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EMPLOYMENT AND RESOURCE EFFICIENCY IN THE FOREST PRODUCTS INDUSTRIES OR ECUADOR

Jan G. Laarman and Jeffrey P. Prestemon

FPEI Working Paper No. 40

School of Forest Resources
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INTRODUCTION

Small-scale enterprises (SSEs) are a focus of development assistance in a number of developing countries. In forestry and forest industries, SSEs are an important but neglected element of policy. Very little is known about their extent, size, and basic characteristics. However, it is generally assumed that forest-based SSEs are the source of much employment. Other attributes frequently ascribed to them include: respectable incomes for proprietors and their families; wage income to employees; skill transfer through informal training; and general contributions to local and national economies. Earnings from forest-based SSEs are said to improve farmers' income security, reducing pressures which lead to overexploitation of the agricultural land base. Moreover, those receiving income and employment include many among the landless, women, and other socially targeted groups (FAO 1987, p. 1).

With the exception of the work cited by FAO and a few other previous studies (e.g., Page 1978; Laarman 1982), there is insufficient empirical investigation of these statements to regard them other than as working hypotheses. The present study tests some of these hypotheses using the case of forest-based SSEs in Ecuador. It provides employment estimates, and examines a few issues pertinent to enterprise efficiency.

Data are from a 1987 survey of 545 forest-based enterprises covering 19 of Ecuador's 20 provinces (Galapagos is omitted). Enterprises selected for interviews were identified through a cluster sampling framework. In addition, the nine interviewers (organized into three crews) performed a field count of all wood-based enterprises they personally observed or were informed that existed in and around Ecuador's cities, towns, and highways. This systematic tally provided a minimum estimate of the country's population of such enterprises. Finally, 14 relatively large-scale enterprises were studied separately to provide a comparison with the SSEs.

The present study does not stand in isolation of much recent inquiry into the efficiency and employment aspects of SSEs. Different analysts are applying different methods to different sectors and industries, arriving at different conclusions. The issues remain far from settled, warranting considerably more examination and clarification for policy-making audiences (Rhyne 1988, p. 20).

NUMBER AND COMPOSITION OF ECUADOR'S FOREST-BASED SSEs

A field count carried out during the last four months of 1987 resulted in a tally of 3,445 enterprises in primary and secondary forest-based industries. This included 316 sawmills;

12 plywood plants and other panelboard plants; 737 wholesale outlets (wood deposits); and 2,455 carpentry shops, furniture plants, and other secondary manufacturing establishments. Given that some small and remote enterprises undoubtedly escaped the tally, this estimate is a lower bounds.

To the fixed processing establishments must be added approximately 4,500 chainsaw sawmillers ("motosierristas"). These chainsaw operations produce sawnwood at the stump by felling trees and converting them directly into boards and cants in the forest. When including the chainsaw operations, the total number of active forest-based enterprises probably exceeds 8,000.

No matter how scale is defined, the vast majority of these enterprises are small. Table 1 presents a profile of the surveyed enterprises, providing indicators of scale. The maximum number of hired workers is only 13 among the primary processors, and only 18 among the secondary establishments.

Another measure of scale is wood input. Mean roundwood input for the primary processors is only 2.69 thousand cubic meters, although the standard deviation is very high. It is difficult to define concepts and measurements of wood input for secondary establishments, given their great variety. However, the mean volume of 333 cubic meters implies establishments of very modest scale at the lower end of the spectrum.

The interviewed primary processors have mean annual sales equivalent to US$23.8 thousand on a mean fixed investment of US$43.8 thousand. Equivalent figures for the secondary manufacturers are US$16.3 thousand and US$10.0 thousand, respectively. Whether capital is measured as a stock or a flow, capital-labor ratios exhibit large differences between primary vs. secondary establishments. The primary processors use approximately four times as much capital per worker as the secondary establishments.

EMPLOYMENT ESTIMATES

Table 2 shows national employment levels in Ecuador's forest-based SSEs. Employment data from the survey are projected to a national estimate of 22.4 thousand persons by using the tally of establishments. Approximately 62 percent of this employment is in the secondary establishments.

Another key dimension of sectoral employment is its composition. Among the surveyed secondary establishments, 72 percent of labor input is by permanent hired workers. The equivalent figure among the primary establishments is 44 percent. This difference is consistent with the data on establishment size, given that mean level of employment in the secondary establishments is higher than in the primary establishments. Hence one explanation is that the secondary establishments require greater numbers of hired workers to complement the family

TABLE 1. Selected Characteristics of Forest-Based SSEs in Ecuador (Late 1987).

	Primary Industries[1]			Secondary Industries[2]		
		Mean	Min.		Mean	Min.
	(n)	Std. Dev.	Max.	(n)	Std. Dev.	Max.
Age of Estab. (no. of years)[3]	(184)	8.7 7.2	0.5 45.0	(228)	9.8 8.9	0.5 50.0
Wood Input (cubic meters)	(184)	2698 7157	4 83812	(228)	333 670	3 7917
Annual Sales (thousand sucres)[4]	(184)	5958 10141	11 6303	(228)	4071 5980	15 63063
Value-Added[5]	(178)	3010 7722	-8179 44170	(223)	-13 3621	-20980 22225
(thousand sucres per year)						
Labor						
Permanent[6]	(184)	1.13 2.32	0.00 13.00	(225)	1.38 2.26	0.00 18.00
Part-Time[6]	(184)	1.59 0.20	0.00 15.00	(228)	0.94 1.52	0.00 8.00
Family[7]	(181)	1.20 1.34	0.00 8.00	(228)	1.34 1.43	0.00 6.00
(no. persons, annual full-time equivalent)						
Value of Plant and Equipment (thousand sucres)	(105)	1538 3069	50 19700	(119)	2510 7800	6 80000
Working Capital (thousand sucres)	(184)	371 942	0 11175	(228)	619 1178	0 10000
Flow of Capital Services[8] (thousand sucres per year)	(105)	232 455	10 3075	(119)	271 71	1 7847

(Continued)

(TABLE 1, CONTINUATION)

	Primary Industries			Secondary Industries		
		Mean	Min.		Mean	Min.
	(n)	Std. Dev.	Max.	(n)	Std. Dev.	Max.
Capital Stock per Labor (thousand sucres per annual full-time unskilled equivalent) [9]	(104)	3232 4177	217 31080	(119)	2159 6008	12 58667
Capital Flow per Labor (thousand sucres per annual full-time unskilled equivalent) [9]	(103)	297 259	9 1218	(44)	202 219	7 1241
Value-Added per Unit Cap. Stock (thousand sucres per thousand sucres)	(101)	2.34 6.30	-18.36 24.32	(115)	-0.31 4.57	-37.60 12.77
Value-Added per Unit Cap. Flow (thousand sucres per thousand sucres)	(101)	27.26 72.22	-201.98 351.26	(42)	-0.68 20.47	-68.21 40.56

Notes:
1. Includes chainsaw sawnwood, sawmills, and three panel plants.
2. Includes wood depots and secondary forms of wood processing (e.g., furniture, moldings, etc.).
3. Establishments opened within one year of the interview were assigned an age of 0.5 years.
4. Exchange rate: 250 sucres = 1 U.S. dollar.
5. Total sales minus all purchased inputs, except labor and capital.
6. Hired labor.
7. Unpaid labor.
8. Determined using a 12 percent discount rate for capital recovery (see Appendix).
9. Family labor is weighted at one-half unskilled labor. Proprietary labor is weighted equivalent to skilled labor. Assumed working days per year: chainsaw sawnwood, 150 days; sawmills, 162.5 days; wood deposits, 250 days; secondary processors, 262.5 days.

Source: Survey Conducted by INFORDE, Sept.-Dec. 1987.

TABLE 2. Employment in Ecuador's Forest-Based SSEs (Late 1987).

	Primary Industries		Secondary Industries	
	Chainsaw Sawnwood	Sawmills	Secondary Converters	Depots and Wholesalers
Nationwide Count of Establishments	4500[1]	312	2376	737
Number of Establishments Sampled	117	67	93	138
Annual Full-Time Equivalent[2] Hired Labor:				
Per Establishment	0.61	3.08	3.72	1.59
Nationwide	2745	961	8841	1168
Annual Full-Time Equivalent[2] Unpaid Family Labor:				
Per Establishment	0.98	1.07	1.22	1.39
Nationwide	4410	334	2887	1025
Annual Full-Time Equivalent[2] Labor (Hired + Family):				
Per Establishment	1.59	4.15	4.94	2.98
Nationwide	7155	1295	11728	2193

Notes: 1. Estimated indirectly. See text.
2. Full-time equivalent computed from a weighted average of full-time workers (weight = 1.0) and part-time workers (weight = proportion of time worked).

Source: Survey conducted by INFORDE, Sept.-Dec. 1987.

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Women comprise only a very small proportion of the labor force in Ecuador's forest-based sector. The survey estimates this proportion as 0.7 percent, or 157 full-time equivalent women workers.

ENTERPRISE EFFICIENCY

The employment case for SSEs depends on a reasonable level of efficiency. Efficiency must be defined and assessed in social terms, considering opportunity costs rather than market prices (Little et al. 1987, p. 5).

Tables 3 and 4 present three types of benefit-cost ratios for the forest-based SSEs in Ecuador. (These ratios are defined in an appendix). Size of establishment is alternatively expressed by number of hired workers (Table 3) and level of fixed investment (Table 4).

For primary establishments, benefit-cost ratios range from a minimum of 1.10 to a maximum of 5.43, depending on the type of ratio and the particular size class. Most estimated ratios are statistically different from unity. Despite the great amount of variation from establishment to establishment, the primary SSEs as a group appear to be highly efficient according to all three expressions of benefit-cost. Moreover, by either scale index, efficiency extends to even the smallest establishments.

This contrasts with very low measures of efficiency in the secondary SSEs. Only a few benefit-cost ratios exceed unity, and these pertain to just a handful of establishments. The most important ratios, applying to aggregates of many establishments, are small and even negative.

How is it possible for these secondary SSEs to suffer such poor economic performance and stay in business? First, the survey considers the firm's sales and purchases at only one interval in time, not continuously. The survey may have coincided with a period of depressed demand, rising costs, or both. According to McKean (1987), segments of the secondary SSEs have encountered escalating costs and strong competition in the last few years.

Another explanation for the exceedingly low benefit-cost ratios is simply weak data, either through errors of the interviewers or through the respondents' inability or unwillingness to supply reliable figures. Table 5 provides a sensitivity analysis showing effects on benefit-cost ratios if actual sales were double those reported to the interviewers. Benefit-cost ratios rise to very high levels, even among the secondary establishments. Although it cannot be assumed that respondents uniformly underreported sales to such an exaggerated extent, the test indicates the extreme sensitivity of the

TABLE 3. Estimated Benefit-Cost Ratios, by Size of Employment.

Establishment Size (No. of Hired Workers)	No. Estab. Surveyed	Benefit-Cost Ratios 1/ Private	Social	Entrepreneurial
---------- Primary Industries ----------				
0 - 5	91	2.84**	2.77**	2.54**
5 - 10	8	4.14*	3.83*	3.73*
0 - 10	99	2.94**	2.86**	2.64**
10 - 49	3	1.67	2.79	0.84
---------- Secondary Industries ----------				
0 - 5	36	-0.40**	-0.15**	-1.21**
5 - 10	5	2.09	1.96	1.46
0 - 10	41	-0.09**	-0.02**	-0.88**
10 - 49	1	1.93	2.14	2.13

Notes: 1. See Appendix for calculations.

2. Mean ratio is significantly different from 1.00 at 95 (*) and 99(**) percent confidence levels.

Source: Survey conducted by INFORDE, Sept.-Dec. 1987.

TABLE 4. Estimated Benefit-Cost Ratios, by Size of Capital Stock.

Establishment Size (Thousand Sucres)	No. Estab. Surveyed	Benefit-Cost Ratios 1/		
		Private	Social	Entrepreneurial
Primary Industries				
< 250	33	2.19**	2.24**	1.93**
250 - 1000	38	1.46*	1.69**	1.10
> 1000	32	5.43**	4.93**	5.10**
Secondary Industries				
< 750	12	-0.02**	-0.58	-0.51**
750 - 2000	13	-1.75**	0.15*	-2.79**
> 2000	17	1.24	0.99	0.49*

Notes: 1. See Appendix for calculations.

2. Mean ratio is significantly different from 1.00 at 95 (*) and 99 (**) percent confidence levels.

Source: Survey conducted by INFORDE, Sept.-Dec. 1987.

TABLE 5. Sensitivity Analysis of Social Benefit-Cost Ratios to Increased Sales, by Establishment Size.

Establishment Size	Social Benefit-Cost	
	Base Case	Sales x 2
Primary Industries		
A. No. of Hired Workers:		
0 - 5	2.77	9.92
5 - 10	3.83	9.14
0 - 10	2.86	9.86
10 - 49	2.79	9.74
B. Capital Stock, Thousand Sucres:		
< 250	2.24	8.26
250 - 1000	1.69	7.19
> 1000	4.93	14.76
Secondary Industries		
A. No. of Hired Workers:		
0 - 5	-0.15	6.13
5 - 10	1.96	9.89
0 - 10	-0.02	6.36
10 - 49	2.14	7.31
B. Capital Stock, Thousand Sucres:		
< 750	-0.58	5.71
750 - 2000	0.15	7.96
> 2000	0.99	5.89

Sources: Tables 3 and 4.

benefit-cost ratios to reported sales levels. Liedholm and Mead (1987, p. 116) stress the importance of measuring flow variables through long-term monitoring and periodic visits, in contrast to the single visit which produced the data for the current study.

Still another source of error is the possibility of inappropriate assumptions in the computation of the benefit-cost ratios, e.g., referring to the methods and data in the appendix. For example, common difficulties include inaccurate estimation of the social cost of capital, inappropriate allowances for price differences to reflect differences in product quality, and poor estimation of opportunity costs of entrepreneurial capital and labor (Cortes et al. 1987, Ch. 3). However, known deficiencies in methods and data cannot explain the marked difference in benefit-cost ratios between the primary vs. secondary SSEs.

Here it is instructive to consider efficiency measures for a group of 14 large-scale enterprises in the sector (Table 6). These 14 larger establishments were surveyed a few months after the survey of the SSEs, but prices and costs had not shifted to any noticeable extent. Table 6 shows all benefit-cost ratios to exceed unity for primary as well as for secondary establishments. Capital costs for these firms are highly subsidized, but even the social benefit-cost ratios (at the opportunity cost of capital) are greater than one.

DISCUSSION

This study of forest-based SSEs in Ecuador reinforces many previous findings about small-scale enterprises generally. However, it also reveals a few anomalies and surprises. That Ecuador's forest-based SSEs number in the several thousands seems plausible in view of the widespread distribution of commercial timber, the relatively low barriers faced by entrepreneurs entering many categories of wood-based businesses, and the large and diffuse demand for basic wood products. A large number of small firms is consistent with the early Westoby (1962) model of forest industries development: (1) limited skills and low capital; (2) (2) flexible location and production technologies; and (3) strong backward and especially forward linkages.

Likewise, employment of over 22 thousand persons (full-time equivalent) is reasonable, considering that Ecuador's total manufacturing employment is about 354 thousand persons (Banco Central del Ecuador 1987, p. 212). This implies that the forest-based SSEs provide more than 6.3 percent of the country's manufacturing employment, a proportion which does not strain credibility. Adding the workers in larger enterprises, Ecuador's forest-based employment is 25 thousand persons, or 7.1 percent of total manufacturing.

The more provocative observations concern the share of hired labor in total labor (61 percent), and the low proportion of women workers (0.7 percent). The preponderance of hired labor is not consistent with the data published for six countries by FAO

TABLE 6. Selected Characteristics of Large Forest-Based Enterprises in Ecuador (Midyear 1988).

	Primary Industries[1]			Secondary Industries[2]		
	(n)	Mean	Std. Dev.	(n)	Mean	Std.Dev.
Employment (no. persons)	(7)	184	93	(7)	196	331
Annual Sales (thousand US$)						
Financial Prices	(7)	560	358	(7)	241	394
Economic Prices	(7)	635	398	(7)	243	393
Input Costs (thousand US$)						
Financial Prices	(7)	306	162	(7)	132	270
Economic Prices	(7)	300	142	(7)	133	274
Benefit-Cost Ratios						
Private I [3]	(7)	2.19*	2.37	(7)	2.24**	1.05
Private II [4]	(7)	2.56*	2.97	(7)	2.40**	1.15
Social [5]	(7)	1.54*	1.29	(7)	1.68**	0.85

Notes:
1. Includes plywood and particleboard.
2. Furniture, both solidwood and from particleboard.
3. Value-added in the numerator, labor and capital costs in the denominator, all at financial prices.
4. Value-added in the numerator, and labor in the denominator, at financial prices.
5. Value-added in the numerator, labor and capital costs in the denominator, all at economic prices. Assume real cost of capital is 7.5 percent.
6. Mean ratio is significantly different from 1.00 at 95 (*) and 99 (**) percent confidence levels.

Source: Fernando Guerron V., 1988, survey conducted by INFORDE.

(FAO 1987, p. 6), which show entrepreneurial labor to comprise 41-89 percent of total labor in forest-based SSEs. Finally, the very small representation of women in Ecuador's forest-based SSEs gives little support to the notion that these enterprises provide women with jobs and income (FAO 1987, pp. 41-42).

Why does the survey for Ecuador differ from the surveys for FAO? The survey planners in Ecuador adopted a relatively conservative and traditional view of forest-based enterprises. In addition to wood, the studies for FAO included activities related to baskets, mats, reeds, vines, grasses, and similar non-wood materials. These are predominatly household activities requiring no power equipment; are smaller than factory and workshop enterprises; and are often run by just one person, including many women (FAO 1987, pp. 7, 41).

These non-wood microenterprises are largely absent from the Ecuador survey. This implies that a broader definition of the forest-based sector would have resulted in a higher tally of enterprises, higher total employment, higher proportion of entrepreneurial and family employment; lower average capital investment, and higher proportion of women.

The discouraging social efficiency of the secondary SSEs--to the extent that this survey's observations are accurate and more than merely ephemeral--presents a bleak perspective for sectoral growth and development. McKean (1987, Ch. 7) made the following observations for small furniture manufacturers in Guayaquil for the year 1986: (1) most firms were facing rapidly rising prices for inputs of sawnwood, plywood, and new machinery; (2) most firms depended on only a few suppliers for these inputs; (3) most firms depended on intermediaries for working capital, and most were unable to integrate forward into retailing; (4) firms contended with rising labor costs by keeping establishments small and workers on temporary status; and (5) most firms reported intensified competition over the past few years. If McKean's observations apply not only to small furniture enterprises but also to other categories of small secondary establishments, then it is easily understood why the present survey finds unfavorable benefit-cost ratios.

This overview of employment and efficiency in Ecuador's forest-based SSEs leaves more questions than answers. This is expected when considering the lack of ready prescriptions and tailored formulas (Pickett and Robson 1986, pp. 12-20). Small is romantic, but small is less beautiful than medium in any number of empirical cases (Little 1987).

Regarding policy directions in Ecuador, it will be critical to re-examine whether the secondary SSEs are in fact incurring losses over a prolonged period. Will this problem correct itself through Darwinian business forces? What factors explain why the secondary SSEs are suffering when the primary establishments appear to be doing well? Is there a particular "missing ingredient" (Liedholm and Mead 1987, pp. 112-113) that can be

supplied, or does progress depend on a set of diverse and integrated factors? These are among the priorities for further investigation.

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APPENDIX: BENEFIT-COST RATIOS

Three benefit-cost ratios used in this study are Entrepreneurial (EBC), Private (PBC), and Social (SBC). The EBC assumes that the proprietor's basic objective is to maximize the return on his own capital and labor inputs in the enterprise. In the numerator the formula subtracts from value-added (the result of subtracting the value of all purchased inputs from total sales) the cost of borrowed capital and the cost of hired labor. In the denominator is found the cost of self-financed capital and the opportunity cost of the family and proprietary labor.

The EBC examines how well the proprietor utilizes his expertise to cover his share of fixed and variable costs. A ratio of greater than one indicates that all costs are covered and that he is earning significant profits. A ratio of less than one but greater than zero indicates that he generates at least positive value-added, but not enough to cover all of his costs. A ratio of less than zero indicates that he is not generating enough value-added to cover **any** of his costs (Cortés et al. 1987).

The PBC relates total benefits to the costs of all resources employed by the enterprise. In the numerator is found only value-added. The denominator includes capital costs from all sources (self-financed and borrowed) and the wage bill (including hired labor and the opportunity costs of the proprietor's and family's labor).

The SBC normally works exclusively with opportunity costs. In the numerator is value-added. In practice, the denominator includes one social opportunity cost of capital applied to all capital (working and fixed), plus the cost of labor valued at its opportunity cost. The SBC can be used to compare efficiencies between firms and groups of firms within industries if domestic prices are used in the calculations of the value-added and capital inputs to production. To compare between industries one must use "world" or "border" prices (Little 1987; Liedholm and Mead 1987). Border prices are the c.i.f and f.o.b. prices of tradable inputs and tradable outputs of production, respectively (Jansen and Ruiz de Gamboa 1987). An Social Benefit-Cost Ratio of greater than 1.Ø indicates that a firm or industry has a positive effect on the total output of the economy; a ratio of less than one implies a negative effect (Biggs 1986; Liedholm and Mead 1987).

Calculations

1. The Private Benefit-Cost Ratio was calculated as follows:

$$PBC = \frac{VA}{rK + wL}$$

where: VA = value-added, calculated as the net of sales minus all purchased inputs to production (i.e., neither working or fixed capital nor the cost of labor are subtracted from total sales);

r = a weighted average of interest rates corresponding to the enterprise's various credit sources, including the proprietor's own capital;

wL = the firm's wage bill, including the opportunity cost of family and proprietary labor;

K = the firm's total fixed and working capital.

In this study, value-added is in sucres per year. The interest rate is assumed to be 7.5% for borrowed capital and 1% for self-financed capital. The 1% figure was arrived upon after considering that most owners of very small enterprises have very little money to invest. The little money that they could invest would most likely go to a commercial bank savings account, many of which (or, rather, during this period, most, if not all of which) paid a negative real rate of return at the time of the survey (McMullen 1988). Currency speculation (purchase of dollars, for instance), on the other hand, although risky, would probably have been the highest-returning investment.

Fixed capital is in terms of buildings, machines, forestry equipment, and vehicles. Working capital is taken to be the value of inventory (Liedholm 1988). The opportunity costs of family and proprietor labor were calculated as follows:

(1) The opportunity cost of family labor was assumed to be one-half of the average monthly wage paid to unskilled workers in the same technology and region. This was multiplied by 12 to obtain annual values.

(2) The opportunity cost of proprietor labor was assumed to be the average monthly wage of skilled workers in

the same technology and region. This wage was multiplied by twelve to obtain an annual value.

2. The Social Benefit-Cost Ratio was calculated as follows:

$$SBC = \frac{VA}{r_s + w_s L}$$

where: VA = value-added, calculated as in No. 1, above;

r_s = the opportunity cost of capital, usually one rate across all sources of capital ($r_s K$ was calculated using the Capital Recovery Factor (see Number 5, below)), fixed and working;

w_s = the opportunity cost of labor for each skill category, including the opportunity cost of family and proprietary labor.

The opportunity cost of capital is taken as 7.5%. The opportunity cost of each hired worker was taken as the 10th-percentile monthly wage. This was disaggregated to skill category (administrative, skilled, and unskilled), subindustry, and region (coast, highlands, Amazonia). This value was multiplied by 12 months to obtain an annual opportunity cost of hired labor.

Family and proprietary labor opportunity costs were calculated as in Number 1, above.

3. The Entrepreneurial Benefit-Cost Ratio was calculated as follows:

$$EBC = \frac{VA - [r_b K(b) + w_h L(h)]}{r_o K(o) + w_o L(o)}$$

where: VA = value-added, calculated as explained above, in sucres per year;

$r_bK(b)$ = the cost of borrowed capital, including (r_1K_1), the cost of borrowed fixed capital, and (r_2k_2), the cost of borrowed working capital;

$w_hL(H)$ = the cost of hired labor;

$r_oK(o)$ = the opportunity cost of the proprietor's self-financed capital. It also includes fixed and working capital;

$w_oL(o)$ = the opportunity cost of proprietary and family labor.

In this study, it is assumed that $r_1 = r_2 = 7.5\%$. Working capital is taken as the value of inventory.

The opportunity cost of the proprietor's self-financed capital (comprising an average of approximately 88.6% of the firm's total capital in the primary industry) was assumed to be 1% (as explained above).

The opportunity costs of family and proprietary labor were calculated as explained in Number 1, above.

4. The returns to family labor were calculated using the following formula:

$$RFL = \frac{VA - (wL_h - rK)}{H_f}$$

where: RFL = net returns to family labor;

VA = value-added;

wL_h = the wage bill for all hired labor, valued at its shadow price;

rK = the annual cost of capital, valued at its shadow price ;

H_f = hours of family labor, including those of the proprietor.

The opportunity cost of capital is the sum of the cost of borrowed plus self-financed capital, as explained in Number 3, above. The hours of unpaid family labor per person per year were assumed to be equal to 1200 for motosierristas and 1300 for small sawmills.

5. The annual cost of capital was calculated using the capital recovery factor (CRF), taken from Liedholm and Mead (1987):

$$CRF = R = \frac{rV}{1 - (1 + r)^{-n}}$$

where: R = annual capital cost;

r = interest rate;

V = present value of the unit of capital;

n = average expected life (in years) of the unit of capital.

The present value of a unit of capital was determined by taking either the proprietor's estimate of the unit's present value or, if the proprietor could not estimate, the unit's original purchase price. That purchase price was inflated to 1987 sucres (average of September and October) using the Ecuadorian Central Bank's consumer price indices (Banco Central Del Ecuador 1977; Banco Central del Ecuador 1987), base 1970 = 100. Capital was then depreciated proportionately each year from the date of the purchase, to

a minimum of 10% of the present value of its original purchase price (i.e., its salvage value).

The average expected life of the units of capital were assumed as follows:

* buildings, 20 years;
* vehicles, 10 years;
* machines, 15 years;
* forestry equipment, 4 years.

Land was not included in the capital stock.

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