[3] working since 1993 in Ecuador and Bolivia, as the two pilot countries. The programme is financed by the Swiss Intercooperation, affiliated to the World Conservation Union (IUCN), with their regional office in Quito (Ecuador), and with participation of the Swiss Technical Assistance Agency (COTESU).

The strategy of the programme is generally aiming at a long-term perspective (10-15 years). It is not strictly focused on project implementation; rather it works with a number of NGOs, GOs and community-based organisations (CBOs) that are already active at the local level, in assisting and improving approaches towards sustainable forest use, mainly through a number of demonstration activities.

The initial diagnostics phase includes forest inventories, mapping of forest cover, choice of demonstration areas, screening of sustainable use options, and studies of ongoing forest uses. The present investigation falls within the latter category, exploring the dynamics of the deforestation process, with special emphasis on the domestic and commercial use of charcoal, timber, and firewood. This article summarizes the main results of a book in Spanish, published by PROBONA (Wunder, 1995).

The scope of this work goes beyond a mere study of markets and domestic uses of wood products. It tries to investigate if these uses constitute a strong motive for the process of deforestation, compared to the agricultural uses of the soil that follow forest conversion. This includes a basic analysis of the rural economy and the peasant's criteria for distributing land, labour and financial capital between wood exploitation, agriculture and cattle ranching. We also aim at clarifying the general relation of the peasant to the forest, i.e. the benefits and costs that he associates with its presence.

2. The data

9 different study areas were selected in 4 different provinces of the Ecuadorean **Sierra** (Loja, Azuay, Cotopaxi, and Bolívar), by a criterium of proximity of human settlements to natural forests, thus allowing for a comparative study of human interaction with the ecosystem and the products it provides. This means that the chosen sites represent relatively recent settlements of the agricultural frontier zones in the Ecuadorean Sierra.

Each of these areas, and the corresponding urban markets, were visited at least twice during a span of 18 months, in order to account for seasonal fluctuations and trends. The methods used include the application of semi-structured interviews of peasants and of rural informers,[4] the observation of production processes **in situ,** the analysis of markets, costs and profit margins, interviews with urban industrial consumers, the revision of existing literature, etc..

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[2] In the first phase of the investigation (September 1993 to February 1994), a preliminary report (unpublished) was produced by the consultants Enrique Laso and Fernando Guerrón. Their contribution to the final report is gratefully acknowledged.

[3] The programme generally works with forests above an altitude of 1,200 m.a.s.l., although users of the forest might be settled in areas of lower altitude.

[4] Basically, the technique used here was a socioeconomic questionnaire of the rapid rural assessment type, designed specifically for the purpose of interaction of resource users with the forest, and the importance of alternative income sources.

The areas are quite different in terms of altitude (ranging from 1,700 to above 4,000 m.a.s.l.), climate zones (from montane cloud forest to sub-alpine **páramo**[5]), precipitation, topography and soil characteristics. As a consequence, productive systems differ in terms of the main crop cultivation, and the balance between agriculture and cattle raising, the latter being dominant in the high altitude parts.

In spite of these difference, a surprising finding was that the basic dynamics of deforestation were much alike across the sample, with the same driving forces and motives for rural change, although the cycle and modalties of land conversion would differ somewhat among the cases studied.

3. Trends in deforestation

According to the statistics published by FAO, Ecuador has one of the highest deforestation rates in South America. However, most of the ongoing deforestation is concentrated in the Western Pacific forests of the Esmeraldas province, and even more accentuated in the Eastern, Amazon part of the country. In contrast, deforestation in the High Andes is already at a more advanced stage, and has slowed down.

However, a main result of the inventories made by PROBONA is that the remnant native Andean forests are more extensive than previously believed.[6] Deforestation occurs mainly on the Eastern and Western slopes of the Andes towards the lowlands, but sometimes also in higher and inaccesible areas. In many cases, the building of roads and other physical infrastructure opens up access for the colonization of new areas.

Most of our 9 study areas thus represent `agricultural frontier' settlements that were founded in the 1970s and 1980s, frequently absorbing a **population surplus** from nearby rural areas that were densely populated and/or characterized by extensive soil erosion. As natural population growth remains high in these marginal areas (4–6 children), the already significant pressure on natural resources is likely to multiply during the next 20–30 years.

The deforestation cycle normally consists of the following stages:

TABLE 1: DEFORESTATION CYCLE AND SUBSEQUENT LAND USES

— **phase 1**: wood and charcoal extraction (1–2 years)

— **phase 2**: slash and burn agriculture (2–5 years):

a) potatoes, beans (1–2 years)

b) maize (1–2 years)

c) wheat, barley (1–2 years)

— **phase 3**: pasture for cattle ranching (7–10 years)

— **phase 4**: fallow and bushland regeneration (1–5 years)

— **phase 5**: slash and burn, agriculture, pasture, etc.

The pattern shown in table 1 is typical for a **medium-high altitude zone,** with an emphasis on cattle ranching: in terms of the time span consumed, pasture is the predominant land use (7–10 years). In contrast, some of the **low-altitude zones** (1,600–2,000 m.a.s.l.) are too humid for burning; instead, the wood mass is left to decay on the ground. In this case, a cattle phase precedes the agricultural phase, taking advantage of the remnant vegetation after slashing. Also, the agricultural crops cultivated here include e.g. bananas and sugar cane, the latter being an important cash crop. In turn, in some of the **high altitude zones** of low agricultural potential, conversion is primarily for cattle ranching, with only one (or even zero) agricultural phase.

[5] According to the Holdridge system, 6 different climate zones were identified.

[6] A total of 3.15 mio ha. of (primary and secondary) native forests and 0.75 mio ha. of bushlands etc. were identified.

For our study areas, only few comparative land use studies exist, hence making it difficult to generalize on long-run trends in the utilization of soils, e.g. my means of aerial photos and satellite images. Nevertheless, from the limited evidence the following tendencies can be outlined for the last 20–30 years:

— primary and secondary **forest area decreases** significantly

— **pastures increase** correspondingly

— crop cultivation areas increase only little, but **cultivation intensifies,** at the cost of fallows, bushlands, etc.

— heavily **erosioned** areas increase only **slowly.**

In other words, the most dramatic and dominant change in land use is the reduction of forests in favour of pastures, in accordance with the picture shown by the deforestation cycle, where pastures represent the `end use' of deforestated lands. As we will see in section 5, this is also in line with the generally more commercial direction taken by the rural economy.

4. Institutional and legal issues

On the institutional and legal side, one of the reactions to the continued deforestation on behalf of the Ecuadorean state has been the creation of “protective Forests”, aiming at the protection of watersheds, fragile soils, wildlife etc.. Both private, communal and state forests can be declared “protective”. In addition, the Ecuadorean Forest Law restricts the possibility of unplanned deforestation.

TABLE 2: EXPLAINING THE FAILURE OF PROTECTIVE FORESTS —

Institutional observations

TYPE OF INSTITUTION	*OBSERVATIONS*
Administrative institutions	** protective declaration without realism* ** no productive alternatives offered* ** lack of resources for protection* ** lack of implementation instruments* ** lack of long-term planning* ** limited capacity for action* ** limited field presence* ** action only wood-focused* ** frequent corruption episodes* ** paternalistic view of local population* ** centralism within the organization* ** lack of coordination with other entities*
Development institutions	** proper agenda in conflict with conservation* ** direct deforestation incentives* ** limited field presence* ** lack of coordination with other entities*
Legal and tenure entities	** proper agenda in conflict with conservation* ** direct deforestation incentives*

	* *limited field presence* * *decade-long land titling procedures* * *corruption episodes* * *lack of coordination with other entities*

Unfortunately, most of the protection declarations have only existed on paper, reflecting good intentions rather than concerted action. Some of the main deficiencies found in the administration and management of Protective Forests are summarized in table 2.

The Ecuadorean Institute for Forestry and Natural Areas (INEFAN) has in most cases been the state agency responsible for the administration and field management of Protective Forests. However, the local population has normally not been consulted on the declaration, including often in the declared "protective forest" large areas that were already without tree cover, and under intensive crop cultivation. A typical top-down approach is taken, without developing proposals of productive alternatives for the population concerned.

Furthermore, the new mandate of protective forests has normally not been backed up by an additional resource allocation to the local INEFAN office in charge. This fact, together with a generally infrequent field presence and the lack of long-term planning instruments, limit the institutional capacity for action.

When conservationist attempts are actually made, these are restricted to the prohibition and control of commercial wood extraction or, in the worst cases, a "personal tax" on these transactions is levied (i.e. corruption episodes). A certain tradition of paternalism towards the local population, and the centralism within INEFAN, constitute additional obstacles to success.

The most serious problem, however, is the lack of mutual coordination with development agencies and tenure and legal institutions. For example, the public Bank of Production and Promotion (BNF) provides almost exclusively credits for extensive cattle ranching in the highlands, and only according to **previously cleared pastures:** the amount of idle pastures and their cattle potential directly determines the amount of credit granted.

Simultaneously, the land titling agency IERAC[7] only has granted land titles according to up to decade-long procedures, creating significant tenure insecurity. Only peasants documenting an **"active occupation",** i.e. deforestating a certain proportion of their land each year, have obtained titles. In turn, landowners who wished to preserve their natural forests have often seen their land occupied by "active" (read: deforestating) squatters, with the silent blessing of IERAC. Individual IERAC officials have also frequently engaged in land trafficking for their personal benefit.

Consequently, the strategies of both public development and land tenure agencies have up to the present been geared towards the promotion of extensive soil uses and colonization, independent of the potential soil uses. Obviously, this agenda is in direct conflict with the aims of conservation. The institutional impact of IERAC and BNF has provided a clear deforestation incentive, independent of the economic dynamics in the rural environment. No mechanisms exist to coordinate actions with INEFAN and the Ministry og Agriculture; instead, institutional rivalry predominates.

5. The commercialisation of wood products

In the literature on Ecuadorean deforestation, the commercial exploitation of wood is frequently seen as a main motive for deforestation, especially in the **Sierra.**[8] In addition, impoverished producers are supposed

[7] IERAC has recently been replaced by the new organization INDA, the strategies and policies of which are still unknown.

[8] E.g. Mougeot (1985), p.116: "…natural forests are still the main sources of firewood, and this is why they are disappearing rapidly (my translation, emphasis added).

to be deprived of most of the benefits from wood trade,[9] because huge middlemen profits would account for the lion share of final value added. However, our field experience shows that this is only partially true.

TABLE 3: THE COMMERCIALIZATION OF WOOD PRODUCTS

- > Characteristics of <u>firewood</u>:

*** a highly marginal product in the peasant economy**

*** low unit value and high transport costs,**

*** used mainly in brick factories, and some minor uses (bakeries, sugar mills, pizzerias, etc.),**

*** a relatively homogenous product, with short commercial chains and low middlemen profits**

*** prices: high seasonal fluctuations and rising longrun price trend**

- > Characteristics of <u>charcoal</u>:

*** in some localities, an economically important product**

*** added value as a result of local processing**

*** specialised uses in broiler restaurants etc., simple energetic use by blacksmiths etc.**

*** product and prices very homogenous, with short commercial chains and low middlemen profits**

*** prices: high seasonal fluctuations rising long-run price trend**

- > Characteristics of <u>timber</u>:

*** a product of little importance, except for few cases**

*** low value added locally,**

*** ordinary species used in industry and construccction, valuable species for furniture, floors, windows etc.**

*** products and prices very heterogenous, with longer commercial chains and high middlemen profits**

*** prices: low seasonal fluctuations and rising long-run price trend**

Table 3 gives a summary of the characteristics of firewood, charcoal, and timber commercialisation. In particular, it reveals that firewood and charcoal are highly homogenous products, with in most cases a large degree of competition in the transport and distribution functions, thus reducing intermediary profits to a minimum. Only in the case of timber, a more heterogenous product with a number of intransparencies in distribution and processing, we found high middlemen profits.

All of the three are subject to important seasonal fluctuations, due to a lower extraction and transport feasibility in the rainy season. Also, all three products face a long-run relative price rise, because of the diminishing forest stock and the gradual increase in transport distances between producers and consumers.

TABLE 4: ESTIMATING CHARCOAL DEMAND AND SUPPLY IN QUITO

(Number of large sacks) (1)

[9] This refers exclusively to internal trade: timber exports from the Ecuadorean highlands are likely to be less than 1% of total production; charcoal and firewood are not exported at all.

USE / DISTRIBUTION	DEMAND	SUPPLY
1. Broaster restaurants, demand Particip. Sigchos zone 25%	45,300	11,325
2. Informal grills, demand (2) Particip. Sigchos zone 25%	20,000	2,500
3. Supermaxi supermarket sales Particip. Sigchos zone 0%	11,700	0
4. Informal markets (3) Participation Sigchos zone 46% (4)	19,250	8,975
5. TOTAL DEMAND SUPPLY SIGCHOS ZONE FOR QUITO MARKET	**96,250**	**22,800**

AGGREGATED PARTICIPATION SIGCHOS ZONE: 22,800/96,250 = 23.7%

NOTES:

(1) Large sacks of arrayán (50 kg) and soft species (30 kg)

(2) Crude estimate based on few enquiries

(3) 20% of the total, excl. of grills demand counted in 2.

(4) Calculated as a residual: 4. =5. -3. -2. -1.

SOURCES: Field data, urban market and user enquiries

In terms of rural impact, the most important product is **charcoal,** mainly consumed in broiler restaurants, where consumers prefer the charcoal taste. In Quito, we found that the consumption in 50 restaurants of this type was about 95 kg each per day; about 1.7 million kg per year, which represents about half of our estimated total charcoal consumption in Quito. The rest is utilized for private barbecues, small-scale mobile grills, etc., as can be seen from table 4: as an approximation, 100,000 sacks of charcoal are consumed each year. The proportion from our study zone of Sigchos, about 80 km South of Quito, is about 24%. Other main production zones are situated to the Northeast (Nanegal, Guallabamba) and the Southwest (Chiriboga, San Juan) of Quito.

Whereas the “simple energetic uses” (e.g. blacksmiths) are in decline, the “specialized uses” (like broilers) have proved to be resistant to the price hike of charcoal during recent years, caused by the growing scarcity of wood. As easily observed from table 5, the market structure and unit prices are surprisingly homogenous throughout the country, with a producer price of 3–4 USD and a consumer price of 5–7 USD, for a sack of 50 kg. Transportation is a main cost element. Commercial chains consist of 2–4 agents, without evidence of huge intermediary profits and “exploitation” of the producer.

TABLE 5: WHOLESALE AND RETAIL PRICES FOR CHARCOAL

Yearly averages for selected zones

AREA	*CASE STUDY*	*ALTITUDE*	*PRODUCER PRICE (1)*	*CONSUMER PRICE (2)*	*PRINCIPAL MARKETS (3)*
Dudas	*1*	*medium*	*3.08*	*6.16*	*Cuenca, Azogues*
Uritusinga	*2*	*high*	*3.83*	*6.94*	*Loja*
Las Illinizas	*3*	*high*	*3.46*	*7.20*	*Quito, Latacunga*
Quilotuña	*3*	*high*	*3.46*	*7.20*	*Quito, Ambato*

AREA	*CASE STUDY*	*ALTITUDE*	*PRODUCER PRICE (1)*	*CONSUMER PRICE (2)*	*PRINCIPAL MARKETS (3)*
Cashca Totoras	*4*	*high*	*3.32*	*5.60*	*Chimbo, Guaranda*

NOTES:

(1) In USD for a "standard" sack of 50 kg (both soft and hard species).

(2) In USD, retail price in informal urban markets or to final consumer.

(3) If more than one market is mentioned, prices refer to the first.

SOURCE: *Field data*

On the production side, extremely simple earth-covered holes are used as kilns, of varying sizes (the burning process takes between 4 and 20 days). There is a large energetic waste in the conversion, but due to the local abundance of wood, there has not yet been much interest in more sophisticated technological alternatives. Transport to town is arranged by intermediaries; sometimes these are ex-producers that have "vertically integrated" and bought a truck. Charcoal is a 100% commercial product that is not consumed locally.

The commercial use of **firewood** is the least important of the wood products: its low value per weight unit only allows for short transport distances to be economically feasible. Necessarily, commercial chains need to be extremely short (2–3 agents), and the product markets are relatively homogenous. Only high-density tree species are commercialized. Table 6 shows typical wholesale and retail price for firewood: whereas the producer price is almost identical in the 4 zones, the consumer price depends on the transport distances to the urban market in question.

TABLE 6: PRICE RANGES FOR FIREWOOD IN STUDY AREAS

Per "load", in USD#

AREA / MARKET	RURAL MARKET	URBAN MARKET
CASE 1 (DUDAS-CUENCA)	0.5 – 0.6	2.0 – 2.2
CASE 2 (LOJA PROVINCE)	0.5 – 0.7*	0.8
CASE 3 (TOACHI-PILATON)	0.5	0.6+
CASE 4 (CASHCA-CHIMBO)	0.8	1.2

NOTES:

(#) Average price winter-summer. Each "load" contains 15–20 kg.

(*) For harder "faique" species: 0.6 – 1.2 rural, 1.6 – 1.7 urban

(+) Local markets of Saquisilí and Sigchos

SOURCE: Field data

Firewood is confined to a number of specialized uses, in rural or semi-urban areas, such as tile-works and bricks, bakeries, grills and to some extent small-scale sugar cane mills. Urban specialized uses, in pizzerias etc., are insignificant.

The importance of **timber trade** from the native Andean forests is limited by the fact that valuable species in most areas have been exhausted, whereas these are still available in the Coastal and Amazonian part of the country. Only factors such as the construction of new roads open up the access to the exploitation of new primary sources, mainly in the Eastern and Western flanks of the Andes. Secondary forests with remaining ordinary species are also exploited, in a few areas close to the cities, and mainly for the sale to urban construction firms.

Table 7 gives an idea of the structure of prices and margins in the timber trade. The producer price of ordinary species timber is as low as 0.4–0.5 USD for each board; for valuable species the price range is 1–4 USD. Unlike firewood and charcoal, markets and products are very heterogenous, with larger commercial chains (3–5 agents) and larger middlemen profits. Consequently, consumer prices rise to between 4 and 8 USD per board. Both production, transport and distribution are characterized by large inefficiencies and high costs. Lack of transparency is aggravated by the, involuntary or deliberate, confusion of species.

TABLE 7: TIMBER WHOLESALE AND RETAIL PRICES

Yearly averages for selected zones

AREA	*CASE STUDY*	*ALTITUDE*	*PRODUCER PRICE (1)*	*RETAIL PRICE (2)*	*MAIN MARKETS (3)*
Dudas	*1*	*medium*	*0.94+ 2.20**	*7.70**	*Cuenca, Azogues*
Jimbilla-Imbana	*2*	*high*	*2.65+ 4.00**	*5.80**	*Cuenca, Loja Huaquillas*
Las Illinizas	*3*	*high*	*0.39+ 0.66**	*4.40**	*Quito, Latacunga*
Quilotuña	*3*	*high*	*0.46+ 0.66**	*4.40**	*Quito, Ambato*
Las Pampas	*4*	*high*	*0.95+ 1.40**	*3.60**	*Quito*

NOTES:

(1) + Average board price, net of external costs, in USD * Gross price of the typical specie in each zone: Dudas: mollón, Jimbilla: romerillo, Quilotuña, Illinizas: colorado Las Pampas: canelo; in USD

*(2) * Board price equivalent to (1)*, retail sale to urban consumer, in dried state of elaboration/semi-elaboration*

(3) If more than one market is mentioned, the price refers to the first.

SOURCE: *Field data*

Table 8 shows an example of the commercialisation of the canelo species, in the mega-market of Quito. The table confirms conventional wisdom on middlemen profits, for the timber case: the margin of the producer, net of external costs, represents only about 10% of the retail price. Moreover, the standing wood price, i.e. the rent paid for the primary source,[10] only constitutes 20–25% of the final price.[11]

A noteworthy observation is the dual structure in the market of Quito, divided between the (wealthy) North and the (poor) Centre and South: apparently the same is product is sold at much higher prices in the North, whereas poor carpenters and artisans in the Centre/South are only prepared to pay an inferior price. It seems that the storehouses in the Centre/South compensate for their lower unit profit margins by a higher sales turnover.

TABLE 8: TIMBER COMMERCIALISATION MARGINS: THE CASE OF CANELO
Prices per board in sucres, for Quito market (1)

ITEM	VALUE SUCRES (0) (1)	RELATIVE MARGIN (0)	% OF FINAL PRICE (0)
Standing wood price (2)	*1,750*	*50%*	*19% (26%)*

[10] The timber producer may or may not be the owner of the trees: in many cases, specialised lumber jacks operate with high mobility, `buying' trees from the land owner on a share basis (delivering to the owner 50% of the physical timber output, or of the sales receicts).

[11] Naturally, this share varies according to the species, with fine species obtaining a higher share than ordinary ones, as production and transport costs are rather fixed. The present value of canelo presented here is in the intermediate range.

"External" costs (chainsaw, gasoline, etc.) (3)	*850*	*25%*	*10% (13%)*
Sale to intermediary (4)	*3,500*	*100%*	*39% (52%)*
Producer margin (5)	*850*	*25%*	*10% (13%)*
Purchase from producer	*3,500*	*63%*	*39% (52%)*
Sale to Quito storehouse	*5,200*	*100%*	*57% (76%)*
Gross margin intermed. (6)	*1,800*	*37%*	*18% (24%)*
Purchase from intermediary	*5,200*	*57% (76%)*	*57% (76%)*
Sale to consumer (0) (8)	*9,000 (6,800)*	*100%*	*100% (100%)*
Gross storehouse margin (7)	*3,800 (1,600)*	*43% (24%)*	*43% (24%)*

NOTES:

(0) Numbers without parenthesis: average storehouse in the North of Quito; Numbers with parenthesis: average storehouse Centre/South of Quito;

(1) 1 USD = S/.2,300

(2) Estimated in 50%

(3) Estimated in 25%

(4) Dry season price

(5) Includes all labour costs

(6) Includes costs of gasoline, depreciation of truck, and all labour

(7) Includes costs of labour, rent of sales storehouse, elaboration and wood drying

(8) Price of dry wood; fresh wood is sold at S/.1,500–2,500 less

SOURCE: *Field data, urban market and user enquiries*

Both charcoal, timber and firewood production are subject to **seasonal fluctuations:** production goes down (up to 50%) during the rainy season, and producer prices go up (up to 50%). Large markets such as Quito receive their provision from different climate zones, which stabilizes prices. This means that local intermediary profits must act as "buffers", with depressed incomes during the local rainy season, where wood supplies fall short of urban demand, and local producer prices rise. For all three products, we also found indications of a **rising price trend,** above the general inflation rate, due to the gradually increasing transport distances and wood shortages.

5. Wood products and rural incomes

Naturally, the rural incomes derived from wood products are directly related to the commercialisation structure described in the previous section, combined with the quantities produced in each of the study areas.

As shown in table 9, the incomes from **charcoal,** net of external costs, range for the four specialized frontier zones (Illinizas, Quilotuña, Uritusinga, Dudas) from 30,000 USD to 60,000 USD yearly each; for the 5th zone (Cashca Totoras), charcoal income is negligible. This makes charcoal the second local source of income in the respective areas (between 20–40% of the total), after cattle ranching; the two are frequently combined in the early stages of frontier colonization. With rising income, savings and employment opportunities, charcoal tends to decline in importance, just like the timber and firewood production.

TABLE 9: CHARCOAL PRODUCTION AND INCOMES IN STUDY AREAS

Data for selected zones

AREA	*CASE STUDY*	*ALTITUDE*	*CHARCOAL (1) PRODUCTION*	*CHARCOAL INCOME (2)*	*PRINCIPAL MARKETS*
Dudas	*1*	*medium*	*340–605,000*	*21–37,000*	*Cuenca, Azogues*
Uritusinga	*2*	*high*	*512–678,000*	*40–52,000*	*Loja*
Las Illinizas	*3*	*high*	*823,000*	*57,000*	*Quito, Latacunga*
Quilotuña	*3*	*high*	*621,000*	*43,000*	*Quito, Ambato*
Cashca Totoras	*4*	*high*	*67,830*	*4,500*	*Chimbo, Guar.*

NOTES:

(1) In kg, yearly (both soft and hard species)

(2) In USD, gross annual income, deducing "external" costs (chainsaw, truck, etc.), but including own labour costs, domestic animal transport, etc.

SOURCE: *Field data*

The importance of **firewood sales** for the rural economy is negligible, typically about 10% of the corresponding charcoal income level. Only the tile-works consumption is large enough to have an impact on the speed of deforestation in selected zones.

As shown in table 10 on the quantity and value of **timber sales,** the sales of ordinary species from two areas in the Cotopaxi province, of about 215,000 boards each year, mainly to the Quito construction sector, provides a yearly income of 40–50,000 USD to each of the two areas. In comparison, areas like Dudas and Las Pampas extract much smaller timber quantities, but specialize in valuable species.

In the special case of Jimbilla/Imbana, high-value species are extracted from areas towards the Amazon region, with 5–6 hours of extraction transport by mules, and sales to the Southern markets of Cuenca, Loja and Huaquillas (border to Peru). The exceptionally large gross income figures are hence partially counterbalanced balanced by the large labour costs of extraction. The high unit value for wood from Jimbilla is also partially explained by the vertical integration of producers into the intermediary sphere, using their own trucks to transport timber to the town of Loja.

TABLE 10: TIMBER PRODUCTION AND INCOME
Yearly figures for selected zones

AREA	*CASE STUDY*	*ALTITUDE*	*TIMBER (1) PRODUCTION*	*TIMBER (2) INCOMES*	*MAIN SPECIES (3)*
Dudas	*1*	*medium*	*3,600*	*3,375*	*Ishpingo, mollón, sarar — FINE*
Jimbilla-Imbana	*2*	*medium*	*83,000*	*244,000*[*]	*Guayacán, romerillo — FINE*
Las Illinizas	*3*	*high*	*106,000*	*41,000*	*Colorado, chilco, ORDINARY*
Quilotuña	*3*	*high*	*108,000*	*50,000*	*Morado, chilco, ORDINARY*
Las Pampas	*3*	*high*	*20,000*	*19,000*	*Cedro, canelo FINE*

NOTES:

(1) Annual figures, in boards of about 250 cm x 25 cm, or their equivalent.

(2) In USD, gross annual income, excl. of 25% "external" costs (chainsaws, gasoline, etc.), but including labour costs, domestic animal transport, etc..

(3) Main exploited species, and dominance of FINE (valuable) vs. ORDINARY (less valuable) species.

[*] *Includes 10% gross profit of transport Jimbilla-Loja in producer-owned trucks.*

SOURCE: *Field data*

Finally, it is not only of interest to highlight the absolute sales quantities and values for wood products, but also the **relative share** in rural incomes should be considered, in order to understand their importance for the livelihood of rural families.

For this purpose, the difficult task of rural income estimation has to be solved first: **direct enquiries** about rural family incomes result, for obvious reasons, in severe underestimates, or in generally denied information.[12] A useful and more accesible check is the enquiry of **consumption levels,** providing a downward limit on the size of income levels. As a third method, we engaged in the **direct estimation** of gross and net income from cattle ranching (milk, cheese, meat, offspring) and commercial crops (potatoes, maize, sugar cane, fruits), and their variations in productivity, market prices and costs. Combining these methods, we estimated annual household income ranges for all study areas.

The general trend affecting the rural economy is, first and foremost, an increasing **commercial integration:** from the former emphasis on subsistence crops, a productive specialisation occurs, opening up for the sales of crops, fruits and especially cattle-based products. As a consequence, monetary incomes gain increasingly in importance, resulting e.g. in a shift from nonmonetary labour exchange modes to formal, monetary labour markets. In particular, a strong link between cattle ranching and savings-capital accumulation reinforces integration with the urban markets.[13] Naturally, this has an important impact on the observed pattern of deforestation.

Table 11 denotes both some approximate family income ranges, and the respective wood income shares. The high variance within each site-specific range of family incomes is, to a certain extent, due to insecurities regarding the estimates but, to a more important extent, it can be attributed to the significant **internal income inequalities,** e.g. according to differing land size, cattle holding, credit access, etc.. As an interesting observation, these difference are seldom visible to the visitor in terms of peoples' clothes, houses, furniture etc.: the first impression of indiscriminate poverty should be taken with much caution.

In interpreting table 11, it is obvious that two of the areas with higher income estimates (Vilcabamba, Las Pampas) have reduced their wood income share below 5%. This is in accordance with the hypothesis that wood incomes are **"inferior",** i.e. they decline with an increasing income level and the opening-up of new, higher remunerated employment options.

The relation between poverty and wood incomes is even clearer within each of the communities: the persons specialising in timber and especially charcoal tend to be **landless labourers,** working on the plots of the more wealthy landowners. It is important to remember that the decision to deforestate is never taken by the (poor) charcoal producer, but rather of the (priveleged) landowner hiring the former, based mainly on a wish to increase land cultivation and/or cattle ranching.

TABLE 11: THE ROLE OF WOOD PRODUCTS IN THE RURAL ECONOMY
Approximations of their relative significance

AREA	*CASE STUDY*	*ALTITUDE*	*MAIN ACTIVITY (1)*	*TYPICAL INCOME (2)*	*% WOOD PRODUCTS*
Dudas	*1*	*medium*	*Cattle-Charcoal*	*1,000–2,000*	*20–40%*
Vilcabamba	*2*	*low*	*Agric.-Cattle*	*2,000–3,500*	*0–5%*

[12] *Motives for misinformation include fears of **tax collection,** of **INEFAN's interference** in the case of (illegal or informal) wood exploitation, and a general attitude of **downplaying own welfare,** e.g. compared to that of their neighbours.*

[13] *In more than half of the cases, cattle products are the most important income source (see table 11).*

Tambo-Merced	*2*	*low*	*Agric.-Firewood*	*1,000–2,000*	*10–30%*
Jimbilla-Imbana	*2*	*medium*	*Timber-Cattle*	*1,500–3,000*	*40–60%*
Uritusinga	*2*	*high*	*Cattle-Charcoal*	*1,500–2,500*	*20–30%*
Las Illinizas	*3*	*high*	*Cattle-Charcoal*	*1,500–3,000*	*20–30%*
Quilotuña	*3*	*high*	*Cattle-Timber*	*2,500–4,000*	*15–25%*
Las Pampas	*3*	*low*	*Cattle-Agric.*	*4,000–8,000*	*> 1%*
Cashca Totoras	*4*	*high*	*Agric.-Sheep*	*1,000–1,500*	*10–15%*

NOTES:

(1) Productive activities, according to their importance as monetary income sources

(2) In USD, annual family income, net of "external" costs (machinery, gasoline, chemical fertilizers, fungicides), but including costs of labour, domestic animals etc.

SOURCES: *Field data*

In the middle and low-income ranges (1,000 – 3,000 USD), there is considerable variation in the wood income share. A large part of this is explained by the **recentness of colonization** and the abundance of wood: the older the settlement, the larger areas of forest have already been cleared, and the lower the share of wood incomes. In our sample, a majority of incomes derived from wood is only found in the special case of Jimbilla-Imbana.

6. The domestic use of wood

In our study areas, the main non-commercial use of the forest is without any doubt the use of **firewood.** The monthly consumption levels of between 0.4 and 1 cubic meters that we found (see table 12) are higher than some of the results obtained by other authors[14], but definitely lower than the official estimates in use, based on a rural census that was carried out 15 years ago[15]. National firewood consumption figures are thus rather to be seen as "guesstimates",[16] and we find that the most likely range is between 4 and 5 million m3 of national yearly consumption.

Obviously, the 1980 census did not capture the massive penetration of bottled gas that has occurred during the last decade, favoured by a costly policy of massive subsidies to gas consumption. However, firewood use is never fully abandoned, but rather **combined** with gas stoves, the latter being used preferentially for rapid meals. This leaves the peasant with a maximum flexiblity to respond to price changes, liquidity shortages, availability of firewood, seasonal factors, etc..

TABLE 12: AVERAGE FIREWOOD CONSUMPTION IN STUDY AREAS
Domestic monthly consumption per household (1) (3)

ALTIT./ GAS USE	ONLY FIREWOOD (2) (4)	FIREW. & GAS (2) (5)
HIGH ALTITUDE	1.01 m3 (16.8 loads)	0.50 m3 (8.4 loads)
LOW ALTITUDE	0.76 m3 (12.6 loads)	0.38 m3 (6.3 loads)

NOTAS:

(1) Cooking and heating, excl. artesan or industrial uses

[14] E.g. Mougeot (1985) for part of the Cuenca province.

[15] See Andrade & Moran (INE), 1981.

[16] Estimates of yearly consumption, based on different interpretations and conversion methods, have ranged between 3 mio. m3 (ITTO-INEFAN 154/91) and 6 mio. m3 (ITTO-INEFAN 137/91).

(2) Figures in parenthesis: 1 average "load" = 0.06 m3

(3) Family of 5 – 7 persons

(4) High altitude: 4 loads weekly; low altitude: 3 loads weekly

(5) High altitude: 2 loads weekly; low altitude: 1.5 loads weekly

As shown in table 12, the consumption of firewood is about halfed when a combined use of gas exists, and it is about 25% lower in the low-altitude zones with higher temperatures. The factors with the strongest impact on the gas versus firewood substitution are the access to firewood and to gas bottle transportation (distance to roads), and the attainment of a minimum monetary income treshold. On the other hand, the price of cooking stoves, identified as an important factor in other studies,[17] was not found to be significant: in spite of poverty, most peasants with access to gas cilindres dispose of a small gas stove.

Due to the relative abundance of wood in most of the areas studied, firewood and other domestic uses (for construction, cattle fences, etc.) do not constitute a pressure on natural forests. This contrasts sharply with other studies for the Sierra, painting a vision of a "vicious circle" of firewood — led deforestation, driven by poverty and ever growing wood shortages.[18] In contrast, in our areas the peasant responds flexibly to growing wood shortages by using several options, such as gas use, augmented time for firewood collection, preserving single native trees, or planting eucalyptus near his home.

7. Tenure regimes and deforestation

For the social scientist, the tenure of forest and the associated access rules to forest resources are essential variables in understanding the sustainable management, degradation, and deforestation of woodlands. It is e.g. often argued that communal management is a regime favourable to sustainable management,[19] whereas "free access" state forests tend to be prone to degradation. In the case of Ecuador's Amazon region, it has also been shown empirically that tenure insecurity induced by the IERAC land titling agency favours deforestation.[20] Finally, increasing wood shortages are also expected to induce restricted access to wood resources previously regarded as free "common goods".[21]

For many of these hypothesis, we find support in our study. The tenure of forests in our study areas is private, state-owned or communal. As expected, we found that regimes of **de facto** "free access" (state-owned forests, and communal ones without management authority) and the presence of tenure insecurity both tend to favour **degradation** (unmanaged wood extraction) although, unexpectedly, they did not favour deforestation. In turn, private and secure ownership actually accelerates **deforestation.**

The latter result could be perceived as surprising, in regard to theory: private and secure ownership is often believed to lead to **"rational resource use".** The answer is that in our case, land conversion is the rational use, in the perception of the peasant, turning unproductive land to be productive.

Communal ownership is often sought to be converted to private tenure, because it is a **disincentive to individual clearing:** land clearing constitutes a large labour effort, without subsequent tenure guarantee — anybody might take advantage of a piece of land ready for agricultural use, and not formally owned by an individual. Communal ownership is also an obstacle to obtaining **credits,** that are mostly granted on an individual basis. On the other hand, communal ownership may also favour conservation, through a collective valuation of ecological or cultural benefits, but this was found to be a highly exceptional case.

[17] This applies e.g. to the study of McKenzie (1994) for the coastal provinces of Manabí and Los Ríos.

[18] See e.g. CESA (1991) and Brandbyge & Holm Nielsen (1991).

[19] See e.g. Kervin (1982).

[20] See Southgate et.al., 1991.

[21] McKenzie (1994) for the Manabí and Los Ríos provinces.

It was also widely confirmed, both in cross-section as in temporal terms, that **growing wood shortages** tend "to change the rules of the game". Previously, there was a traditional free access to the collection of firewood, independent of forest ownership, but this has changed through time and place: in those places where wood has become a scarce resource, firewood is either bought or, in the words of forest owners, "stolen" on behalf of individuals without forest access. In turn, areas of recent settlement with an abundance of wood stick to the traditional principle of "free access".

8. The peasant's perception of the forest

One of the sections in our questionnaire tried to shed light on the costs and benefits associated by the peasant with the presence of the forest. Table 13 summarizes the results:

TABLE 13: PERCEIVED COSTS AND BENEFITS FROM THE FOREST
(arranged according to their importance)

FOREST BENEFITS:

1. **"agricultural reserve"** for future use (soils)
2. source of **wood** for **domestic** uses (firewood, poles)
3. source of **capital accumulation** (charcoal, timber)
4. **non-timber products** (hunting, medicinal plants)
5. **ecological services** (soil & water protection)

FOREST COSTS:

1. incursion of **birds** into crops
2. attacks from **carnivora** on domestic animals
3. induces excess **humidity**

It seems that most of all, the rural population sees the existing forest ecosystem with a certain **indifference,** perceiving both few benefits and few costs. Supernatural animals and other cultural myths handed over from previous generations describe the forest as a dangerous and unpredictable place that should be respected. However, what matters in productive terms is the potential agricultural soil that it covers, which is only gradually included in the productive system by deforestation, as part of a traditional risk-averse strategy on behalf of the peasant.

The most important tangible **benefit** from the forest is clearly the extraction of wood, first for domestic consumption (especially firewood) and second for commercial sales (especially charcoal, sometimes timber). **Non-timber forest products,** important e.g. for the livelihood of the Amazon tribes, come way down the line of priorization. Only hunting and, in certain regions, medicinal plants are of importance, but both are in decline: hunting because of an over-exploitation, medicinal plants because the considerable time it takes to gather them can be spent better on other activities (domestication or purchase of synthetic substitutes are the alternatives).

On the very end of the list of priorization come the **ecological services,** such as soil and water conservation. There is generally no environmental consciousness to be found, except for areas of advanced colonization where environmental damages are already highly visible. This is e.g. the case in

the rather dry Loja province, where farmers tend to leave standing trees around the water sources in order to impede their drying up. Nevertheless, generally there is no protection element embedded in the traditional practices, neither for foraneous **colonos** nor for native (indigenous) settlers, although the latter are often assumed to dispose of intergenerationally transferred ecosystem knowledge.

A paradox example is the standard conservationist argument included in environmental education speaches to local settlers: “You should preserve this forest, in order to maintain the climate and humidity”. In fact, in our cases of high-altitude, forest-rich recent settlements, climate is cold, cloudy and extremely wet. Consequently, it does not surprise that humans actually perceive an excess humidity (see “forest costs”), and that a less humid climate is seen as a benefit derived from deforestation.

Instead, the real costs are perceived by the **downstream** population that depend on the water flow (irrigation and agriculture, drinking water, hydroelectrical power, etc.). Naturally, these costs are perceived as **externalities** by forest dwellers. This points to the necessity of identifying and quantifying the important external forest benefits (urban water, ecotourism, hydroenergy, biodiversity uses, sedimentation control), and to develop appropriate **compensation mechanisms** that provide the forest dwellers with something more than mere rethorics: a tangible incentive to preserve forest benefits captured by externals.

9. Wood products and deforestation — a numerical example

A central finding of this article is that agricultural soil uses matter more for deforestation than wood products. Therefore, let us close with an illustrative example of explicit comparison between the benefits derived from the two types of income sources.

Table 14 represents a quantification of the typical forest conversion cycle described in table 1, i.e. a numerical 'stylized' scheme of the profitability attached to the different stages of land conversion. Employing net present values, it allows us to incorporate the temporal perspective, i.e. the advantage to obtain wood extraction incomes now, in comparison with farming and animal husbandry incomes in the future.

TABLE 14: THE DEFORESTATION CYCLE AND PER HECTARE PROFITABILITY
Contribution of different productive activities

YEAR	ACTIVITY	NET PROFIT	DISCOUNTED VALUE	
			1=5%	1=10%
1	Timber and	274	274.00	274.00
2	charcoal	274	260.95	249.09
3	Agriculture	369	334.69	304.96
4	Agriculture	263	227.19	197.60
5	Agriculture	178	146.44	121.58
6	Agriculture	111	86.97	68.92
7	Cattle pasture	168	125.36	94.83
8	Cattle pasture	168	119.39	86.21
9	Cattle pasture	168	113.71	78.37
10	Cattle pasture	168	108.29	71.25
11	Cattle pasture	148	90.86	57.06
12	Cattle pasture	128	74.84	44.86
13	Cattle pasture	108	60.14	34.41

YEAR	ACTIVITY	NET PROFIT	DISCOUNTED VALUE	
14	Cattle pasture	88	46.67	25.49
15	Cattle pasture	48	24.24	12.64
		Sum wood products	534.95	523.09
		Sum agriculture	795.30	693.05
		Sum cattle	763.51	505.13
		Sum agric. & cattle	1,558.81	1,198.18
		Net present value	2,093.76	1,721.27
		% Share wood products	0.26	0.30

The example[22] is typical for a medium-altitude zone, with a remaining primary forest rich in wood resources, and with close infrastructural access to markets for wood products. In this sense, it represents the scenario that is most favourable to wood-led deforestation. As to the assumptions behind table 14, values refer to the use of 1 ha. of land, during a cycle of 15 years, where the first two are dedicated to commercial timber and charcoal extraction, the next four to agriculture and the final seven years to cattle ranching. For agriculture, this includes a gradual shift from the most profitable (potatoes) to' the less remunerated crops (maize, wheat); for cattle ranching the income profile also shows a decline, in both cases due to soil nutrient exhaustion.

External costs (transport services, chainsaw maintenance, gasoline, seeds, fertilizers, offspring costs, etc.) were deducted in each case, according to field data: 25% of gross income[23] in the case of timber, 15% for charcoal, 15% for agriculture, and 10-20% for cattle. In regard to the deducted **labour costs,** hired hands were valued slightly higher than family labour, reflecting a relatively higher abundance of the latter.[24] Required labour is highest for wood products and lowest for cattle ranching, with crop cultivation occupying an intermediate position.

Looking at the results in table 14, we see at the bottom that the total net present value (NPV) is 2,093 USD at a 5% and 1,721 USD at a 10% discount rate. Decomposing this total, timber and charcoal incomes combined account for only 26% and 30% of NPV, at the two respective discount rates. This means that even in the case of very prosperous wood extraction conditions, the bulk of net incomes over the cycle is derived from the subsequent agricultural and animal husbandry use of the land.

This result is quite robust to changing assumptions. An extremely high real discount rate (of 35%) is needed to equalize the (immediate) wood income gains with the (subsequent) agricultural and animal husbandry incomes, something which would only be relevant in extreme cases of short-sightedness or credit scarcity.[25]

For comparison, we also calculated the same example for a situation of zero labour costs, i.e. with an **extreme labour abundance** in rural areas. Obviously, this makes labour-intensive timber and charcoal

[22] Values and parameters for the per ha. rentability of wood product extraction, agriculture and animal husbandry were collected from different areas, supplemented by comparable studies (see e.g. Castro (1995) on wood resources) and the interviews of local agricultural experts.

[23] Gross incomes were calculated as **yearly averages,** thus including price and quantity variations during the year. The **size** of gross incomes per hectare might be significantly less in more remote areas with limited market access and/or less wood resources and less fertile soils, but we believe that the **distribution** between activities is relatively stable.

[24] Hired hands 2 USD/day, family labour (that sometimes includes children) 1.6 USD/day.

[25] This would apply e.g. when squatters seek to maximize incomes during only 3-4 years, in order to **sell the land** and move to the cities (also valid when **tenure insecurity** abounds), or, alternatively, when only informal credits at **extreme usury interest rates** are available to farmers lacking own savings.

production better off, but they still account in combination only for a minority of total incomes over the cycle (38% at i=5%, 43% at i=10%).[26]

This confirms that wood products do not constitute the main economic motive for deforestation in our study areas: in terms of the net income derived, farming and cattle ranching on the converted forest area is more lucrative. However, a number of factors can reinforce the relative importance of wood products:

* presence of high-value timbers and rich wood resources
* closeness and infrastructural access to mega-markets
* chronic liquidity shortages and credit scarcity
* an extreme short-sightedness in the peasants' land use planning, e.g. planned migration to the cities.

10. Conclusions, perspectives and recommendations

This article has summarized a number of comparative case studies from four provinces of the Ecuadorean highlands, investigating the type and importance of wood exploitation, and its relation to the rapid ongoing deforestation process, especially in the still fertile Eastern and Western flanks of the Andes.

Normally, timber exploitation tends to be selective, and is mainly to be blamed for forest **degradation,** whereas firewood and especially charcoal production may be causing proper deforestation in some cases. On the other hand, deforestation without subsequent soil uses is practically non-existent. The main motive is clearly the high demand for soils in agriculture and animal husbandry: the end use of deforestated land is typically pasture.

There are two exceptions to this general pattern of deforestation led by the demand for agricultural soils: First, in the areas that are **close to the mega-market of Quito,** there is a high demand for boards in construction and for charcoal in broiler restaurants, which may accelerate the process of deforestation.

Second, in areas of severe **credit scarcity,** peasants capitalize a once-and-for-all rent from wood to buy cattle for their recently cleared pastures, or to cover any casual liquidity shortage, e.g. for buying Christmas presents or for unexpected costs (e.g. replacement of thefts, medical expenses, etc.).

Markets for wood products tend to be rather competitive (charcoal, firewood), except for timber, as a more heterogenous product (lack of transparency, inefficiencies). Only in the latter case, middlemen profits are high. High transport costs generally limit the expansion of wood trade. There is only a negligible value attached to the primary wood source; a fact that, together with low labour costs, favour the urban consumer by depressing retail prices. Basically, this has to do with wood being a by— product of colonization: if no infrastructural access exists, most of the wood is simply burned on the spot.

We found basically three factors that **determine deforestation.** First, **demographic pressures** are extremely high in our 'agricultural frontier' settlements, with labour abundance, low salary levels and a continuing out-migration, and there is a direct link between the division of plots after an inheritance and the clearing of new lots. Second, most peasants have a strong desire to **integrate into the market economy,** mainly by means of extensive cattle ranching, which represents the end use of almost all deforestated areas. Unlike Central America and the Brazilian Amazon, cattle ranching is not promoted by “perversive” subsisidies, giant export markets or international funding; it is rather a small-scale, gradual process favoured by rapid urbanization and the rising incomes of milk, cheese, and meat consumers. Third, and generally less important, is the (slow) **degradation** of soils, caused by inappropriate agricultural practices, that gives an incentive for peasants to 'move on' to cultivate pristine land.

[26] On the contrary, some observers would object that land is the most abundant factor, and that all calculations should be carried out per labour unit, instead of per hectare. However, our field data (rural salaries, migration patterns, etc.) suggest that labour is highly abundant in rural Andes regions of Ecuador.

We did not find support for the widely accepted hypothesis[27] of a direct link between **poverty** and a "push" for deforestation: the 'implementing agent' often belongs to the poorest class (e.g. landless labourers specialized in charcoal), but the 'decision maker' is the (relatively priveleged) landowner, who bases his decision more on "pull" factors of rural development. On the contrary, the richest landowners tend to deforestate more, because they can afford to hire more hands and invest in subsequent soil uses. Consequently, the frequently held belief that any type of poverty alleviation reduces deforestation turns out to be naive.

In the perception of the peasant, the most important **present benefit from the forest** is clearly the use of wood. Non-timber forest products have a limited, and declining, role: collection of fruits, medical plants, etc. takes too much time, compared to other employment opportunities and the availability of cheap synthetic substitutes. "Free access" resources such as fish and game have already been over-exploited. Ecological forest services are normally not recognized, and mostly they provide benefits to the external population, not to the locals.

A number of **forest disadvantages** (e.g. predators attacking animals, birds eating seeds) are also perceived, but not as dominant. Most of all, the peasant is indifferent to the forest as an ecosystem; he sees it as an **"agricultural reserve"** for the future, which he exploits only gradually, as part of a riskaverse strategy.

Not surprisingly, the field actions of **public institutions** have tended to accelerate deforestation, through their obsolete concept of "colonization without limits and planning", although they cannot be said to constitute decisive actors in the process. The **land title agency IERAC** (now reshaped as **INDA**) has always required a minimum active forest clearing during a number of years, as a precondition for granting a title. They have also favoured small-scale "active" squatters in their struggle against large, absent landowners that "passively" conserved the forest. For the **Bank of Production & Promotion (BNF),** the picture is similar: cleared land as a precondition for credits, and a strong bias towards cattle ranching, as the most extensive land use.

Finally, the **forest agency (INEFAN)** has been administering the denomination of "Protective Forests", which in most cases only exist on paper, as a result of endless deficiencies: lack of consensus across sectors and of realism in the demarcation of protected areas, lack of local participation and of productive alternatives, limited capacity and presence in the field, and highly centralistic organization. Moreover, INEFAN is often locally accused for corruption in its administration of the Forest Law.

On aggregate, the picture that we found is characterized by a strong dynamics of agricultural land conversion, whereas the exploitation of wood products is a derived phenomenon. It is also an 'inferior' activity that tends to lose significance at a growing stage of development. The outlook for counter-acting the ongoing deforestation process is quite pessimistic, at least with a strategy based only on managed product extraction from the forest. Instead, more attention should be given, in the first place, to changing the direction of agricultural dynamics and, secondly, to create mechanisms for the remuneration of various forest services.

Our recommendations as to a more successfull strategy of conservation and sustainable use are, in a summary version:

To PROBONA, INEFAN, and the environmental agencies:

> — to initially stress actions **outside the forest,** in the field of **agricultural change** (land-intensifying, labour — extensive methods with higher and more sustainable yields), and other **value-added creating options** (absorbing labour surplus and "win time" for a forest conservation strategy),
>
> — to then gradually shift emphasis **inside the forest,** towards **raising the local value of the forest,** through forest management (with a vertical integration into marketing), selected commercial non-timber forest products, but also

[27] See e.g. Sainz (1995) on charcoal production.

— with a high profile for **"external" benefits** (ecotourism, biodiversity, ecological services) and mechanism to generate direct or indirect payments or compensations to forest owners,

— to recognize **cross-sectoral linkages,** choose integrated approaches, and search for cross-sectoral partners, at the local and national level, regarding "green" conditionalities and other coordinated action,

— to generally abstain both from further **prohibitions** on the commercial use of wood products and from further **subsidies** to alternative energy sources, but to encourage the introduction of selected **energy-saving technologies,** whereever there is a manifested local interest to use them,

To INEFAN, as the legal and administrative forest entity:

— to reform the declaration of **Protective Forests** towards more realism, local participation, institutional consensus — building and pre-identification of productive alternatives,

— to increase decentralization and field presence, but also to raise control with corruption episodes,

— to search for a closer **cooperation** with the public and the non-governmental development agencies.

To the development and land tenure agencies:

— to abandon **obsolete requirements** of "minimim clear cuts", to strengthen tenure security, independent of use, and to increase control with corrution episodes,

— to **abandon biases** towards cattle ranching credits and against communal credits, and to promote diversification, small-scale rural industries and intensified land uses,

— to search for **coperation** and **coordination** with entities regarding forests, potential land use, and technical assistance within the agricultural fields.

LIST OF LITERATURE

Anderson, A. (ed.): Alternativas a la deforestación, chapter 1: "Deforestación de la Amazonía: dinámica, causas y alternativas" (Spanish version), Abya-Yala, Quito 1990

Andrade, J. y E. Morán: Estudio sobre el consumo energético de leña en el área rural del Ecuador, INE study no. 6, 1981

Brandbyge, J. y L.B. Holm Nielsen: Reforestación de los Andes Ecuatorianos con especies nativas, CESA, Quito, 1991.

Brownrigg, L.A.: Economic and ecological strategies of Lojano migrants to El Oro, in: Whitten, N.E. (ed.): Cultural transformation and ethnicity in modern Ecuador, Urbana-Chicago 1981

Castro et.al.: Evaluación socio — ambiental rápida de la cuenca alta del río Guallabamba (internal draft), Maquipucuna/PROBONAUICN, April 1995

CESA: Usos tradicionales de las especies forestales nativas en el Ecuador, Volume I, Research report. Quito, August 1991.

Edelman, M.: Rethinking the Hamburger Thesis: deforestation and the crisis of Central America's beef export, in: Painter & Durham (eds.): The social causes of environmental destruction in Latin America, University of Michigan, 1994

Ekstrom, J.P.: Colonist strategies of verticality in an Eastern valley, in: Whitten, N.E. (ed.): Cultural transformation and ethnicity in modern Ecuador, Urbana-Chicago 1981

Hardin, G.: The tragedy of the commons, Science 162, p.1243-48, 1968

ITTO/INEFAN 137/91/STCP: Estrategias para la Industria Sostenida de la Madera en el Ecuador", final report, Quito 1994.

ITTO/INEFAN 154/91: Desarrollo integrado de la estructura de comercialización de la madera y productos de la madera en el Ecuador", final report, Quito 1994

Kervin, B.: Teoría económica y medio ambiente, Ruralter no. 10, CICDA 2nd semestre, p.91-108, Cuzco 1992

Laso, E.G. & F. Guerrón: Comercialización y mercadeo de especies maderables nativas y usos energéticos de los bosques nativos andinos, Probona-UICN, Preliminary internal report, February 1994

Mckenzie Hedger, M.: La política y la gestión de la energía rural: la experiencia del Ecuador, FLACSO, Quito 1994

Morris, A.: Forestry and land-use conflicts in Cuenca, Ecuador, Moutain Research and Development, vol. 5, no. 2, 1985

Mougeot, L.: Circulación de un combustible crítico en el callejón andino: la leña en la cuenca alta del río Paute, Revista Geográfica, no. 101, January-March 1985

Sainz, J. L.: Carbón vegetal — producción artesanal en la comunidad de Khora, en: FAO-DFPA: Pequeñas empresas forestales de Bolivia, industrias 2, 1991

Southgate, D.: The causes of land degradation along "spontaneously" expanding agricultural frontiers in the Third World, Land Economics, vol. 66, no. 1, February 1990

Southgate, D. et.al.: The causes of tropical deforestation in Ecuador: a statistical analysis, World Development, vol. 19, no. 9, pp. 1145-51, 1991

Townson, I.M.: Forest products and household incomes — a review and annotated bibliography, primera parte: "Fuelwood and charcoal enterprises", Oxford Forestry Institute, Oxford, May 1994.

White, S. & F. Maldonado: The use and conservation of natural resources in the Andes of Southern Ecuador, Mountain Research and Development, vol. 11, no. 1, pp. 37-55, 1991

Wunder, S.: Los caminos de la madera — una investigación de usos domésticos y comerciales de los productos de la madera, y su relación con el proceso de deforestación, PROBONA-UICN, Quito 1995 (forthcoming)