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REGIONAL OFFICE FOR CENTRAL AMERICAN PROGRAMS

(ROCAP)

SUPPLY AND DEMAND TRENDS OF MECHANICAL WOOD PRODUCTS IN CENTRAL AMERICA

José G. Flores Rodas

San José, Costa Rica

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I. INTRODUCTION

The intention in this paper is to provide a basis for estimating the demand and supply situation of primary wood products in the Central American/Panamá (CA/P) Region in the short and the long run. (Arbitrarily, as a long run horizon, the year 2010 has been established).

The terms of reference (scope of work) for this study can be found in the annex of this report.

1.1 Basic information

Basic data for this paper has been obtained from published and unpublished information originated by national forest services and other government institutions such as planning offices and statistics bureaus. Additional information was also obtained from, primarily, FAO reports and other specific studies. The sources of information are listed in the Literature Cited Section at the end of this paper, and in the particular references cited throughout the text.

The depth or detail of the information, as well as the uniformity and even the availability of criteria and of the basic data imposed a number of constraints in the analysis of the situation of each individual country.

1.2 Products analyzed

As the terms of reference specify, this paper looks at primary wood products, their supply trend and their macro-level demand trends. The most obvious products that are missing in this analysis are pulp, paper and paper products. There are two reasons for this:

First, and most important, is the availability of information at the level of detail required to estimate real apparent consumption, given the short time available for this study. The statistics on paper and paper product consumption in the CA/P Region are biased in the sense that the largest proportion of paper products is not for domestic consumption *per se*, but, rather, are destined to the conversion of carton and medium corrugated products to banana boxes. These banana boxes are exported with hardly any added value. However, these boxes are not accounted for in the export statistics such that real apparent consumption can be greatly overestimated. The research required to "clean" these statistics would have taken more time than was stipulated for this study.

Secondly, as there are no pulp and paper production facilities in the CA/P Region that consume industrial roundwood from natural forests, their effect on the duration of these natural forests is not significant.

If in the time horizon considered for this study such facilities appear, their effect would be to accelerate the depletion of productive natural forests, unless they are based on residue utilization, in which case, their effect would be to significantly increase the utilized volume per hectare. Nonetheless, the existence of these production facilities is not only needed to improve the balance of trade situation but also needed to enhance early plantation forestry products and therefore improve industrial plantation yields and cash flows.

Therefore, for the purposes of the study, the exclusion of P & P products from the analysis has no effect on the estimated duration of the productive natural resource, and their demand for P & P products would only increase the demand for industrial plantations, therefore, further enhancing the need and justification for industrial plantations in the CA/P Region.

As such, the products analyzed in this paper are the major mechanical wood products, namely, sawnwood, veneer, plywood and other wood-based panels. Indeed, markets for these broad categories are extremely diverse. It is generally true that the number of potential buyers is large, particularly considering regional and extra-regional markets. In the CA/P Region, what little data are available, suggest that the major uses of tropical woods (coniferous and hardwoods) are, in order of importance, construction, furniture, packaging and other (1). The aggregation of data, however, makes it impossible to analyze this diversity such that meaningful and dependable predictions can be made. The analysis of macro-trend information, therefore, had to be the basis for an adequate model.

1.3 Modeling considerations

Available evidence suggests that the behavior of prices, supply and demand is extremely erratic. Furthermore, price information is hardly available and, if it is, it is not very dependable and may be only a short run response to market conditions. In addition, price behavior may vary as a function of weather and other short-run conditions and may not reflect a long-run demand function.

Numerous studies have established the construction activity as being the most determining factor in mechanical wood products' demand (even furniture manufacture is closely tied to the construction activity). FAO (1), in a recent study, used the construction sector's added value as the major contributing variable for estimating mechanical wood

products demand functions. However, for the CA/P Region, this information is not readily available. Furthermore, a number of elasticity considerations need to be taken into account that were not adequately treated in that study and may account for the poor prediction behavior of the estimated models, particularly when estimating country-level demand functions.

In the CA/P Region, readily available information that fit well into a theoretical model for demand functions is not easy to find. Nevertheless, when estimating aggregate demand for mechanical wood products, there is a direct correlation between per capita income or per capita gross domestic product (GDP) and per capita mechanical wood product consumption. The variations in this relationship are accounted for by the response in per capita consumption as a function of a change in per capita income or GDP. This response, for the purposes of this study, has been named the elasticity of mechanical wood products demand:

$$e = \frac{\text{\% change in per capita consumption}}{\text{\% change in per capita income or GDP}}$$

The other variable in the model would therefore be, P, the percent increase, or change, expected in per capita income or GDP. The per capita demand in the nth year, y_n, would then be a function of: the per capita demand (consumption) in the base year, y_o; the percent change in per capita income or GDP, P; and of said demand as a function of P; thus:

$$Y_n = y_o\ (1 + Pe)^n$$

Once estimating Y_n, the per capita consumption in the nth year, the total apparent consumption can be estimated by multiplying it times the population in year n.

The demand for V_{logs}, logs placed at mill site, is then a function of the total apparent consumption (or fraction thereof that is expected to be supplied by domestic production) and the estimated recovery or yield factor, F_r, for the mechanical wood industries (published studies or estimated by the consultant). The demand for standing volume, V_{stand}, would therefore be the demand for logs placed at mill site divided by the estimated proportion of standing volume that actually arrives at mill site (also published data or estimated by the Consultant), f_e:

$$V_{stand_n} = \frac{V_{logs}}{f_e} = \frac{Y_n}{(F_r)(f_e)}$$

The estimated standing volume inventory for each country is then reduced by V_{stand}, each year, to estimate the depletion of the productive resource due to industrial roundwood removals.

In some cases, where no national forest inventory is available, but forest area has been estimated, or where deforestation rates (published) are much higher than industrial removals, the depletion of the forest resource is estimated on an area basis. There is an explanation of each case, for each country in the CA/P Region, in this paper.

1.4 Reforestation needs and land availability

Some countries, such as Nicaragua, have a national forestry development plan that includes areas of plantation needs. This paper uses those estimates in those cases. For other countries, the Consultant makes an estimate based on the expected depletion of the productive natural resource and on the basis of reducing any potential gap in the supply of industrial roundwood. The assumptions and projections are explained in each case.

The land availability estimate is based on published information of forest lands that may be potentially available in each country. Where information was available, land tenure constraints are mentioned in each case.

The following six chapters analyze the 6 countries in the CA/P Region, individually. Chapter VIII summarizes the regional situation, as a whole. Chapter IX takes a look at some industrial plantation case studies from the CA/P Region, while the final Chapter analyzes potential regional, extra-regional markets and constraints to trade.

II. GUATEMALA

1. Supply trend data for wood products

1.1 Characterization of the forests of Guatemala

1.1.1 Description of forest types

Guatemala does not have a national forest inventory. The information presented here is based on published information of photo-interpretation of LANDSAT imagery, on a scale of 1:250,000 (15). According to this information, 39.6% of the country's total area of 108,890 Km^2 is covered by natural dense forest stands, most of which are located in the Petén Region, where 65.7% of the total forest land area of Guatemala is located (see Table 2.1).

According to the typified ecological limits, the country is divided into six regions: the Altiplano Occidental Region (Western highlands), the Costa Sur Region (South Coast Region), the Eastern Region, the Central Region, the Low Northern and the Petén Regions.

The Western Highlands have 13.9% of the total forest land area of the country, of which 3,342 Km^2 are coniferous forests with hard pines, white pine and cypress species (the most important in the country). These forests have been severely affected by bark beetle attacks in the past (Dendroctonus sp.).

The South Coast Region is primarily an important agricultural area, having a total forest area of only 205 km^2, composed of, mainly, hardwood and mangrove stands.

The Eastern Region is covered by severely high-graded forests that have been historically affected by forest fires, counting with only 101 Km^2 of forest area, half of which is constituted by coniferous forests.

Similarly, the Central Region forests are also severely affected by forest fires and its forests, covering some 1601 Km^2, are 67% coniferous.

The Low Northern Region has some 7480 Km^2 of forests, 17% of which consist of coniferous stands.

The Petén Region has, by far, the most important forest area of Guatemala (65.7% of the total forest cover of the country), primarily composed of mixed tropical hardwoods, since only 6,800 ha are coniferous forests.

1.1.2 Area by forest type

Since there are no data on the areas and volumes based on a national forest inventory, this study has relied upon published land cover (15) and land use capacity studies (14) to estimate the areas of commercially productive forest land. The basic assumption, underlying these estimates, is that present forest cover has an equivalent proportion of commercially productive forests remaining, as if deforestation occurred equally in protection forests as in production forests. This basic assumption tends to conservatively overestimate the area for commercial forests. The information is presented in Table 2.1.

TABLE 2.1 FOREST LAND AREA OF GUATEMALA

Region	Area Dense Forest (Has)	% of Country's Total	Total Forest Area: Conifer. Forest Area(Ha)	Total Forest Area: Hardwood Forest Area(Ha)	Produc. Forest Area: Coniferous (Ha)	Produc. Forest Area: Hardwood (Ha)
I. W. Highlands	603,800	13.9	334,200	269,600	249,980	201,660
II. South Coast	20,500	0.5	-	20,500	-	13,470
III. Eastern	10,100	0.2	5,050	5,050	2,715	2,715
IV. Central	1,900	-	1,270	630	915	455
V. Dry Cent.	104,200	2.4	69,800	34,400	37,905	18,680
VI. Low North.	748,300	17.3	127,210	621,090	94,445	461,180
VII Petén	2,833,800	65.7	6,800	2,827,000	5,550	2,307,790
TOTAL Country	4,322,600	100.0	544,330	3,778,270	391,520	3,005,950

1.2 Timber removals from commercial forests

1.2.1 Industrial removals

Production data for the last six years are shown in Table 2.2, for the different major wood products.

TABLE 2.2 PRODUCTION OF MAJOR INDUSTRIAL FOREST PRODUCTS (M^3)

Products/ Year	1978	1979	1980	1981	1982	1983
Sawnwood	343,200	137,958	109,004	134,583	129,060	103,799
Conif.	246,000	125,541	74,095	81,387	74,474	72,239
Hardwood	97,200	12,417	24,909	53,196	54,586	31,560
Ties/	3,366	95	774	1,683	730	380
Post, Poles, etc.	1,710	-	1,805	2,605	4,140	5,015
Veneer	25	2,290	23	824	867	910
Plywood	4,388	4,337	3,743	2,763	820	877
Particle Board	2,506	4,213	4.349	3,903	3,807	3,710
Fiber-Board	595	567	537	564	556	549
Total Production	355,790	149,460	120,235	146,925	139,980	115,240

Studies of industrial removals (18) have shown that, depending on the log size and the species, only 25-38% of the volume cut is converted into final product. For the purposes of this report, an average of 31.5% was used to estimate the standing volume removals from the production data.

Further studies have reported (8) that timber removals for industrial purposes are, on the average, 10 m^3/ha, from hardwood forests, and 30 m^3/ha, from coniferous forests. Published information shows that the proportion of coniferous versus hardwood removals, is 45% to 55% (17). On these basis, the area cut for industrial purposes has been estimated for each year, as shown in Table 2.3.

TABLE 2.3 AREA CUT DUE TO INDUSTRIAL TIMBER REMOVALS

Year	Total Produc. (M^3)	Stand. Vol. Cut (M^3	Equivalent Area Cut (Ha)		
			Conifers	Hardwood	Total
1981	146,925	466,430	7,005	25,655	32,660
1982	139,980	444,380	6,665	24,440	31,105
1983	115,240	365,840	6,710	16,465	23,175

1.2.2 Deforestation rates and implications

The estimates for deforestation rates in Guatemala vary between 63,000 ha (8) and 68,000 ha per year (18). According to Mittak (18), during the period of 1954 to 1975, 26.5% of the coniferous forests of the Western High lands disappeared, corresponding to 1.5% or 11,000 ha per annum. FAO/PNUMA (8) estimate that this rate increased to some 16,000 in 1980 and with a tendency to increase 10% more, mainly in the Petén region, during the period 1981-1985.

For purposes of this study, a deforestation rate of 45,000 ha was assumed, for 1981, with an annual increase of 2.5%. This is in accordance with the rates of increase estimated by other studies. The more conservative figure for the initial deforestation rate is based on the fact that more recent forest cover information has revealed a somewhat lower deforestation rate than intially estimated. It also represents the best of all cases in the estimate of the disappearance of commercial forests.

1.3 Man-made forests

Table 2.4 denotes the reforestation efforts in Guatemala by the Government, communities and private entities, from 1979 to 1983.

TABLE 2.4 PLANTATION AREAS 1979-1983 (Ha)

Year	Government/ Communities	Private	Total
1979	7,671	891	8,562
1980	3,898	477	4,375
1981	5,765	766	6,531
1982	4,290	171	4,561
1983	1,803	154	1,957
TOTALS	23,527	2,459	25,986

As can be observed, the area planted in the last five years doesn't amount to 58% of the area deforested in 1981.

The mean annual increment estimated for coniferous and hardwood plantations in Guatemala (18) is 6.3 m^3/ha/yr and a production of 240 m^3/ha (total volume) for the final harvest in a rotation of 50 years. Thus far,

coniferous plantations have constituted 60% of the total area planted. On this basis, two commercial thinnings, at ages 25 and 35, would produce 26 m^3/ha, repectively, such that the total volumes available, for industrial purposes, would be as follows:

TABLE 2.5 POTENTIAL VOLUME AVAILABLE FOR INDUSTRIAL USE FROM AREAS PLANTED

Year	Area Subject to thinning (Ha)	Total Volume Available for Ind.Purp.(M^3)	Log Volume (60%) Avail. (M^3)	Sawnwood Equivalent (M^3)
2002	8562	222,612	133,567	66,784
2003	4375	113,750	68,250	34,125
2004	6531	169,806	101,884	50,942
2005	4561	118,586	71,152	35,576
2006	1957	50,882	30,529	15,265
2007	8562	256,860	154,116	77,058
2008	4375	131,250	78,750	39,375
2009	6531	195,930	117,558	58,779
2010	4561	136,830	82,098	41,049
2011	1957	58,710	35,226	17,613

Final harvest volume, from the 1979 plantations, won't become available until the year 2029, a year that is outside the scope of this paper. Nevertheless, it can be ascertained that the roundwood coming from the 1979 plantations can easily be 50% of the hardwood industrial demand, under ceteris paribus conditions. In the best of cases, the raw material from the 1983 plantations' final harvest won't provide more than 13% of the industrial roundwood demand for the year 2033. The 1979 plantations, which are the most extensive of any one of the previous years will provide some raw material for the lumber industry from its commercial thinnings, but this proportion will be, at best 17-19% of the industrial roundwood demands for the years 2002 and 2007, respectively. A word of caution is worth mentioning, however. Although there are no figures on how much of this area may be economically viable, or just surviving, not all these areas are really going to produce what is expected nor are all those areas really in existence, for sure.

2. Macro-level market trends for major wood products

2.1 Population and income trends

Since 1978, Guatemala's population has grown, from just over 6.5 million, to over 7.7 million, in 1984. Population trends, estimated by the Dirección General de Estadística (10), consider that the country's total population will grow to over 12.2 million by the year 2000, denoting a 2.7% average annual population growth. Per capita income has followed the per capita gross national product (as explained in section 2.4.1), showing a real increase of 2.4%, from 1984 to the year 2000.

It is on the basis of the above trends that the population and per capita income columns of Table 2.7 were estimated.

2.2 Production of major mechanical wood products

Table 2.2 in Section 1.2.1 of this report denotes the major forest products production for the years 1978-1983. No information is available on the value of this production. Nevertheless, the volume information served as a basis for the total production figure in Table 2.7 for the same years.

Since Guatemala is, and has been, a net exporter of mechanical wood products, the proportion of production to the total apparent consumption has been maintained for the years 1984-2010, assuming that ceteris paribus conditions prevail in the future, as they have on the average, in the past, showing an annual increase of 5.6%, as a result of the increase in demand due to increases in population and in per capita income (see Section 2.4.1 of this Chapter).

2.3 Trade in mechanical wood products

Traditionally, since 1978, sawn lumber (primarily hardwoods) has contributed 93.7% of all exports, in volume. However, the proportion of these exports in volume and value, has significantly decreased in the 1979-1983 period, compared to the previous 1974-1978 period. The volume of all exports in wood products, since 1978, has never exceeded 21.7% of production. The per unit value, of exports more than doubled between 1974 and 1978 ($53.18/m^3 and $113.42, respectively), and it has again doubled by 1983 ($283.97/m^3).

Imports have also decreased significantly, being at a maximum, of 25% of total apparent consumption of mechanical wood products, in 1980, and at a minimum, in 1982, at 6.3% of the total apparent consumption. The principal imported mechanical wood products are veneer and plywood, almost 70% from Costa Rica. The value of imports has steadily increased since 1978 but it has greatly increased between 1982-1983. Nevertheless, Guatemala changed from being a net exporter of mechanical wood products, in volume, prior to 1982, to a net importer, in volume and value, in 1983. There is no reason to believe this will continue in the future, particularly with the new CELGUSA sawmill in Rancho (primarily, an export facility). Table 2.7 shows the expected trends for imports and exports of mechanical wood products.

2.4 Apparent consumption of major mechanical wood products

The apparent consumption of mechanical wood products of Guatemala is shown in Table 2.6 for the years 1978-1983.

TABLE 2.6 APPARENT CONSUMPTION OF MECHANICAL WOOD PRODUCTS 1978-1983

Year	Production m^3	Imports m^3	Exports m^3	Total Ap-Consumpt. m^3	Population 1000's	Per Cap. Consump. m^3	Per Cap. Income ($)
1978	355,790	11,180	41,608	325,362	6,542.5	0.0497	1,059
1979	149,460	13,915	32,420	130,995	6,726.3	0.0195	1,085
1980	120,235	9,785	25,975	104,045	6,916.8	0.0150	1,112
1981	146,925	12,645	27,455	132,115	7,113.4	0.0186	1,140
1982	139,980	11,880	16,580	135,280	7,315.5	0.0185	1,168
1983	115,240	12,055	7,485	119,810	7,523.9	0.0159	1,198

2.4.1 Per capita apparent consumption of mechanical wood products

As denoted by Table 2.6 the per capita comsumption has decreased significantly in 1983 as compared to 1978. This has been primarily due to the large contraction in the construction sector of the economy.

Due to this contraction, a significant, positive correlation between per capita consumption of mechanical wood products and per capita income would have not made much sense without including data from years prior to 1977.

As such information was obtained for the years 1973-1977 and the analysis revealed a direct positive correlation between the two variables, equal to 0.96. On this basis, having the trend increase in per capita income, and in total population, the per capita wood production consumption as well as the total apparent consumption can be projected (always assuming ceteris paribus conditions) into the future.

This projection was done on the basis of our model.

$Y_n = Y_o (1 + Pe)^n$, where

Y_n, Y_o = per capita consumption for the base year and for the nth year, respectively.

P = per capita income growth rate

e = elasticity of demand as a function of changes in the gross domestic product or per capita income.

In Guatemala's case, the estimate of P = 2.4% (published Government statistical projections) and the estimated e= 1.00, between 1973 and 1983. Therefore, the estimated parameters yield the function for the projected changes in per capita mechanical wood products consumption, for 1984 - 2010:

$$Y_n = Y_o (1.024)^n$$

and the base year, 1983, $Y_o = 0.0159\ m^3$.

2.4.2 Projections of apparent consumption and commercial timber demand

Table 2.7 takes into account the conversion parameters, mentioned in previous sections, of standing commercial volumes to final product, as well as the projected per capita consumption, total apparent consumption, population, the proportion of production to total apparent consumption, and the proportion of softwood versus hardwood production.

Table 2.7 also takes into account the reduction in forest area in 1981, 1982 and 1983 (since the forest area information, presented in Table 2.1, is the area estimated at the end of 1980).

2.5 Predictions of unmet demand

Already the volume of imports, in the year 2010, exceeds $11.5 million with a greater tendency to increase, particularly, to meet the unmet demand for coniferous products, from the year 2003 on. Some of that demand may be met by commercial thinnings from the 1979-1983 plantations but it will certainly not be enough.

Furthermore, the remaining hardwood commercial forest will not exist beyond the year 2025, i.e. 40 years from now. There is no question that the gap in the industrial roundwood supply will increase if no action is taken to introduce man-made industrial forests, as soon as possible, to cover that gap. This is particularly true of coniferous industrial plantations.

TABLE 2.7 PROJECTED DEMAND AND SUPPLY OF INDUSTRIAL ROUNDWOOD NATURAL COMMERCIAL FORESTS 1984-2010

Year	Production (M^3)	Imports (M^3)	Exports (M^3)	Total App. Consumpt. (M^3)	Total Population (1000's)	Per Capita Consumption (M^3)	Per Capita Income $	Stands Vol. Cut (M^3)	Equiv. Area Commercial Forests Cut (Hectares)		Area Comm/Forests Remaining Ea. Year (Hectares)		
									Coniferous	Hardwood	Coniferous	Hardwoods	Total
1984	136735	12230	22730	126235	7744.4	0.0163	1228	434080	7960	19535	344265	2866350	3210615
1985	143825	12885	23720	132990	7963.4	0.0167	1258	456590	8370	20545	329890	2831060	3160950
1986	146645	13260	23045	136860	8195.1	0.0171	1290	465540	8535	20950	315155	2794915	3110070
1987	152525	13975	22269	144230	8434.3	0.0176	1322	484205	8875	21790	300925	2757870	3057895
1988	160180	14805	22195	152790	8681.1	0.0180	1355	508510	9325	22885	284515	2719900	3004415
1989	172740	15930	24260	164410	8935.4	0.0184	1389	548380	10055	24675	268615	2680980	2949595
1990	185205	16840	28215	173830	9197.4	0.0189	1424	587955	10780	26460	252350	2641035	2893435
1991	195685	17795	29815	183665	9467.4	0.0194	1459	621220	11390	27955	235550	1600195	2835845
1992	206610	18790	31480	193920	9744.7	0.0199	1496	655905	12025	29515	218530	2558280	2776810
1993	219065	19920	33375	205610	10029.8	0.0203	1533	695445	12750	31295	200980	2515320	2716300
1994	229855	20900	35020	215735	10322.1	0.0209	1572	729700	13380	32835	182995	2471285	2654280
1995	242170	22020	36895	227295	10621.2	0.0214	1611	768795	14095	34595	164560	2426150	2590710
1996	254980	23185	38850	239315	10927.6	0.0219	1651	809460	14840	36425	145665	2379885	2525550
1997	269490	24505	41060	252935	11241.5	0.0225	1692	855525	15685	38500	126295	2332465	2458760
1998	283340	25765	43170	265935	11562.3	0.0230	1735	899490	16490	40475	106440	2283860	2390300
1999	298050	27185	45550	280585	11889.2	0.0236	1788	949050	17400	42710	86090	2234035	2320125
2000	315320	28655	48010	295765	12221.7	0.0242	1822	1000380	18340	45015	65230	2182965	2248195
2001	331965	30190	50580	311575	12563.5	0.0248	1868	1053855	19320	47425	43850	2130620	2174470
2002	349505	31785	53255	328035	12914.8	0.0254	1915	1109535	20340	49930	21935	2076955	2098901
2003	369175	33570	56245	346500	13275.9	0.0261	1963	1171990	21485	52740	-	2021440	2021440
2004	388225	35305	59150	364380	13647.2	0.0267	2012	1232470	22595	55460	-	1942045	1942045
2005	409545	37245	62400	384390	14028.8	0.0274	2962	1300150	23835	58505	-	1860665	1860665
2006	431755	39260	65780	405235	14421.1	0.0281	2113	1370655	25130	61680	-	1777250	1777250
2007	454685	41365	69305	426945	14824.4	0.0288	2166	1444085	26475	64985	-	1691750	1691750
2008	478970	43555	72975	449550	15239.0	0.0295	2220	1520545	27875	68425	-	1604115	1604115
2009	504045	45835	76795	473085	15665.1	0.0302	2276	1600150	29335	72005	-	1514285	1514285
2010	531870	48365	81035	499200	16103.2	0.0310	2332	1688480	30955	75980	-	1422210	1422210

3. Areas potentially available for tree planting

3.1 Plantation requirements to meet potential gaps

If management activities and rotation estimates hold true for all industrial plantations, it would be almost inevitable to avoid the gap in the supply of coniferous industrial roundwood and the country would be hard-pressed to provide an adequate hardwood supply. It is for this reason that steps need to be taken to verify annual yields from industrial plantations and to select the productive areas in order to ensure higher productivity and lower rotation ages.

If commercial thinnings could occur at ages 18 and 25, with rotations of 40 years, and with an emphasis (60-70% of the area) on coniferous plantations, the gap in their supply would be greatly narrowed, the useful life of hardwood productive natural forests would be extended. Assuming the same mean annual increment (6.3 m^3/ha/year), this would mean a yield of 26 m^3, 30 m^3 and 115 m^3/ha of sawlogs for the first, second thinnings and for the final harvest of industrial plantantions.

Establishing a goal of supplying 50% of industrial demand coniferous logs, in 2003, from industrial plantations, with the changes suggested above, the need for industrial coniferous plantations, for 1985, would be 8652 ha with an increase of 6% per annum. In addition, in order to extend the productive life of industrial hardwood, natural forests, another 4522 ha of hardwood plantations would be needed in 1985, increasing at a 5% rate per annum, as shown in Table 2.8.

TABLE 2.8 INDUSTRIAL PLANTATION REQUIREMENTS 1985-1995

Year	Plantation Requirements (Ha)		
	Coniferous	Hardwood	Total
1985	8,652	4,522	13,174
1986	9,171	4,748	13,919
1987	9,721	4,986	14,707
1988	10.305	5,235	15,540
1989	10,923	5,497	16,420
1990	11,578	5,771	17,349
1991	12,273	6,060	18,333
1992	13,009	6,363	19,372
1993	13,790	6,681	20,471
1994	14,617	7,015	21,632
1995	15,500	7,366	22,866
TOTALS	129,539	64.244	193,783

3.2 Land Use

Table 2.9 shows the areas of productive forest capacity and the area of forest cover, at the end of 1980.

TABLE 2.9 PRODUCTIVE FOREST LAND CAPACITY VERSUS LAND USE 1980

Region	Total Prod.-Forest area (Ha)	Prod. Forest Land Capacity (Ha)	Area Ponten-tially Avail. f/Ind. Plant. (Ha)	% Total Country Potential
I. Western Highlands	451,640	1,055,200	603,560	44.7%
II. South Coast	13,470	113,100	99,630	7.4%
III. Eas-tern	5,430	345,00	399,970	25.2%
IV. Cen-tral	1,370	55,000	53,630	4.0%
V. Dry Cent.	555,585	309.000	252,415	18.7%
VI. Low Nor-thern	555,635	526,900	-	-
VII. Petén	2,313,340	1,630,800	-	-
TOTAL COUNTRY	3,397,470	4,035,400	1,349,205	100.0%

The average, annual, total industrial reforestation over the next 11 years is 17.616 ha for a grand total of 193.783 ha. The average, annual coniferous plantations would be 11,776 ha for a total of 129,539 ha and hardwood industrial plantations would average 5,840 ha/year, for a total of 64,244 ha in the same period.

There is no question that the Western Highlands Region presents the largest potential area for industrial plantations, followed by the Eastern, and finally, the Dry Central Regions, on an immediate basis. It must be established, however, that the Petén Region has the highest potential of all regions, regardless of its present land cover and, as forests are logged, an effort must be made to maintain forest cover through pure or enrichment plantations.

III. EL SALVADOR

1. Supply trend data for wood products

1.1 Characterization of the forests of El Salvador (8)

El Salvador has a total land area of 20,988 Km^2 and the highest population density of the region. The forest vegetation of El Salvador covers some 262,308 ha, of which only 53% is forest (inland), 17% mangrove forests and 30% is shrubby vegetation. The country's forests are very disperse, forming irregular and isolated stands.

Apart from the mangroves, a number of disperse hardwood stands remain, including some along the rivers, some cloud forest associations (1,500 ha) in the highest points of the two mountain ranges, with no less than 2,000 mm of precipitation during 10 months of the year.

In the coastal region, within the tropical humid life zones, the forests of *Myroxylon balsamum* form pure stands that are used as coffee shade.

The mangroves are located in the Pacific Coast in five differentiated blocks, constituted by four species, but often forming pure stands. The most important ones are *Rhizophora mangle* (8,200 ha) and *Laguncularia racemosa*. There are some 19,600 ha of degraded *Rhizophora mangle* due to the misuse of these stands.

The conifers are distributed in the northern region and in the highest elevations of the Central Mountain Range, from 500 m to 2,500 m above sea level. They are formed sometimes by pure stands and others, by mixed hardwoods, primarily by *Quercus* species. Half of those forests occur in steep slopes that preclude industrial utilization.

Finally, there are some 78,000 ha of shrubby vegetation lands, dispersed throughout the country, in marginal soils. These exist as a result of man's action and they consist of highly degraded vegetation.

TABLE 3.1 FOREST AREA OF EL SALVADOR IN 1978 (22)

Type	Area (Ha)	Area of Productive Forests (Ha)
Conifers	48,477	24,238
Hardwoods	90,759	-
TOTAL	139,236	24,238

1.2 Timber removals

1.2.1 Timber removal for industrial purposes

TABLE 3.2 PRODUCTION OF MAJOR INDUSTRIAL FOREST PRODUCTS (M^3) (22)

Products	1976	1977	1978	1979	1980	1981
Sawnwood	32,477	34,583	34,364	35,131	35,000	33,060
Ties, etc.	5,491	6,404	6,154	7,903	6,592	5,909
TOTAL	37,968	40,942	40,518	43,034	41,592	38,969

Timber volume removals to produce the above products, would be equivalent to 2.90 times their volume, considering that only 34.5% of the standing volume (commercial) is converted to final product (8). Logging is not limited to well-defined areas but it is estimated that the equivalent area logged is roughly 2,600 ha of the pine forests of the North (8).

Very few changes are expected to occur in the future. The importance of the hardwood forests lies in the consumption of the fuelwood whereas the pine forests will supply a small percentage of the demand of sawlogs (8).

1.2.2 Deforestation rates and implications

Every year, permits are granted to clear some 15,000 ha of "shrubby vegetation" (which is generally consumed as fuelwood) so it can be

cultivated for agricultural crops, as "Shifting" agriculture, for a period of 2-3 years, when it returns to its "original" state, one year later.

The deforestation rate in the pine forests is estimated to be around 500 ha/year (8). On the other hand, some 400 ha of productive hardwood forests are deforested. In addition, 3,600 ha of unproductive hardwood forests are annually converted to "shrubby" vegetation without returning to forests in any near future.

1.3 Man-made forests

Table 3.3 demonstrates the areas reforested in El Salvador until 1981, by both Government as well as private institutions.

TABLE 3.3 AREAS PLANTED UP TO 1976 THROUGH 1981

Sector	Up to 1976 (Ha)	1977 (Ha)	1978 (Ha)	1979 (Ha)	1980 (Ha)	1981 (Ha)	TOTAL
Private	1,985	396	715	482	-	-	3,578
Government	714	676	1,306	1,445	1,447	1,877	7,465
TOTAL	2,699	1,072	2,021	1,927	1,447	1,877	11,403

About 23% of the area reforested corresponds to coniferous plantations, namely *Pinus oocarpa* and *P. caribaea*, and *Cupressus lusitannica* (27%).

Despite these reported figures, Vega (26) reports that, of the 1980-1982 plantations, only 51% of the area can be considered economically viable, so that, at best, of the 11,403 ha, perhaps some 6,000 ha can be expected to yield industrial roundwood. The same study reports mean annual increments, on the average, of 9.56 m3/ha/year for hardwood plantations and 8.56 m3/ha/year for coniferous plantations.

Furthermore, 81% of the area planted has been established after 1976, reason for which they will have very little effect on the balance of raw material supply in the short or medium term.

2. Macro-level market trends for major mechanical wood products

2.1 Population and income trends

Since 1977, El Salvador's population has grown from 4.25 million to almost 4.7 million in 1984.

Population trends estimated by the "Dirección Ejecutiva de Planificación" (20), consider that the country's total population will grow to almost 7.1 million by the year 2000, denoting a 2.7% average annual increase.

As in the other countries of the region, per capita income trends have closely followed the per capita gross national product, showing a very negligible real increase between 1970 and 1981.

However, the same office projects an expected average annual increase of 3.8% in the future, after a slow start of 1.1% until 1985, increasing steadily until the year 2000.

The above assumptions are the basis for calculating the corresponding columns of population and per capita income in Table 3.5.

2.2 Production of major wood products

Table 3.2 denotes the major forest products production of El Salvador for the 1976-1981 period. It shows that railroad ties and lumber are the only two major industrial forest products of El Salvador, averaging, for the period, 40,504 m^3/year with very little variation (less than 1,800 m^3/year).. This fairly constant production figure is characteristic of a country with a highly defficient raw material supply; so, even with a modest increase in the per capita wood consumption, national production will tend to remain constant, at best, or decrease with a dwindling raw material supply.

2.3 Trade in mechanical wood products

As can be expected, El Salvador is a net importer of mechanical wood products, primarily sawnwood, followed by veneer and plywood and other wood-based panels. The largest suppliers of sawnwood are Honduras and Guatemala and of veneer and wood-based panels, Costa Rica.

The very small volume of exports of El Salvador consists, primarily, of furniture and furniture parts.

Imports have decreased fairly significantly since 1980, particularly of mechanical wood products. Per unit prices of imports have increased greatly,

particularly for sawnwood, where the 1981 price was 6.68 times greater than in 1979. Veneer and plywood prices increased more modestly, 114% in the same period. The 1981 average price for sawnwood was $388.24/m^3 and for plywood (both of which constitute 95% of the mechanical wood products imports), it was $173.76/m^3. These price statistics reflect the fact that high quality sawnwood is imported by El Salvador's important furniture industry and that the grade of plywood that is imported represents construction quality. It is to be expected that plywood and other wood-based panels will substitute sawnwood imports in the short and medium term.

These changes in the price of imports, for a country so highly dependent on them, have caused a significant decrease in the volume of imports. In addition, foreign exchange restrictions have greatly influenced trade in wood panels, causing a further decrease in the volume of imports (see Table 3.4).

2.4 Apparent consumption of mechanical wood products

The apparent consumption of mechanical wood products of El Salvador is shown in Table 3.4, for the years 1977-1981.

TABLE 3.4 APPARENT CONSUMPTION OF MECHANICAL WOOD PRODUCTS 1977-1981

Year	Production (M^3)	Imports (M^3)	Exports (M^3)	Total Apparent Consump. (M^3)	Population (1000's)	Per Capita Consump. (M^3)	Real Per Capita Income $
1977	40,942	43,400	555	83,787	4,253,667	0.0197	650
1978	40,578	26,140	900	65,758	4,372,000	0.0150	650
1979	43,034	35,225	2,950	75,309	4,451,683	0.0169	650
1980	41.592	11,840	1,800	51,632	4.513,391	0.011	650
1981	38,969	7,224,	1,470	44,723	4,554,467	0.0098	650

2.4.1 Per capita apparent consumption

As can be observed in Table 3.4, and as it was mentioned in the previous section, the high price of imports and foreign exchange restrictions, along with a significant contraction of the construction market for mechanical wood products, have all greatly

contributed to the sizeable decrease in the per capita apparent consumption of these wood products.

Furthermore, the stagnation in the real per capita income has made it difficult to establish a significant correlation between per capita income and the per capita consumption variables. Nevertheless, taking the previous 5-year period, 1972-76, a significant correlation was established (0.94) between them, permitting to extrapolate the 1984-2010 per capita consumption in relation to the expected increase in per capita income for the same period (always assuming that ceteris paribus conditions prevail).

The demand elasticity of mechanical wood products was estimated, for the 1972-1981 period, as equal to 1.96, denoting an elastic demand with changes in the GDP. Projected per capita GDP increases expect a rate of increase of 2.32%, such that the (Pe) factor of our model = 4.54%. The estimated parameters of this model for per capita consumption is:

$$Y_n = Y_o \ (1.0454)^n$$

This factor is high compared to other countries as a result of the high elasticity, characteristic of a resource deficient country.

2.4.2 Projections of apparent consumption and commercial timber demand

Table 3.5 takes into account the fact that, in 1978, there were 24,238 ha of productive pine forests; that hardwood forests were mainly non-productive for industrial purposes, except wood for energy; that the volume of sawnwood/ha from the productive pine forests is 30 m^3/ha. (high for regional standards); and, that the per capita consumption variable will hold its correlation with the behaviour of the per capita income and demand elasticity.

Furthermore, it also takes into consideration that the forest cover area information is

TABLE 3.5 PROJECTED SUPPLY AND DEMAND OF INDUSTRIAL ROUNDWOOD FROM NATURAL CONIFEROUS FORESTS OF EL SALVADOR, 1984-2010

Year	Production (M^3)	Imports (M^3)	Exports (M^3)	Total Apparent Consumption (M^3)	Total Population	Per Capita Consumption (M^3)	Per Capita Income ($)	Area of Remaining Productive Forest
1984	40504	13286	1400	52390	4677694	0.0112	679	16068
1985	"	16577	"	55686	4718770	0.0118	620	14718
1986	"	21405	"	60509	4840695	0.0125	700	13367
1987	"	31365	"	70469	4962620	0.0142	712	12017
1988	"	41740	"	80844	5084546	0.0159	724	10667
1989	"	50968	"	90972	5206472	0.0173	740	9318
1990	"	59471	"	98575	5328397	0.185	753	7967
1991	"	69617	"	108721	5450979	0.0198	767	6617
1992	"	79621	"	118725	5653562	0.0210	784	5267
1993	"	87688	"	126792	5816144	0.0218	800	3916
1994	"	97609	"	136913	5978727	0.0229	815	2567
1995	"	108287	"	147391	6141309	0.0240	832	1216
1996	-	158900	-	158900	6330756	0.0251	850	-
1997	-	166915	-	166915	6520203	0.0256	870	-
1998	-	175790	-	175790	6709650	0.0262	891	-
1999	-	185422	-	185422	6899098	0.0269	914	-
2000	-	195100	-	195100	7088545	0.0275	936	-
2001	-	206910	-	206910	7291727	0.0284	965	-
2002	-	218845	-	218845	7494908	0.0292	993	-
2003	-	231570	-	231570	7698090	0.0301	1023	-
2004	-	244885	-	244885	7901271	0.0310	1054	-
2005	-	258570	-	258570	8104453	0.0319	1085	-
2006	-	274020	-	274020	8320304	0.0329	1120	
2007	-	289160	-	289160	8536154	0.0339	1152	-
2008	-	306251	-	306251	8752005	0.0350	1190	-
2009	-	323035	-	323035	8967855	0.0360	1225	-
2010	-	340260	-	340260	9183706	0.0371	1260	-

from 1978, deducting the 8,170 ha of forest cover that has been logged, 50% of which was totally deforested (8).

A very serious situation of an even greater deficit of industrial roundwood can be foreseen before the end of the century, along with the serious economic, social and ecological consequences the disappearance of all commercial pine timber of El Salvador may carry.

2.5 Predictions of unmet demand

Unless there is a major shift to the utilization of productive hardwood forests, which may amount to some 25,000 ha, an even greater gap between supply and demand of industrial roundwood is likely to occur in the short run.

There is no question that El Salvador will continue to heavily depend on wood products imports, at an increasing rate. Furthermore, there is no way that existing plantations will meet the demand for industrial roundwood since the final harvest of those plantations (200 ha), prior to 1976, will not yield more than 20,000 m^3 (r) by 1996, 6% of the roundwood demand for that year. The yield from existing industrial plantations (that are, in reality, economically viable) will not be able to supply more than 10-12% of the industrial demand in any given year, after 1996. Nevertheless, some steps may be taken to significantly increase industrial plantations immediately, so as to reduce the effects of such a large deficit.

3. Areas potentially available for tree planting

3.1 Plantation requirements to reduce future gaps

Any plantation program that is begun now will not yield any industrial roundwood until its first commercial thinnings. It is important to select the highest productivity sites available for this purpose, to ensure high yields in the intermediate and final harvests. For this purpose, and assuming a mean annual increment of 8.56 m^3/ha/year for coniferous forests, and 9.56 m^3/ha/year for hardwood plantations (27), 6928 ha of coniferous plantations and 4520 ha of hardwood plantations need to be established in 1985, increasing this annual area by 5.33% per year, for the entire 1985-1995 period (See Table 3.6).

TABLE 3.6 INDUSTRIAL PLANTATION REQUIREMENTS 1985-1995 (Ha)

Year	Coniferous	Hardwood	Total
1985	6,298	4,520	10,818
1986	6,634	4,761	11,395
1987	6,988	5,015	12,003
1988	7,360	5,282	12,642
1989	7,752	5,564	13,316
1990	8,166	5,861	14,027
1991	8,601	6,173	14,774
1992	9,060	6,502	15,562
1993	9,543	6,849	16,412
1994	10,052	7,214	17,266
1995	10,588	7,600	18,188
TOTALS	91,672	65,341	157,013

3.2 Availability of land for plantation forestry

Anaya and Guevara (19) report the area for potential "availability" of land for industrial forestry plantations as being in the order of 242,615 ha (11.5% of the total country area), as shown in Table 3.7:

3.7 AVAILABILITY OF LAND FOR INDUSTRIAL PLANTATIONS

	Region	Area Potentially Available
I.	Chalatenango/Metapán	77,310
II.	Monteca/Perquín	41,094
III.	Alegría/Jucuarán	55,071
IV.	San Salvador/Chichontepec	45,470
V.	Dispersed South and West	23,670
	TOTAL	242,615

The national Agrarian Census of 1971 revealed that there are 275,669 farms in El Salvador, 61.32% of which are less than 100 ha, covering some 890,300 ha. The average farm in El Salvador, as reported by this census, is 5.3 ha. Therefore, one cannot foresee the possibility of large-scale industrial plantations in this country, but rather, small, farm or linear plantations that may cover, altogether an important fraction of future roundwood demand. The feasibility of management, harvest and transport would have to be analyzed, in detail, before making a judgement on their viability, in the short and long run.

IV. HONDURAS

1. Supply trend data for wood products

1.1 Characterization of the forests of Honduras

1.1.1 Description of the forest types

Of the total area of Honduras (112,090 Km^2), 39,863 Km^2 are covered by forests (35.6% of the total area). Nearly half of these forests consist of coniferous stands.

The pine forests of Honduras consist of primarily three species: Pinus caribaea, that is found, in its greatest extension, in the flatlands of La Mosquitia; the low lands of the north coast of Honduras and in isolated pockets, in the interior of the country, up to an elevation 700 of meters above sea level. The species Pinus oocarpa is the most extensive, in volume and in area, of the three main pine species. It is found in elevations of 700 m to 1,400 m above sea level, in pure stands, or mixed with a number of Quercus species. From 1,500 to 1,900 meters above sea level, Pinus pseudostrobus is found, either mixed with P. oocarpa, in its lower habitats, or with Liquidambar styraciflua, in its higher elevations.

Virgin dense and mature stands of pine are now only found in the Department of Olancho and the northern part of Francisco Morazán. Pine forests, in areas that have been readily accessible, have been severely high-graded and are now constituted by medium or small-sized trees, mixed with denser stands in the isolated, inaccessible sites.

Mixed tropical hardwood forests occur primarily in the northren ranges, in the valleys of the main rivers and in the Mosquitia Mountains. In the tropical moist forest life zones, the Vochysia hondurensis, Terminalia amazonia, Cordia alliodora, Cedrela mexicana, C. odorata, Ceiba pentandra, Tabebuia guayacan, T. donnell-smithii, Swietenia macrophylla are the most frequent commercial species.

The dry tropical forest is found mainly in some valleys and in the southern region of the country. It is also heterogeneous and includes species such as Acacia sp, Enterolobium cyclocarpum, Mimosaceae species, etc.

The very wet subtropical forest of the interior highlands, in elevations of 600 to 1500 meters above sea level, consists of more than 50 tree species, generally in denser stands, and contiguous to higher cloud forests of mixed Quercus and Podocarpus species.

1.1.2 Areas by forest type

Table 4.1 presents the area of the hardwood and pine forests of Honduras. FAO/PNUMA (8) estimate that the dense undisturbed forests constist of unproductive hardwoood forests in some 20% (i.e., they don't produce industrial roundwood), and that 80% of the hardwood productive forests have been logged at least once.

TABLE 4.1 FOREST LAND AREAS AND VOLUME OF PINE FORESTS OF HONDURAS (END OF 1980)

Forest District	Area of Hard-Wood Forests (1000 Ha)	Area of Pine Forests (1000 Ha)	Commmercial Pine Volume (1000 M3/)	Avg. Commer. Volume/Ha (M^3 Pine)
Comayagua	63.8	266.7	3,455.9	13.0
Copán	32.0	243.9	3,039.1	12.5
Fco. Morazán	147.8	332.5	2,071.3	6.2
Gracias a Dios	298.5	103.3	1,513.1	14.7
Nor-occi-dental	616.5	136.4	1,062.8	7.8
El Paraíso	127.4	228.7	1,712.6	7.5
Olancho	639.8	484.3	28,700.2	59.3
Yoro	110.6	154.1	2,715.9	17.6
TOTALS	2,036.4	1,949.9	43,670.9	22.4

Undoubtedly, the Olancho Reserve constitutes the only large potential of dense, mature pine forest of Honduras. It is here that, recently, a large sawmill was established with an installed capacity of 83 million board feet (426,000 m^3 of roundwood consumption). Gracias a Dios, the Mosquitia area of Honduras, is an isolated, inaccessible area whereby its

commercial volume is not available and will not be in the medium term. Without these two regions, the commercial area of pine forests of Honduras is reduced to just over 1.3 million hectares, and the commercial pine volume is reduced to just over 13.4 million m^3.

1.2 Timber removals

Production data for the past six years are shown in Table 4.2, for the major mechanical wood products.

TABLE 4.2 PRODUCTION OF MAJOR MECHANICAL FOREST PRODUCTS (M^3)

Prod./Year	1978	1979	1980	1981	1982	1983
Sawnwood	627,715	575,132	556,016	551,297	475,297	456,188
Conifer.	616,196	567,344	545,396	543,036	472,991	453,356
Hardwood	11,519	7,788	10,620	8,261	2,312	2,832
Plywood	13,809	14,053	10,780	10,923	4,663	5,542
Conifer.	9,125	7,824	5,393	7,447	1,784	936
Hardwood	4,684	6,229	5,387	3,477	2,879	4,606
TOTALS	641,524	589,185	566,796	562,220	479,967	461,730

COHDEFOR (34) studies have shown that, on the average, 35.9% of the volume cut is converted into final product. On this basis, the annual volume cut was estimated in Table 4.3.

TABLE 4.3 COMMERCIAL VOLUME CUT FOR INDUSTRIAL PURPOSES

Year	Total Prod. (M^3)	Commer.Vol. Cut (M3)	Standing Timber Inv. Conifers (1000 (M^3)
1980	566,796	1,270,610	43,670.9
1981	562,220	1,260,350	42,410.6
1982	479,967	1,070,040	41,340.5
1983	461,730	1,035,080	40,305.4

1.2.2 Deforestation rates and implications

FAO (8) reported an area of 4,072,000 ha of hardwood forests in 1965 with 70% of dense forests, between commercial and protection forests, and 30% of other types of forests, consisting of open palm cover (200,000 ha) and scrubland (1,022,000 ha). Therefore, dense

hardwood forest cover was reduced from 2,852.000 ha to 2,036,400 ha in 15 years, a deforestation rate equivalent to 54,373 ha/year.

In addition, the survey of the pine forests of Honduras (8) revealed that there were 2,740,000 ha of these forests in existence, in 1963. The 1980 figures estimate the pine forest as being 1,949,900 ha, a reduction of 790,000 ha in 17 years, a deforestation rate of 46,476 ha/year. In total, the deforestation rate of the forests of Honduras adds up to 100,849 ha/year, the highest rate in the Central American region.

The expansion of the agricultural production front is the main cause for deforestation, followed by forest fires and timber extraction. At this rate, Honduras should lose its hardwood forests (except some 20% located in inaccessible areas) in less than 30 years. An approximately equal life span can be expected for its pine forests.

1.3 Man-made forests

During the decades of 1940 and 1950, the United Fruit Company established some 2,000 ha of hardwood plantations, although the great majority were cut and burned for the establishment of African palm plantations (33). Some teak (*Tectona grandis*) plantations are still in existence and constitute a valuable raw material for furniture.

Table 4.4 summarizes the plantation efforts made in Honduras, with pine species, primarily *Pinus oocarpa*.

TABLE 4.4 PLANTATION AREAS 1974-1983

Year	Area Planted (Ha)	Forest District(s)
1974-1978	673	La Mosquitia
1979	1,312	La Mosquitia
1980	1,246	Comayagua
1981	783	Comayagua
1982	1,758	Comayagua
1983	5,012	Comayagua
TOTAL	10,748	

COHDEFOR has had a fair experience in solving some of the technical problems of nursery production and of pine plantations but has yet to solve the social/cultural problem of the destruction of these plantations through burning, grazing, etc. Furthermore, the Comayagua plantations have been established through funding of the Interamerican Development Bank and the fulfillment of goals of establishment has overshadowed the quality of the plantation. For example, FAO estimates that of 5012 ha planted in 1983, an average of only 30% survival had been estimated after the first year.

2. Macro-level market trends for major mechanical forest products.

2.1 Population and income trends

Honduras has one of the highest population growth rates in the continent. In 1978, a population of 3.6 million was reported and, in 1984, a population of over 4.4 million has been reported, denoting a net annual growth rate of 3.4% . Under these conditions, the total population of Honduras will be almost 10 million by the year 2010.

Honduras is also the poorest country in Central America with a per capita income of around $600. Historically, economic growth has been slower in Honduras than in the rest of the region. Because of rapid population growth, average per capita income has declined by almost 20% between 1979 and 1983. Expectations of an improved situation, however, hold that per capita income may double in the next 20 years. It is on this basis that the population and per capita income columns of Table 4.7 were estimated.

2.2 Production of major mechanical wood products

Table 4.2 of this report denotes the production of the major mechanical wood products for the years 1978-1983.

Honduras is the strongest exporter of wood products in Central America and, as such, the proportion of total production to the total apparent consumption, with an export surplus been maintained throughout the period being projected. This is a valid assumption in the cases of strong exporters, with an adequate supply of roundwood, to maintain their share of the markets. (Although lately Honduras has lost some its share in its markets, this is really considered a temporary situation due to the economic slump, foreign markets

have contracted and competitors in its major Caribbean markets (U.S. producers, mainly) have increased their share. In the medium and long run, however, this is unlikely to continue. As economic recovery, in the next few years, begins to occur, U.S. producers will turn to its domestic market and Caribbean consumers will again turn to their traditional suppliers. The Caribbean Basin Initiative will also open new markets for Honduran mechanical wood products. The projected total production of mechanical wood products for the 1984-2010 period, is shown in Table 4.6. Total production of these products for 1978-1983 is shown in Table 4.5.

TABLE 4.5 APPARENT CONSUMPTION OF MECHANICAL WOOD PRODUCTS 1978-1983 (M^3)

Year	Production	Exports	Total Apparent Consumption	Total Population	Per Capita Consumption (M^3)
1978	641,524	358,121	283,403	3,606,084	.0786
1979	589,185	333,533	255,652	3,732,297	.0685
1980	566,796	271,080	295,716	3,856,707	.0767
1981	562,220	289,562	272,658	3,991,691	.0683
1982	479,967	309,612	170,355	4,131,400	.0412
1983	461,730	262,072	199,658	4,276,000	.0467

2.3 Trade in mechanical wood products

Imports of mechanical wood products in Honduras for the 1978-1983 period, have been negligible (averaging less than 1000 m^3 per year). Exports, however, have been a significant proportion of the total national production (56% during the 1978-1983 period). Table 4.5 shows the export volumes for this period. The small proportion of imports has been omitted because they are so negligible.

Exports have had a tendency to decrease (5% per year, on the average, for the 1978-1983 period), but have averaged 304,000 m^3 per annum with a variation of, more or less, 12%.

2.4 Apparent consumption of mechanical wood products

The apparent consumption of mechanical wood products of Honduras is shown in Table 4.5, for the years 1978-1983.

2.4.1 Per capita apparent consumption

As shown in Table 4.5, the per capita consumption of mechanical wood products decreased by more than 40% in the period considered. This has been in accordance with the decrease in the per capita gross domestic product. The elasticity of demand as a function of the % change in gross domestic product (GDP) for Honduras, has been, on the average, 0.86, showing an inelastic demand of mechanical wood products as a function of GDP.

The projected real annual growth in per capita GDP is estimated at 3.4%, thus making the product of growth and demand elasticity equal to 2.93%. The parameter estimate for our projection model for per capita mechanical wood consumption, therefore, is the following:

$$Y_n = y_o \, (1.0293)^n$$

2.4.2 Projections of apparent consumption and commercial timber demand

Projections of growth in per capita consump-consumption, following the model explained before, are based on the parameter shown in the above equation.

The demand for standing commercial volumes is based on the following conversion parameters: 86% of standing volume cut is converted to logs at mill site and 52% of log volume is converted to product, resulting in a total conversion parameter of 0.446. The results are shown in Table 4.6. Troensengaard [36] reports negligible growth of the timber stock inventory as a result of fire and deforestation. As a result, the standing volumes required by industry have been deducted from a static standing mature timber inventory.

2.5 Predictions of unmet demand

Considering negligible growth (as reported by Troensengaard) of presently young stands, mature standing stock of coniferous forests may end by the year 2008. If pine forest fires are controlled, promoting and enhancing their natural regeneration

TABLE 4.6 PROJECTED DEMAND AND SUPPLY OF INDUSTRIAL CONIFEROUS' ROUNDWOOD FROM NATURAL FORESTS, 1984-2010

Year	Production (M^3)	Exports (M^3)	Total Apparent Consumption (M^3)	Total Population	Per Capita Consumption	Per Capita GDP	Standing Volume Requirements	Conif. Mature Standing Timber Inventory
1984	473367	266138	207229	4418533	.0469	607	1061170	39244.3
1985	491233	276183	215050	4565818	.0471	628	1101220	38143.0
1986	509763	286601	223162	4718012	.0473	651	1142760	37000.3
1987	530095	298632	232063	4875279	.0476	674	1188340	35811.9
1988	552370	310556	241814	5037788	.0480	697	1238270	34573.7
1989	558724	300000	258724	5205714	.0497	722	1252510	33321.2
1990	576594	300000	276594	5379230	.0514	747	1292570	32028.6
1991	595817	300000	295817	5558546	.0532	773	1335670	30692.9
1992	616377	300000	316377	5743831	.0551	801	1381760	29311.2
1993	638365	300000	338365	5935292	.0570	829	1431050	27880.1
1994	661881	300000	361881	6133135	.0590	858	1483770	26396.3
1995	687032	300000	387032	6337573	.0611	889	1540150	24856.2
1996	699933	300000	399933	6548825	.0632	920	1569070	23287.1
1997	741413	300000	441413	6747473	.0654	952	1662060	21625.1
1998	770721	300000	470721	6952146	.0677	986	1727760	19897.3
1999	801975	300000	501975	7163027	.0701	1020	1797820	18099.5
2000	835303	300000	535303	7380306	.0725	1056	1872530	16226.9
2001	870845	300000	570845	7604176	.0751	1094	1952210	14274.7
2002	908746	300000	608746	7834836	0777	1133	2037170	12237.6
2003	949164	300000	649164	8072493	0804	1173	2127780	10109.8
2004	962265	300000	692265	8317358	.0832	1214	2157150	7952.6
2005	1038228	300000	738228	8569651	.0861	1257	2327440	5625.2
2006	1087242	300000	787242	8829597	.0892	1301	2437310	3187.9
2007	1139511	300000	839511	9097428	.0923	1347	2554490	633.4
2008	1195250	300000	893250	9373384	.0955	1395	2679440	-
2009	1254690	300000	954690	9657710	.0989	1443	2812690	-
2010	1318077	300000	1018077	9950660	.1023	1495	2954790	-

and growth; and, if the reduction in pine forest cover (46,476 ha/year) can be diminished significantly, this gap in the supply of mature pine roundwood will not occur. Nevertheless, as Table 4.7 confirms, the expected average annual cut by forest district in Honduras, clearly demonstrates that most pine forests, with the exception of Olancho, are in grave danger of disappearing even in the short run. Hardwood forests, at their rate of depletion, may disappear in 30 years.

TABLE 4.7 DURATION OF THE MATURE PINE FORESTS OF HONDURAS

Forest District	Area Hdwd Forest 1000 (Ha)	PINE FOREST Area 1000 Ha	Commer. Volume 1000 M^3	% of Annual Cut	Average Annual Cut	Duration Pine for (yrs.)
Comayagua	63.8	266.7	3455.9	16.2%	258.8	13.3
Copán	32.0	243.9	3039.1	4.0%	64.4	47.2
Fco. Morazán	147.8	332.5	2071.3	22.5%	358.9	5.8
Gracias a Dios	298.5	103.3	1062.8	4.5%	71.0	15.0
Nor-Occidental	616.5	136.4	1062.8	4.5	71.0	15.0
El Paraíso	127.4	228.7	1712.6	11.2%	178.2	9.6
Olancho	639.8	484.3	28700.2	34.9%	556.1	51.6
Yoro	110.6	154.1	2715.9	9.7	156.5	13.5
TOTAL 1/	2036.4	1949.9	43670.9	100.0	1594.0	27.4
TOTAL 2/			42157.8		1594.0	26.4

3. Areas potentially available for industrial plantations

3.1 Plantation requirements to meet the potential gaps

Existing plantations, which according to previously mentioned estimates, may only have a 30% survival, will provide 66,640 m^3/year of growing stock. (Mean annual increment for pine plantations in Honduras is 6.2 m^3/ha/year). The estimated, average rotation age is 45 years. Final harvest volumes of some 1.6 million m^3 can be foreseen but not before the year

1/ Including the inaccessible area of Gracias a Dios.
2/ Excluding the inaccessible area of Gracias a Dios.

2025 with some 0.7 - 0.8 million m^3 of commercial thinnings in the years 2006 and 2016. These volumes may account to almost 1/3 of the required standing volumes for those years. Nevertheless, the startup of the Olancho sawmill and the precarious situations of the Comayagua, Francisco Morazán, El Paraíso, Northwest and Yoro Forest Districts, demand continued efforts of plantations in their best sites. The Western and Northern ends of Comayagua, the north area of Francisco Morazán, the Northeast zone of El Paraíso, the Western and Southern regions of the North Western District and the Eastern portion of Yoro, are the most productive forest lands in each forest district. Among them, Olancho, Francisco Morazán and El Paraíso offer the highest productivity. It is necessary that efforts of reforestation should be concentrated in these areas.

Many of the above areas have been too high-graded to permit natural regeneration; however, natural regeneration is important to many areas of Honduras and efforts should be made to protect these areas from fire and to manage them to promote growth. Nevertheless, Honduras needs, in addition, a considerable effort in reforestation to maintain its importance as a timber producer.

Plantation needs in Honduras should be concentrated in pine species (primarily) at a rate of some 7,500 ha/year in 1985 (considering that natural regeneration will be encouraged and protected in an area equivalent to no less than 1% of existing pine forest area). This rate should increase 7.2% annually until reaching 15,000 ha/year in 1995, as shown in Table 4.8.

TABLE 4.8 PLANTATION REQUIREMENTS, 1985-1995

Year	Coniferous Plantation Req. (Ha)
1985	7,500
1986	8,038
1987	8,615
1988	9,235
1989	9,895
1990	10,605
1991	11,365
1992	12,185
1993	13,060
1994	13,995
1995	15,000
TOTAL	119,493

This area, added to the 1% managed, natural regeneration area/year will amount to 314,483 ha of established pine stands by 1995. The reforestation efforts must continue to increase by at least the same rate of increase as the industrial roundwood demand' increase rate.

3.2 Land availability for man-made forests

The lack of a cadastral survey in most forest lands, and the existing legislation, have contributed to an undefined land tenure situation. The numerous possibilities of "rights-to-use" of municipal lands; the right to ownership after 10 years of use and occupancy of national (state) lands and the right to sell the use of municipal lands, have created a number of "owners" with a variety of rights. This fact, added to the number of occupancies in different ownerships, have created some situations of questionable validity. Nevertheless, the fact remains that occupants of forest lands make decisions as do the outright private landowners, that seriously affect the management and the very existence of the forest resource.

In general, the State is the largest landowner of forest lands in Honduras. This, by itself, ensures the availability of lands for man-made forests. However, some densely populated areas in the Central Massif of Honduras present numerous problems due to the complicated land tenure/occupancy situation previously explained. The incorporation of this population will be a "must" in order to ensure the success of a reforestation program. Large-scale industrial plantations, in blocks, may only be feasible in Olancho, Northeastern El Paraíso and Gracias a Dios.

Overall, the potential land area available is 1,050,100 ha for pine forests, and 2,473,496 ha for hardwood forests, adding to a total of 3,523,596 ha in the whole country.

V. NICARAGUA

1. Supply trend data for wood products

1.1 Characterization of the forests of Nicaragua (38)

Figure 5.1 denotes the various forest districts, regions (R) or special zones (ZE) of Nicaragua.

In Region (R-1), the pine forests are concentrated in the mountains of Nueva Segovia, although there are some disperse stands in other departments. The average total volume of these pine forests is estimated to be 48m^3, with bark, per hectare. Some hardwood species (oaks, primarily) can appear in mixed stands. The hardwood stands are generally of secondary growth and are of little industrial interest.

There is no adequate information on species and volumes for Regions 2,3 and 4. Nevertheless, it has been estimated that all industrial volumes have been harvested in these regions. IRENA's (the Nicaraguan Institute of Natural Resources and the Environment) information estimates that there are some 23,000 ha of very low volume industrial timbers in Region 2, of which some 20,000 ha are of agricultural aptitude.

Most of the forests of Region 5 are found in its eastern portion, where an average of 40 m^3, with bark, of commercial volume, per hectare, can be found in some 444,000 ha.

Region 6 is practically all deforested in its southern and western portions while its central area has some 459,000 ha of potentially commercial forests that have been only slightly affected by agricultural activities.

The northeastern corner of the so-called Special Zone 1 is dominated by low-density pine forests where average volume is estimated at about 7 m^3/ha, with bark. As an average total volume per hectare for the 341,000 ha of pine forests, an estimate of 31 m^3, with bark, has been established. An area of 1,237,000 ha of commercial hardwood forests and a volume of 40 m^3 have been estimated for the region.

Special Zone 2 is predominantly hardwood forests (576,000 ha) with an average volume of 40 m^3/ha, with bark. Its pine forests amount to only 10,000 ha in disperse stands, near the Río Grande of Matagalpa.

Special Zone 3 has only hardwood forests with very little disturbance (268,000 ha) and an average commercial volume of 40 m^3 ha, with bark.

Table 5.1 denotes the areas and volumes estimated for Nicaragua, in 1984.

TABLE 5.1 AREA AND VOLUMES OF NATURAL COMMERCIAL FORESTS OF NICARAGUA, 1984 (38)

Region or Zone	Natural Pine Forests		Hardwood Forest	
	Area (Ha)	Vol. (1000 M^3)	Area (Ha)	Vol. (1000 M^3)
1	45,000	1,512.0	65,000	2,184.0
2			23,000	460.0
5			444,000	17,760.0
6			459,000	18,360.0
Special 1	341,000	10,571.0	1,237,000	49,480.0
Special 2	10,000	310.0	576,000	23,040.0
Special 3			268,000	10,720.0
TOTALS	396,400	12,393.0	3,072,000	122,004.0

1.2 Timber removals from commercial forests

1.2.1 Industrial removals

The 65 sawmills and one plywood plant operating in Nicaragua, have a combined production capacity of 240,000 m^3/year. No information is available on historic production of this industry, except that, in 1982, their combined total was 119,000 m^3, slightly less than 50% of their installed capacity. It is also estimated that, in 1978, there were 80-90 sawmills operating, and the total industrial production reached 300,000 m^3 of which, 112,000 m^3 were exported (38).

It is estimated that 2.50 m^3 of coniferous roundwood are required to produce 1 m^3 of sawnwood, and that 2.67 m^3 of roundwood are required to produce 1 m^3 of hardwood product (37.4% yield). In this sense, 310,250 m^3 were removed, in 1982, to produce 119,000 m^3 of lumber and plywood, and that 782,140 m^3 were removed, in 1978. FAO (8) considers that the area logged annually, between 1976 and 1980, averaged 18,900 ha of pine forest and 46,500 ha of hardwood forests. If conditions remained the same, one would assume that the total area logged, in 1982, was 25,200 ha.

1.2.2 Deforestation rates and implications

About 2.7 million hectares of old forests, relics from the original vegetation, are found in the midst of agricultural and grazing lands. These are considered land reserves or are situated in areas of difficult topography.

As usual, the timber felled, in this deforestation process, is not used. The deforestation front progresses from the west to the east, and from the south to the north. Although demographic pressures have been much greater in the Western part of the country, they are expected to increase significantly, in the eastern side, as time progresses. For example, already the Río Escondido area has had an increase in its deforestation rate that has gone from 11,000 ha/year, in the 1940-1959 period, to 31,000 in the 1961-1970 decade. The pine forests of Nueva Segovia decreased from 154,000 ha in 1954 to 45,000 in 1984. FAO (8) estimates an annual deforestation rate of 67,900 ha (net change) for hardwood forests and 14,000 ha/annum for pine forests. If this continues, productive hardwood forests will tend to disapper in 45 years and the productive pine forests, in 28 years.

1.3 Man-made forests

Prior to 1975, there were no industrial plantations established in Nicaragua. In 1975 and 1976, 430 ha and 600 ha, respectively, were established (*Pinus caribaea*). There is no information available on any further efforts to establish man-made forests.

2. Macro-level market trends for major mechanical wood products

2.1 Population and per capita gross domestic product.

Table 5.2 shows the population and gross domestic product (GDP) changes in Nicaragua for the 1966 - 1977 period (38)

TABLE 5.2 POPULATION AND GROSS DOMESTIC PRODUCT INCREASE, 1966-1977

Item	Unit of Measure	1966	1977	Increase (%) Period	Increase (%) Annual
Population	1000's	1,652.3	2,324.3	40.7	3.2
GDP-Total	Millions C$	3,995.9	6,886.6	71.4	5.3
GDP-per capita	C$	2,418.4	2,953.5	122.1	1.8

Projections of population estimate an average annual increase of 3.1%, placing the total population at levels of 3,218,000, in 1985, 3,778,000, in 1990, and 5,150,000 for the year 2000 (38)

2.2 Production, trade and consumption of mechanical wood products

In the period 1967-1982, sawnwood production doubled between the beginning of the period (149,000 m^3) and 1978 (301,000 m^3). In 1979, production decreased significantly, to 178,000 m^3, and to 96,000 m^3, in 1980. Since 1981, there has been a slight tendency to recover. High peaks of production are reported for the 1973-1974 biennium as a consequence of the increased demand originated by the post-earthquake construction period.

In terms of species, production for the entire period consisted of pine lumber (40%) and hardwood lumber (60%, *Swietenia macrophylla* and *Cedrela* sp, primarily).

Lumber exports reached a high of 98,300 m^3 in 1978 but, as of 1979, these fell significantly, in proportion to the reduction in production.

Total apparent consumption doubled, from 102,000 m^3 in 1967 to 202,000 m^3, in 1978, but has fallen to 92,000 m^3 per annum since 1980. The species composition of this total apparent consumption has been 13% pine lumber and 87% hardwood lumber (the inverse proportion of the exports). Table 5.3 denotes sawnwood consumption for the years 1966 and 1977 (actually, this volume is the average volume for the 1976-1978 period).

TABLE 5.3 CONSUMPTION OF SAWNWOOD, 1966 - 1977

Consumption	1966	1977	% Change Period	% Change Annual
Total	82,000	193,600	134.1	8.02
Per Capita	0.0500	0.0833	66.5	4.74

Statistics on the production and trade of wood panels are incomplete. The only plywood plant in the country has an installed capacity of 25,000 m^3/year, but, it has only operated at a normal level of capacity, in the 1977-1978 biennium. The apparent consumption of plywood is shown in Table 5.4.

TABLE 5.4 PRODUCTION, TRADE AND APPARENT CONSUMPTION OF PLYWOOD

Year	Production (M^3)	Imports (M^3)	Exports (M^3)	Total Ap. Consump. (M^3)	Population (1000's)	Per Capita Con (M^3)	% participation consump.
1978	22,530	1,200	13,564	10,166	2,409.6	.0042	4.8%
1979	15,852	-	10,892	4,960	2,493.0	.0020	3.4
1980	14,736	-	6,225	8,511	2,579.0	.0033	9.2
1981	6,896	-	4,154	12,543	2,667.3	.0048	10.9
1982	16,042	-	2,107	13,835	2,758.4	.0850	13.6

The relative consumption figures of sawnwood and plywood consumption are shown in Table 5.4, showing an increasing tendency, over-all, in the participation of plywood in the total apparent consumption of mechanical wood products (38).

The projection of demand for these products takes into account the fact that, more than in the other countries in the Region, the demand elasticity factors in Nicaragua, are higher due to the high priority that the construction sector has had in this country. While the per-capita Gross Domestic Product (GDP) 1966-1977 increased at an average annual rate of 1.8% (See Table 5.2), per capita consumption of sawn products increased 4.7% (Table 5.3). As such, for each % increase in the per capita GDP, the per-capita sawnwood consumption rose 2.58%. There are, however, indications that the proportion of wood products used in construction has decreased over the years, surely due to a substitution of wood by other materials as its relative price increased (See Table 5.5).

TABLE 5.5 WOOD CONSUMPTION IN CONSTRUCTION (38)

Period	Gross Domestic Prod. Million C$		Wood Consump. (1000 m^3)	M^3 consum. per million C$ const.
	Total	Construction		
1970-72	4.91	0.34	130.8	386
1973-74*	5.64	0.51	235.2	464
1975-76	6.29	0.60	185.5	308
1978	6.87	0.69	193.6	279

* Post-earthquake reconstruction period.

2.3 Projections of demand for sawnwood and plywood

Swedforest (38) estimates the following probable demand for sawnproducts and wood panels.

5.6 PROBABLE DEMAND FOR SAWNWOOD AND WOOD PANELS, 1985-2000 (1000's OF M^3)

Use/Year	1985 Vol.	1985 %	1990 Vol.	1990 %	1995 Vol.	1995 %	2000 Vol.	2000 %
Construc.	66.6	55.7	134.7	72.0	214.0	72.5	317.1	66.3
Mine Timber	16.0	13.4	25.1	13.4	23.9	8.1	24.0	5.0
Ties	3.1	2.6	18.9	10.1	5.1	1.7	5.1	1.1
Furniture	33.1	27.7	7.5	4.0	51.6	17.4	130.9	27.4
Other Secondary Prod.	0.7	0.6	0.8	0.4	0.9	0.3	1.0	0.2
TOTALS	119.5	100.0	187.0	100.0	296.5	100.0	478.1	100.0

TABLE 5.7 DERIVED INDUSTRIAL ROUNDWOOD DEMAND 1985-2005 (1000's (M^3)

Period	Internal Prod. Demand	Exports	Production	Roundwood Demand
1985-89	597.5	112.5	710.0	1,853.1
1990-94	935.0	176.1	1,111.1	2,900.0
1995-99	1,428.5	279.1	1,761.6	4,597.8
2000-05	2,390.5	540.1	2,840.6	7,414.0
TOTALS	5,405.5	1,017.8	6,423.2	16,764.9

For the period 1985-2005, if the proportion of coniferous versus hardwood species remains constant both for apparent consumption as well as for exports, the coniferous industrial roundwood total demand would be 4.15 million m^3, and for hardwoods, it would be 12.61 million m^3.

2.4 Predictions of unmet demand to the year 2010

Comparing the projected roundwood demand with the standing stock, there will be no unmet demand for this period. Nevertheless, the depletion of forests due to

agricultural deforestation, combined with industrial needs, can create a gap in the supply of coniferous industrial roundwood by the year 2012. The only danger in the medium term, for hardwood forests, will occur due to their limited accessibility. At the rate of depletion, however, even considering the total area, problems will occur, in the hardwood industrial roundwood supply, by the year 2028.

3. Areas potentially available for tree planting

3.1 Plantation requirements to meet potential gaps

The strategy proposed by the National Forestry Development Plan (38) is summarized in Figure 5.1. In summary, it proposes:

- The establishment of pine plantations in Regions 1, 5, and 6, but primarily, Region 5. These plantations would basically constitute an extension of the natural, pine forests found in Region 1.

- The establishment of hardwood plantations (especially Tectona grandis) in the Cosigüina Península and in the southeastern area of the central inland region (see Figure 5.1)

- The main pine species used shall be P.oocarpa for elevations above 800 m., P.caribaea below 500 m, and a mixture of both for the transition elevations, between 500 and 800 m above sea level.

From these proposed alternative reforestation programs, the Development Plan proposes, or recommends, the following (38):

TABLE 5.8 REFORESTATION PROGRAM PROPOSED BY THE NATIONAL FORESTRY DEVELOPMENT PLAN FOR THE PERIOD 1985-2015

Region	Pine (Ha)	Hardwood (Ha)	Total Area (Ha)	MAI M^3/Ha/year
1	40,200		40,200	12.0
2	10,000	10,000	10,000	n.a.
5	116,200	10,000	126,200	18.0
6	45,300		45,300	15.0
TOTALS	201,700	20,000	221,700	

The above program means an average annual reforestation area of 7,390 ha. The mean annual increment is estimated on the basis of a 30 year rotation.

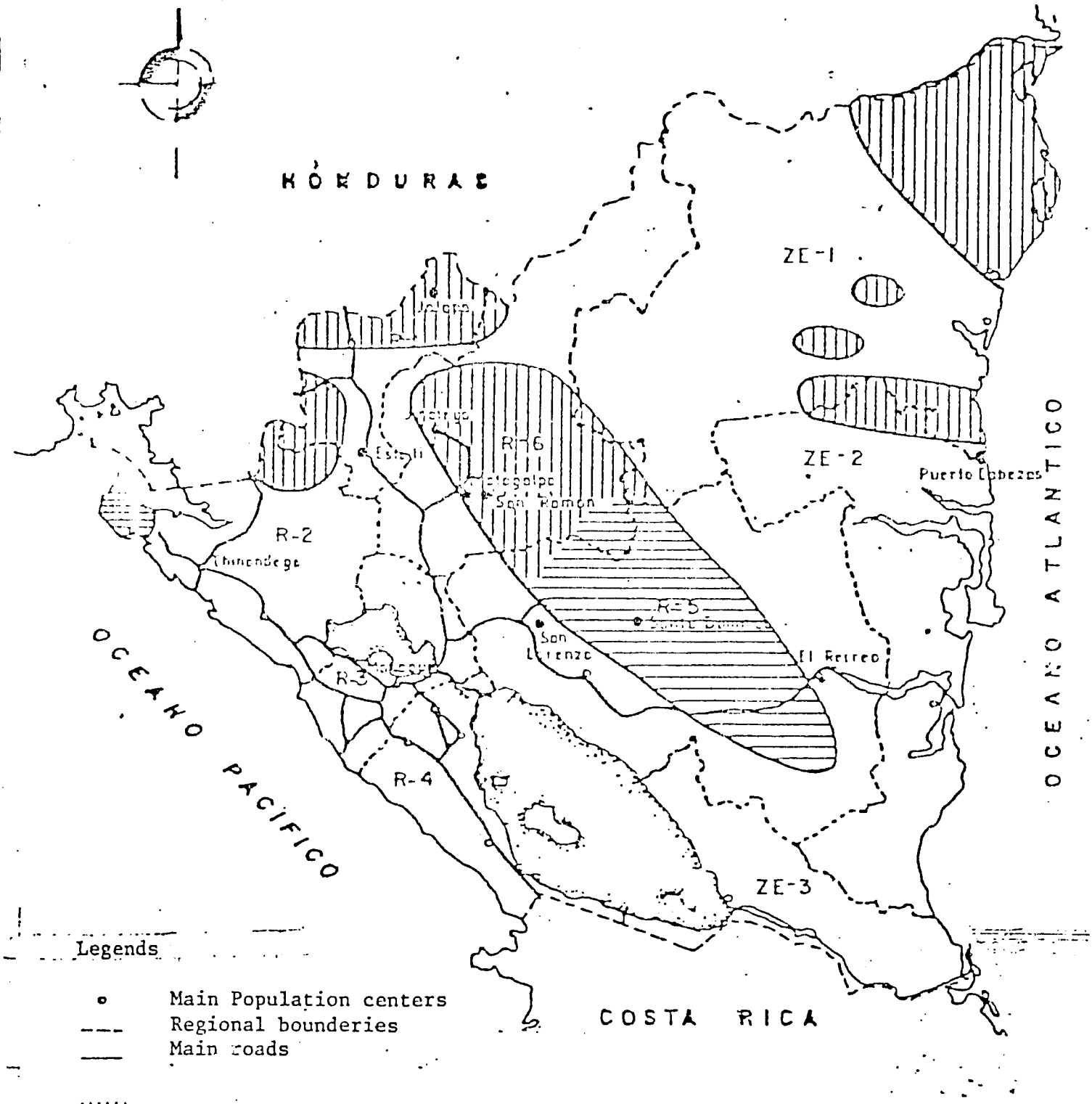
3.2 Land availability for man-made forests

The land availability for man-made forests, in the above regions in Nicaragua and their productive potential is shown in Table 5.9 (39).

TABLE 5.9 LAND AVAILABILITY FOR REFORESTATION (1000 Ha)

Region	Productivity		Total Area
	High	Low	
1	18	328	346
2	21	211	232
5	841	213	1,054
6	111	198	309
TOTALS	991	950	1,941

REPUBLICA DE NICARAGUA



Legends

- Main Population centers
- Regional bounderies
- Main roads
- Areas for pine plantations
- Areas for pine natural regeneration
- Teak plantations

Escala 1:3,000,000

0 50 100km

VI. COSTA RICA

1. Supply trend data for wood products

1.1 Characterization of the forests of Costa Rica

FAO has estimated forest cover areas for Costa Rica based on density classes, as follows (43):

Density Class	Crown Cover
I	Natural, virgin, undisturbed, 90-100%.
II	Moderately disturbed, 60-90%.
III	Strongly disturbed 30-60%.
IV	Pasture, sparse tree vegetation 0-30%.
V	Swamps, mangroves, scrubland.

Table 6.1 denotes the area of forests of Costa Rica on the basis of the above-mentioned density classes, assuming the average forest cover, per class, in each forest district, and considering dense forests only, above 45% crown cover (43). In addition, the same density classes are deducted from the existing dense forest area of the country, which are reserved as wildlife or recreational reserve in each geographic region. Assuming that Hartshorn's (42) proportion, of potential productive versus protection forests remains constant in the existing forest cover, an estimate is made of the existing (beginning of 1984) productive forests of Costa Rica (41):

TABLE 6.1 AREA OF NATURAL PRODUCTIVE FOREST OF COSTA RICA, 1984

Forest District	Area of Dense Forests (Ha)	Area of Dense Forests Reserved for other Purposes (Ha)	Area of Available Dense Forest 1984 (Ha)	% Area Productive Forests (%)	Area of Productive Forest Available 1983 (Ha)	Area Logged in 1983 (Ha)	Area of Productive Forests 1984 (Ha)
Atlantic	464,680	194,700	269,980	45.3	122,450	5,650	116,800
North	262,870	20,900	241,970	75.3	182,271	13,871	168,400
Pacific Central	247,080	52,900	194,180	45.1	87,526	946	86,580
Pacific North	79,300	31,700	47,600	67.1	32,095	1,115	30,980
Pacific South	285,780	93,400	192,380	48.0	92,335	4,615	87,740
TOTALS	1,339,710	393,600	946,110	54.6	516,697	26,197	490,500

Of the 490,500 ha of natural, dense, productive forests remaining, only 146,500 ha are virgin or little-disturbed forests (30%), and, of these, only 90,000 ha (18.4%) have a high production potential in continuous blocks that are equal to, or greater than 3,000 ha. Seventy percent of the remaining natural dense, productive forests (344,00 ha) are forests with different degrees of disturbance, in smaller blocks or units, which not only reduces their commercial volume, but also, increases their harvesting costs.

1.2 Timber removals

1.2.1 Industrial removals

Industrial roundwood consumption for 1983 is shown in Table 6.2 The equivalent standing commercial volumes are based on studies that have shown that only 54% of the standing volume cut reaches the industry (41). The area cut in 1983 was also based on Flores' estimates and this is shown in Table 6.1, above (41).

TABLE 6.2 INDUSTRIAL TIMBER REMOVALS AND LOG DEMAND, 1983

Province	Log Consumption (M3)	%	Commercial Volume Cut Ha	%
San José	204,340	28.2	970	0.1
Cartago	91,400	12.6	-	
Alajuela	219,700	303.0	540,940	40.6
Heredia	60,900	8.4	88,590	6.6
Limón	70,900	9.8	445,700	33.5
Puntarenas	47,800	6.6	220,140	16.5
Guanacste	29,800	4.1	36,320	2.7
TOTALS	724,840	100.0	1,331,600	100.0

It can be noted, in the above table, that while 3 provinces consume more than 71% of the industrial roundwood, (San José, Cartago and Alajuela). three provinces (Alajuela, Limón and Puntarenas) supply almost 91% of that roundwood with only Alajuela as a consumer and supplier among them, since it consumes 41% of its own roundwood. This shows that a large proportion of the indus-trial concentration is located in areas distant from their log supply. Industrial production, for 1983, is shown in Table 6.3.

TABLE 6.3 PRODUCTION OF MAJOR MECHANICAL WOOD PRODUCTS, 1983 (M^3)

Province	Sawnwood	Plywood	Partic. Board	Veneer	Total	%
San José	65,900	23,700	7,700	-	97,300	27.8
Cartago	43,400	-	-	-	43,400	12.4
Alajuela	100,200	-	-	-	100,200	28.7
Heredia	28,500	-	-	-	28,500	8.1
Limón	26,600	-	-	7,700	34,300	9.8
Puntarenas	22,000	-	-		22,000	6.3
Guanacaste	13,700	-	-	-	13,700	3.9
TOTALS	303,300	23,700	15,000	7,700	349,700	100.00

1.2.2 Deforestation rates and implications

Pérez and Protti (41) estimated the deforestation rates for the years between 1950 and 1977. For the period between 1950 and 1961, the rate was 36,000 ha/year; and, between 1961 and 1977, it was 45,000 ha/year. Accordng to Flores' (41) and FAO (43) estimates, 250,390 ha were denuded between 1977 and 1982, an equivalent rate of 50,000 ha/year. This means that the deforestation rate has increased at an average rate of 1.03%/annum, over the past 32 years. If this were to hold true (and given the population growth, there is no reason not to believe this), the deforestation rate in the next decade should increase from 51,040, ha, in 1984, to 56,560 ha in 1994, adding to a total of over 1/2 million ha, in the same period.

Agrarian legislation, that considers deforestation a pre-requisite for ownership rights, bank credits, that consider the deforestation an improvement and a pre- requisite for credit, have been two of the most significant contributors to this deforestation. Even without industrial timber removals, Costa Rica is likely to lose its productive, natural forests in the next decade.

1.3 Man-Made Forests

Table 6.4 denotes the reforestation efforts in Costa Rica. Many of these areas, however, are small and disperse, reason for which, Flores (41) estimates

that no more than some 5,400 ha can be considered industrial plantations. Flores (41) also reports some additional 3248 ha of existing industrial plantations.

Yields from industrial plantations, assume a mean annual increment of 13.5 m^3/ha; 40 m^3/ha of fuelwood, in the first thinning; 30 m^3/ha of fenceposts, and 50 m^3/ha of industrial roundwood, in the 2nd thinning; and 150 m^3/ha in the final harvest. The proportion of sawlogs produced, in each thinning harvest is expected to be 15% and 35% respectively. The thinnings are expected to occur at ages 8 and 13 and the final harvest, at age 20. This is recommended by Flores (41) in view of the critical shortage of roundwood supply in the medium term. These rotation ages may be increased as the industrial reforestation program begins to close the gap between supply and demand, by the year 1998.

TABLE 6.4 PLANTATIONS ESTABLISHED IN COSTA RICA (1984)

Province	Through Fiscal Incent. (Ha)	Other Private (Ha)	Proj. 032 CORENA (Ha)	Other Global (Ha)	Total Area (Ha)
San José	394	883			1,277
Cartago	944	1,727			2,671
Heredia	275	27			302
Alajuela	1,089	15			1,104
Guanacaste	954	350	124		1,428
Puntarenas	112	21			133
Limón	400	80			480
TOTALS	4,168	3,103	124	3,384	10,779

2. Macro-level market trends for major mechanical wood products.

2.1 Population and income trends

The average annual population growth of Costa Rica since 1970 has been 2.6% and the projected total population is shown in Table 6. The projected per capita income is expected to grow at an annual rate of 4.5% over the next 10 years (44). Because of the significant decrease in real per capita income between 1980 and 1983, the real per capita income is not expected to bounce back to 1980 levels, until 1990.

2.2 Production of major mechanical wood products

Table 6.3 denotes the 1983 production of the major mechanical wood products of Costa Rica. Compared to 1980 (a rough estimate of 528,800 m^3), this production was reduced by 34%. Some causes are explained in later sections of this chapter.

2.3 Trade in mechanical wood products

The physical balance of trade, for 1978-1982, is shown in Table 6.5, for the major mechanical wood products.

TABLE 6.5 BALANCE OF TRADE OF SAWNWOOD AND WOOD-BASED PANELS 1978-1982 (M^3)

	Sawnwood			Veneer and Panels			Total
Year	Imports	Exports	Balance	Imports	Exports	Balance	Balance M^3
1978	7,035	1,620	-5,415	1,850	7,740	+5,890	+475
1979	5,150	100	-5,050	1,910	7,480	+5,570	+520
1980	5,100	200	-4,900	2,360	7,970	+5,610	+710
1981	4,095	600	-3,495	480	8,270	+7,790	+4,295
1982	2,400	4,900	+7,300	50	12,800	+12,750	+20,050

There has been a significant improvement in the balance of trade in sawnwood and in veneer and panels. In terms of foreign exchange earnings, sawnwood recovered, from a maximum deficit of $854,300, in 1980, to a surplus of $173,570, in 1982. The veneer and panel products have had a very favorable balance of trade which meant a surplus high of $9.2 million, in 1982.

2.4 Apparent consumption of mechanical wood products.

2.4.1 Total and per capita consumption

Table 6.6 denotes the apparent consumption of these products for the years 1974, 1980 and 1983. These are the only years for which there is production information in sawnwood. No production information is available for any year, other than 1983, for veneer and plywood.

The economic situation of Costa Rica between 1981-1982, had a serious effect on the per capita consumption of mechanical wood products, making it 50% of that observed for 1980, in sawnwood products.

2.4.2 Projections of apparent consumption and commercial timber demand.

The projected real annual growth in per capita GDP is estimated at 3.2% (44). The elasticity of demand, as defined before, has been estimated to be 1.4, showing that demand has been relatively elastic to changes in the gross domestic product (GDP). Therefore, the product of projected GDP growth and the demand elasticity is equal to 4.48%.

Consequently, projections of growth in per capita mechanical wood products consumption, following the same model, are based on these parameter estimates:

$$y_n = y_o\ (1+0.0448)^n = y_o\ (1.0448)^n$$

TABLE 6.6 APPARENT CONSUMPTION OF MAJOR MECHANICAL WOOD PRODUCTS (M^3)

Product/ Year		1974	1980	1983
Sawnwood	Imports	2,000	5,100	2,400
	Exports	9,400	200	4,900
	Prod.	527,900	523,900	303,300
	Total Apparent Cons.	520,500	528,800	300,600
	Per Capita	0.27	0.24	0.12
Veneer and Panels	Imports			
	Exports			24,400
	Prod.			46,400
	Total Apparent Const.			22,000
	Per Capita App. Cons.			0.014

Demand for standing commercial volumes is based on the following conversion parameters (41):

54% of standing volume cut reaches the mills
46.5% of log volume is converted to product.

The standing volumes required have been deducted from the standing mature timber stock inventory. The results are shown in Table 6.7

2.5 Predictions of unmet demand

The Costa Rican forest industry is one of the most wasteful industries in the Region and the consequences of this waste can be seen by the critical shortage of industrial

TABLE 6.7 PROJECTED SUPPLY AND DEMAND OF INDUSTRIAL ROUNDWOOD FROM NATURAL FORESTS, 1984-2010

Year	Production. (M^3)	Imports (M^3)	Exports (M^3)	Total Ap. Consump. (M^3)	Natur. Population (1000's)	Per Cap. Consumption (M^3)	Stand. Vol. Requir. (M^3)	Stand Timbe Inven (M^3)
1984	358,770		13490	345280	2466.3	.140	1428810	2348859
1985	383,880		14440	369440	2530.4	.146	1528785	2195980
1986	410,040		15420	394620	2596.2	.152	1632980	2032682
1987	440,080		165550	423530	2663.7	.159	1752615	1857421
1988	417,410		17730	453680	2733.0	.166	1877380	1669683
1989	596,965		19065	487900	2804.0	.174	2018985	1467784
1990	544,060		20460	523600	2876.9	.182	2166715	1251113
1991	585,800		22030	563770	2951.7	.191	2332945	1017818
1992	629,370		23670	605700	3028.5	.200	2506455	767173
1993	674,780		25380	649400	3107.2	.209	2687290	498444
1994	725,455		27285	698170	3188.0	.219	2889105	209533
1995	526,140	226,170		752310	3270.9	.230	2095335	-
1996		808,770		808770	3355.9	.241		
1997		833,250		833250	3443.2	.252		
1998		932,630		932630	3532.7	.264		
1999		1004,010		1004010	3624.6	.277		
2000		1078,450		1078450	3718.8	.290		
2001		1156,100		1156100	3815.5	.303		
2002		1244,870		1244870	3914.7	.318		
2003		1337,500		1337500	4016.5	.333		
2004		1438,190		1438190	4120.9	.349		
2005		1543,260		1543260	4228.1	.365		
2006		1657,120		1657120	4338.0	.382		
2007		1775,870		1775870	4450.8	.399		
2008		1908,800		1908800	4566.5	.418		
2009		2047,480		2047480	4685.3	.437		
2010		2196,8400		2196840	4807.1	.457		

roundwood supply in the next 11-12 years. Steps are being taken by the Government agencies to promote and encourage improved harvesting and utilization methods so as to extend the life of the productive forests. The program, proposed by Flores (41), expects to extend thelife of these forests up to the year 2003 or 2005. This will mean a reduction of more than 8.6 million m^3 of imports, during that extended period, if the program is implemented.

This depletion is further confirmed by the following estimates, on a region by region basis.

TABLE 6.8 DURATION OF PRODUCTIVE DENSE FORESTS OF COSTA RICA

Region	Area of Dense Forest 1984 (Ha)	Area cut Annually at Indus. Capacity (Ha)	Duration (Years)
000antic	116,800	10,510	11.1
North	168,40	24,915	6.8
Pacific Central	86,580	2,000	43.3
Pacific North	30,980	1,690	18.3
Pacific South	87,740	7,255	12.1
TOTALS	490,500	46,370	10.6

3. Areas potentially available for tree planting

3.1 Plantation requirements to reduce potential gaps

Existing plantations, as was mentioned earlier, will hardly provide any significant proportion of industrial roundwood. Table 6.9 presents the industrial plantations program proposed (41). The proposed management ar . .otation ages are as have been discussed in section 1.3 of this Chapter.

3.2 Land availability for man-made forests

Table 6.10 denotes the denuded forest lands (according to land use capacity criteria proposed by Hartshorn et al) (42). Perhaps the greatest obstacle to large-scale reforestation in Costa Rica is the unwilligness of land owners to commit potential forest lands to tree-growing over such long periods. It is for this reason, that some forest industries are considering options as Cases 2 and 3, presented in Chapter IX of this report. If some option, such as one of these, is not considered, any industrial plantation program will fail.

TABLE 6.9 PLANTATION REQUIREMENTS 1985-1976

Year	Annual Plantation Requirements (Ha)
1985	3,000
1986	6,000
1987	1,000
1988	15,000
1989	20,000
1990	30,000
1991	32,200
1992	34,500
1993	37,000
1994	39,600
1995	42,500
Total Plantation Requirements	267,800

TABLE 6.10 AREAS OF DENUDED FOREST LANDS

Region	Forest Area (ha)		Area Potentially Available for Tree-Growing
	Land Use Capacity	Presently Under Forest Cover	
Atlantic	771,930	464,680	307,250
North	509,320	262,870	246,450
Pacific Cent.	790,600	247,080	543,520
Pacific North	596,570	79,300	517,270
Pacific South	611,440	285,780	325,660
TOTAL	3.279,860	1,339,710	1,940,150

VII. PANAMA

1. Supply trend data for wood products

1.1. Characterization of the forests of Panamá

1.1.1 Description of the forest types

Panamá is the most tropical of the countries in Central America and has an area of 77,082 Km^2 of which 30% has dense forest cover.

Four regions are generally distinguished in the continental division: (Atlantic or Pacific) and located east or west of the Panamá Canal.

- The Atlantic East Region: in its majority included in the Indian Reserve "San Blás District" (250,000 ha). Included in Region 1, below:

- The Pacific East (Region 1): includes the Darién Region.

- The Pacific West (Region 2): includes the Azuero Region but, apart from this forest massif, the total area remaining is dedicated to agricultural activities.

- The Atlantic West (Region 3): includes the Donoso District.

The dense hardwood forests of Panamá can be heterogeneous (767,000 ha of "cuipo" forests (Cavallinesia platanifolia), sometimes associated with Anacardium excelsum and 1,941,000 ha without "cuipo") or homogeneous (with Quercus in the higher elevations), 68,000 of mainly Prioria copaifera, 486,000 ha of mangrove forests and 46,000 ha of mainly Campnosperma panamensis).

1.1.2 Area and volume of forests

Table 7.1 denotes the area of productive forests in each of the provinces of Panamá, in 1980 (55).

TABLE 7.1 AREA AND VOLUMES OF FORESTS , 1980

Province	Protect. Forests (Ha)	Man-groves (Ha)	Pro-ductive Forest (Ha)	Total Area of Forest (Ha)	% of Total Productive Forest	% Total Forest
Bocas del Toro	123,436	-	713,228	838,964	37.5%	23.6
Coclé	94,769	25,193	6,411	126,373	0.4%	3.6
Colón & San Blás	112,906	2,400	220,266	335,572	11.6	9.5
Chiriquí	43,421	66,760	-	110,181	-	3.1
Darién	766,000	470,023	470,023	1,265,248	24.7	35.6
Herrera	4,211	8,450	-	12,661	-	0.4
Los Santos	20,139	8,800	5,846	34,785	0.4	1.0
Panamá	95,050	120,900	365,436	581,386	19.2	16.4
Veraguas	89,805	38,387	118,376	246,568	6.2	6.8
TOTALS	1,349,737	300,115	1,899,886	3,549,783	100.00	100.0

It is estimated that, in 1980, 28% of the productive forest area had already been logged at least once (8), reducing their commercial volume by some 67%.

1.2 Timber Removals

1.2.1 Industrial removals

Production data for the 1978-1983 period is shown in Table 7.2, for the major mechanical wood products that use timber from natural productive forests.

TABLE 7.2 PRODUCTION OF MECHANICAL WOOD PRODUCTS 1978-1983

Product/ Year	1978	1979	1980	1981	1982	1983
Sawnwood	54,023	61,086	52,810	83,072	85,196	87,320
Plywood	24,754	26,263	27,860	24.210	24,537	24,864
TOTALS	87,777	87,249	80,670	107,282	109,733	112,184

Roundwood requirement for tree production is shown in Table 7.3 (55)

TABLE 7.3 ROUNDWOOD AND AREA REQUIREMENTS FOR INDUSTRIAL PRODUCTION

Year	Sawlog Requirements Volume (M^3)	Sawlog Requirements Forest Area (Ha)	Plywood Log Requir. Volume (M^3)	Plywood Log Requir. Total Area (Ha)	TOTALS Volume (M^3)	TOTALS Area (Ha)
1981	285,305	27,650	72,630	3,731	357,935	31,381
1982	292,600	38,360	73,611	3,782	366,211	32,142
1983	300,274	29,103	74,592	3,832	374,866	32,935

1.2.2 Deforestation rates and implications

Table 7.4 shows the forest area for 1970 and for 1980, respectively (54).

TABLE 7.4 FOREST AREAS 1970-1980 AND DEFORESTATION RATES BY PROVINCE

Province	Forest Area (Km^2) 1970	Forest Area (Km^2) 1980	Area Deforested (Km^2)	Deforest. Rate (Ha Year)	% Total Deforestation
Bocas del Toro	8,569.6	8,369.6	200.6	2,000	2.5
Coclé	1,755.8	1,263.7	492.1	4,921	6.2
Colón & San Blás	4,352.0	3,355.7	996.3	9,963	12.5
Darién	15,893.4	12,652.4	3,241.0	32,410	40.8
Chiriquí	1,553.9	1,101.8	452.0	4,520	5.7
Herrera	182.0	126.6	55.3	553	0.7
Los Santos	407.4	347.8	59.5	595	0.7
Panamá	7,401.8	5,813.8	1,588.0	15,880	20.0
Veraguas	3,333.6	2,465.6	868.0	8,680	10.9
TOTALS	43,449.6	35,497.4	7,952.2	79,522	100.0

It can be observed that the Darién Region is the most affected area in the extent of its deforestation rate per annum. Almost 50% of its deforestation is concentrated in the Bazano and Chucunague River Valleys. This region had an increase in road infrastructure in the last few years, reason for which the deforestation rate has increased considerably, lately. Furthermore, it follows that, since deforestation follows this infrastructure, most of the affected areas belong to the productive forest category.

The Region 2 deforestation is very important, compared to the area of remaining forests. The main region, that is affected by this deforestation, is the Azuero Península where it has occurred in favor of changes in land use, to cattle grazing, thus resulting in unproductive scrublands that are unproductive in every sense, and causing severe problems of erosion and watershed drainage obstructions.

The Atlantic West Region is suffering from increasing population pressures originated by westward population migrations from the Colón Province, as well as by agricultural settlements along the coast.

It is interesting to note that the total deforestation rate is almost 2.5 times the area affected by industrial roundwood removals.

1.3 Man-made forests

Table 7.5 denotes the areas planted in Panamá.

TABLE 7.5 INDUSTRIAL PLANTATION AREAS, 1981 (Ha)

Species/ Year	1941-50	1951-60	1961-65	1966-70	1971-75	1976-90	1981	Total
Tectona grandis	300	-						300
Other harwood		-						200
Pinus caribaea		-	100	300	800	2,300	1,700	5,200
TOTALS	300	-	100	300	800	2,300	1,700	5,700

It has been estimated (45) that the mean annual increment of the pine plantations, is equivalent to 8.5 m^3/ha/year among the different site classes. The estimated rotation age for this average is 30 years, for sawlog production, with intermediate thinnings at ages 15 and 22 and an average yield of products, as follows:

TABLE 7.6 AVERAGE PINE PLANTATION YIELDS IN PANAMA

Product	(40%) 1st thinning		(40%) 2nd thinning		Final Harvest		Total
	%	M^3/Ha	%	M^3/Ha	%	M^3/Ha	M^3/Ha
Sawlogs, Poles	15%	7.6	35%	26.2	45%	58.1	91.9
Posts	35%	17.9	30%	22.4	25%	32.3	72.6
Charcoal/ Chips	30%	15.3	20%	15.0	15%	19.4	49.7
Waste	20%	10.2	15%	11.2	15%	19.4	40.8
TOTALS	100.0	51.0	100.0	74.8	100.0	129.2	225.0

2. Macro-level market trends for major mechanical wood products.

2.1 Population and income trends

Panamá's total population has increased from just over 1.8 million, in 1978, to over 2.1 million, in 1984. Population trends estimated by the Dirección de Estadística y Censo (DEC) consider that the country's population will grow to just under 3.0 million by the year 2000, averaging a 2.1% annual population growth (49).

The DEC also estimates that per capita income will increase from its present $1,941 per year to $2,312, denoting a real annual increase rate of 1.1% (49).

The above estimates have formed the basis for Table 7.8.

2.2 Production of major mechanical wood products

Table 7.2 of this chapter shows the production trends for the major mechanical wood products in Panamá.

The National Forestry Development Plan (54) estimates that production and/or volume demand will increase, as shown in Table 7.7.

TABLE 7.7 PROJECTIONS OF PRODUCTION AND LOG DEMAND 1984-2000

	Lumber		Plywood		Total	Total	Area
Yr.	Product.	Sawlog Vol. (M^3)	Product. (M^3)	Log Vol. (M^3)	Product. (M^3)	Log Demand (M^3)	Demand (Ha)
1984	139,976	307,947	25,191	75,573	165,167	383,520	33,729
1985	143,464	315,621	25,518	75,554	165,167	392,520	33,534
1986	146,953	323,297	22,845	77,535	172,798	400,832	35,319
1987	150,441	330,970	26,172	78,516	176,613	409,486	36,112
1988	153,929	338,644	26,499	79,497	180,428	418,141	36,907
1989	157,417	346,317	26,826	80,478	184,243	426,795	37,701
1990	160,905	353,991	27,153	81,459	187,858	435,450	38,495
1991	164,394	361,667	27,480	82,440	191,834	444,107	39,289
1992	167,882	369,340	27,807	83,421	195,689	452,761	40,084
1993	171,370	377,014	28,134	84,402	199,504	461,416	40,877
1994	174,858	384,688	28,461	85,383	203,319	470,071	41,673
1995	178,346	392,361	28,788	86,364	207,134	478,725	41,966
1996	181,835	400,037	29,115	87,341	210,950	487,378	43,620
1997	185,323	407,711	29,442	88,326	214,765	496,037	44,055
1998	188,811	415,384	29,769	89,307	218,580	504,691	44,850
1999	192,299	423,058	30,096	90,288	222,395	513,346	45,553
2000	199,787	430,731	30,423	91,269	230,210	522,000	46,438

2.3 Trade in mechanical wood products

Table 7.8 shows the imports of mechanical wood products in Panamá from 1979-1984. During this period, they increased from 19,130 m^3, to 21,868 m^3, denoting an average annual increase of 2.7%. The share of imports in the total apparent consumption has decreased from 18%, in 1979 to 13.5% in 1984 and they are expected to stay around 14% of the total apparent consumption (the vast majority being of coniferous species).

Exports have been completely negligible in mechanical wood products and, being a country defficient in the production of those products, it is expected to continue in this manner in the foreseeable future.

2.4 Apparent consumption of mechanical wood products

The total apparent consumption for the 1979-1984 period is shown in Table 7.8, and, besides 1980, it has shown a steady increase in this five-year period that has averaged 8.7% annually, certainly the highest in the region where, on the contrary, a decrease has been the pattern in each of the other countries.

TABLE 7.8 PROJECTIONS OF APPARENT CONSUMPTION OF MECHANICAL WOOD PRODUCTS IN PANAMA, 1984 - 2010

Year	Production	Imports	Total Ap. consump. (M^3)	Total Population (1000's)	Per Capita Apparent Consump.	Per Capita income $
1984	165167	21868	187035	2134.2	.0876	1941
1985	169982	22505	191487	2180.5	.0878	1962
1986	172798	23141	195939	2227.2	.0880	1984
1987	176613	23778	200391	2274.4	.0881	2005
1988	180428	24415	204843	2322.0	.0882	2028
1989	184243	25502	209745	2369.8	.0885	2050
1990	187858	25689	213547	2417.9	.0883	2073
1991	191834	26325	218159	2466.2	.0885	2095
1992	195689	26962	222651	2514.6	.0885	2118
1993	199504	27599	227103	2562.9	.0886	2142
1994	203319	28236	231555	2611.1	.0887	2165
1995	207134	28873	236007	2659.1	.0888	2189
1996	210950	29509	240459	2706.7	.0888	2213
1997	214765	30146	244911	2753.9	.0889	2238
1998	218580	30783	249363	2800.0	.0890	2262
1999	222395	31428	253823	2847.3	.0892	2287
2000	230210	32057	262267	2893.3	.0997	2312
2001	234750	32855	267605	2938.8	.0911	2337
2002	239380	33673	272953	2983.9	.0915	2363
2003	244102	34510	278612	3028.4	.0920	2389
2004	248917	35370	284287	3072.4	.0925	2416
2005	253826	36250	290076	3115.7	.0931	2442
2006	258832	37152	295984	3158.5	.0937	2469
2007	263937	38077	302014	3200.7	.0944	2496
2008	269143	39024	308167	3242.4	.0950	2524
2009	274450	39996	314446	3283.6	.0957	2552
2010	279865	40991	320856	3324.4	.0965	2580

The per capita consumption has shown an average annual increase of almost 6% in the same period. This average increase has been primarily due to an average annual increase of per capita income of 7.5% in the same period. The demand elasticity (e) estimate = 0.947, denoting a relatively inelastic demand; i.e., small changes in consumption due to changes in per capita income. The projected per capita income variable (p) = 1.06%, thus making our model parameter estimates, as follows:

$$Y_n = Y_o\ (1.004)^n$$

The projections in Table 7.8 take into account the projections of the National Forestry Development Plan (54) and the demand for industrial logs is shown in Table 7.7. The population and per capita income projections follow the recommended projections of the DEC (49).

2.5 Prediction of unmet demand

If all timber removals from commercial forests were for industrial purposes, the duration of productive forests in Panamá would not be a serious problem, other than their medium and long-run accessibility. However, it is a problem when one considers that the average deforestation rate in the past decade has been almost 80,000 ha/year. Furthermore, it is logical to assume that the great majority of this deforestation will continue to occur in areas of productive forests because their soils and topography are less marginal for agriculture or grazing than those of protection forests, and because productive forests will tend to be more accessible. Taking into account the following assumptions, the productive forests of Panamá will tend to disappear in the following periods.

Assumption	Avg. Defor. Rate/Year	Year in which Productive forests will Disappear
1. Area of Deforestation = (Annual cut in product. forests)	40,050 ha	2027
2. 75% of deforestation in prod. forests	59,642 ha	2011
3. 100% of deforestation in prod. forests	79,522 ha	2003

In the best of circumstances, productive forests will tend to disappear in the next 43 years, the equivalent of the average expected rotation age for coniferous plantations of Panamá.

3. Areas potentially available for tree planting

3.1 Plantation requirements to meet potential gaps

Unless Panamá expects to shift from a primarily hardwood supply to, mainly, a coniferous supply, the major emphasis should be placed in hardwood plantations, where there is the least amount of experience. Assuming that management activities, rotation ages and yields hold true for all industrial plantations, Table 7.9 shows the possible yields from existing coniferous plantations.

For a total industrial demand of 14.64 million m^3 for the period 1981-2010, the sawlog yield from existing plantations will provide only 2.5% of this demand. The gap between sawlog demand and supply from natural and artificial forests is bound to increase as time progresses, particularly from the year 2000, on.

For the period 2011-2015, the expected average annual demand for industrial roundwood will be 688,550 m^3/year. Establishing a goal of satisfying 100% of that demand by 2015, with sawlogs from man-made forests, the requirements would be an annual plantation rate of 6,400 ha/year, starting in 1985 and increasing at a 3% rate/annum through 1995, year when 8,600 ha should be established. The proportion of hardwoods versus softwood plantations is a matter of policy decision, but it is strongly recommended that, at least, some equivalent proportion of consumption should be maintained.

TABLE 7.9 EXPECTED SAWLOG YIELDS FROM EXISTING PLANTATIONS UNTIL 2010

Years	Area subject to 1st. thinning (Ha)	Sawlog Yield (M^3)	Area Subject to 2nd. thinning (Ha)	Sawlog Yield (M^3)	Final Harvest Area (Ha)	Sawlog Yield (M^3)	Total Sawlog Yield (M^3)	% of Sawlog Demand Supplied
1981-85	300	2,190					2,190	0.1
1986-90	800	6,080	300	7,860			13,940	0.7
1991-95	2300	17,480	800	20,960			38,440	1.7
1996-2000	1700	12,920	2,300	60,260	300	17,430	90,610	3.6
2001-2005			1,700	44,540	800	46,480	91,020	3.3
2006-2010					2,300	133,630	133,630	4.3
TOTALS	-	38,670	-	133,620	-	197,540	369,830	2.5

TABLE 7.10 INDUSTRIAL PLANTATION NEEDS FOR PANAMA 1985-1995

Year	Area to be Planted (Ha)
1985	6,400
1986	6,592
1987	6,790
1988	6,993
1989	7,203
1990	7,419
1991	7,642
1992	7,871
1993	8,107
1994	8,350
1995	8,600
TOTAL	81,967

3.2 Land use

Potential land use studies (56) consider that 50% of the total land area of the country should be under forest cover. The areas of Panamá that should have greater forest cover and that present the greatest potential for industrial plantations, are the following:

TABLE 7.11 AREA POTENTIALLY AVAILABLE FOR FOREST PLANTATION

Province	Potential Available (Ha)	Present Forest Area (Ha)	Area Potentially Available (Ha)
Coclé	153,100	126,370	26,730
Colón	417,800	335,570	82,230
Chiriquí	385,000	110,180	274,820
Herrera	114,600	12,660	101,940
Los Santos	229,700	34,780	194,920
Veraguas	563,900	246,560	317,340

FAO and IDB (57) have established some areas for industrial plantations. For these areas, FAO has done on-site and photointerpretation studies for two areas, and photointerpretation for the other four areas. The areas available among all seven sites equal a total of 428,921 ha (43% of the total potential area available).

VIII. REGIONAL SUMMARY

1. Areas of commercial or productive forests

The Central American Region has a little over 13 million hectares of productive forests, of which 21% are coniferous productive forests, and 79% are mixed tropical hardwoods. Table 8.1 presents the global estimates of these areas per country and for the whole region.

TABLE 8.1 AREA OF PRODUCTIVE FORESTS OF CENTRAL AMERICA

Country	Area of Productive Forests (Ha)			% of Region
	Conifers	Hardwoods	Total	
GUAT.	344,265	2,866,350	3,210,615	24.6
ELSALV.	16,068	-	16,068	0.1
HOND.	1,949,900	2,036,400	3,986,300	30.5
NIC.	396,400	3,072,000	3,468,400	26.5
COS.R.	-	490,500	490,500	3.8
PAN.	-	1,899,886	1,899,886	14.5
TOTALS	2,706,633	10,365,136	13,071,769	100.00

2. Prediction of the depletion of commercial forests

The expected duration of the Region's commercial forests is 35 years. However, there are great dangers of depletion of the coniferous resources in Guatemala, El Salvador, Honduras and Nicaragua, within the short and medium run. The two countries whose entire productive resource is in danger of disappearing are El Salvador (already with less than 0.1% of the Region's productive area) and Costa Rica. Table 8.2 denotes the expected durations for the commercial forests of each country and for the whole Region.

TABLE 8.2 AREA OF ANNUAL DEPLETION OF NATURAL PRODUCTIVE FORESTS

Country	Area (Ha)1/ Depletion Conifers	Duration (Yrs)	Area Deple.(Ha) Hwoods1/	Duration (Yrs)	Total Depletion (Ha)	Duration (Yrs)
GUAT.	18,119	19	53,485	53	71,604	45
ELSALV.	1,350	12	-	-	1,350	12
HOND.	46,480	42 2/	54,370	37	100,850	39
NIC.	14,000	28	67,900	45	81,900	42
COS.R.	-	-	40,875 3/	12	40,875	12
PAN.	-	-	79,522	24	79,522	24
TOTAL REGION	79,949	34	296,152	35	376,101	35

3. Expected production and apparent consumption of mechanical wood products for the 1984-2010 period

The estimates presented in Table 8.3 are the annual expected values of each variable for the 1984-2010 period. Based on this, the confidence limits at a 0.9-probability level, for each variable and for the Region are as follows (E = expected value of):

E (production) = 1,747,787 ± 528,000 m^3
E (per capita apparent consumption) = 0.0659 ± 0.0186 m^3.
E (Total apparent consumption) = 2,358,567 ± 664,080 m^3
E (regional balance of trade) = - 610,780 ± 136,030 m^3.

1/ Average depletion rate for the period 1984-2010.

2/ The area of mature pine forests that is to be logged is 72,219 ha/year between 1984 and 2008, so the depletion of mature pine timber will occur in 27 years, sooner than the depletion of the total pine forests. Assuming some management, the depletion rate will be 46,480 ha/year.

3/ Depletion rate at industrial capacity = deforestation rate, a conservative estimate since deforestation has been greater than this area.

TABLE 8.3 PROJECTED AVERAGES OF PRODUCTION, APPARENT CONSUMPTION OF MECHANICAL WOOD PRODUCTS IN THE REGION 1984-2010

Country	Projected Avrg.Ann. Product. (m^3)	Projected Avrg. Ann. Population (1000's)	Projected Avrg.Ann. P/Capita Consump. (m^3)	Projected Avrg.Ann. Total Ap. Consump. (m^3)	Avrg. Ann. Difference (+=Surplus -=Def.) (m^3)
GUAT.	291,225	11,476.3	0.0229	262,725	+28,500
ELSAL.	18,002	6,655.5	0.0247	164,588	-146,568
HON.	795,000	6,889.2	0.0683	470,530	+324,470
NIC.	181,000	4,519.6	0.0598	270,275	-89,275
COS.R.	244,128	3,512.4	0.2683	942,383	-698,255
PAN.	218,432	2,744.1	0.0904	248,066	-29,634
REGION TOTALS	1,747,787	35,797.1	0.0659	2,358,567	-610,780

The average projected annual production for each country may differ from the values estimated in each country report, but this is due to the fact that the previous table estimates the annual expected value for the entire period, such that, if a country's resource is depleted before the period ends, the annual projected expected value, for the period, is lower than the annual production while the productive resource lasts.

It must be noted that only two countries, Guatemala and Honduras, have expected surpluses of production versus total apparent consumption of mechanical wood products. However, this may be misleading because Guatemala is expected to have a serious deficit of coniferous products and Honduras' total expected production is based on coniferous products.

It is also interesting to note that the most highly defficient country, Costa Rica, has an expected annual per capita apparent consumption four times greater than the regional average. This, however, is already so. Most countries will not reach present per capita consumption levels of Costa Rica in the entire 1984-2010 period.

As a whole, the country that should benefit the most from this expected regional deficit is Honduras. It is certainly true that investments in forestry in Honduras will have better expectations, on this basis alone, than in any other country in the Region.

4. Industrial plantation requirements in the Region, to meet possible gaps in the supply of industrial roundwood

There is no questioning the fact that there is a great and urgent need to establish industrial plantations to reduce the gap in the supply of industrial roundwood that is surely to occur, anyway, in the Region. The purpose of these plantations is to reduce this gap and to establish the basis for a plantation-oriented mechanical wood products industry. These total requirements are shown in Table 8.4.

It must be noted that the decision to start this program cannot afford to be delayed. The longer this decision is postponed, the larger the gap in the supply of industrial roundwood, the greater the consequences, and the costlier the solution.

TABLE 8.4 TOTAL INDUSTRIAL PLANTATION REQUIREMENTS FOR THE REGION AND FOR THE 1985-1995 PERIOD

Country	Total Requirements (Ha)	% of the Region Total
GUAT.	193,783	21.5
ELSALV.	157,013	17.4
HOND.	119,493	13.3
NIC. */	81,290	9.0
COS. R.	267,800	29.7
PAN.	81,967	9.1
TOTAL	901,346	100.00

5. Areas potentially available for industrial plantations

The estimates given in Table 8.5 are mostly on the basis of land use capacity. Needless to say, not all these areas are, in reality, available. Some qualifications have been mentioned for those countries where sufficient information was available, to caution over the use of these estimates.

*/ The program has been planned for 1984-2015. This estimate is only for the 1985-1995 period.

TABLE 8.5 TOTAL POTENTIAL AREA AVAILABLE FOR TREE PLANTING IN THE REGION

Country	Total Potential Area (Ha)	% of the Region Total
GUAT	1,349,205	13.5
ELSALV.	242,615	2.4
HON.	3,523,596	35.3
NIC.	1,941,000	19.4
COS. R.	1,940,150	19.4
PAN.	997,980	10.0
TOTAL	9,994,546	100.0

IX. CASE EXAMPLES

The objective of this chapter is to offer some case examples, of wood production, from man-made forests, that offer high welfare gains, in the Region.

The establishment of man-made forests is a recent activity in Central America. This is particularly so with man-made forests oriented to the production of industrial roundwood. As such, case examples of young stands that allow the production, in the short and medium runs, of intermediate products, originated from man-made forests, are not found in the Region. The examples that can be found are variations or combinations of mature plantations and newly established stands, or of natural forests combined with artificial forests. Nonetheless, some examples may be useful in providing ideas on the benefits of tree-growing and as models of successful forestry enterprises on the basis of man-made forests.

1. El Salvador

The only known example in El Salvador, for which no direct information was available to the Consultant, is the case of some teak plantations that are presently being harvested, sawn and made into furniture. Since the Consultant has only indirect knowledge on this venture, it will not be presented as a case but merely mentioned as an on-going project.

2. Honduras

In the late 1940's and early '50's, the United Fruit Company established a number of plantations as trials to put into production significant areas of marginal agricultural land, in view of the post-World War II demand for tropical woods that occurred in the United States and Europe. Most of these plantations were later cut to make room for African palm plantations in the North coast of Honduras (33).

Nevertheless, some teak plantations survived and were later sold to private owners. Although these plantations are now 30-35 years old, they were never managed and their growth was severely stunted as a result. Nevertheless, for the last 10-12 years, they have provided enough roundwood to provide furniture manufacturers with a raw material that has a very high demand (and price) in the domestic market. Unfortunately, the production of teak industrial roundwood has not been a result of management nor is there any effort to renew these artificial stands. It is merely the result of the liquidation of these plantations.

2.1 Las Lajas: a case study of tropical pine forest management and utilization (58).

In 1982, the Food and Agriculture Organization of the United Nations (FAO) chose for anlysis, four case studies of tropical forest management, in various parts of the world. One of them was the Las Lajas Forest Management Model, for tropical pine forest management and utilization (58).

Located in the central part of Honduras, Las Lajas, has a total area of 77,598 ha, of which 68.1% has forest cover, with land tenure and use, as shown in Table 2.1.1.

TABLE 2.1.1. DISTRIBUTION OF LAND USE ACCORDING TO LAND TENURE, IN 1979

Land Use	Total Area (Ha)	Private Ownership (Ha)	Private Ownership (%)	State Ownership (Ha)	State Ownership (%)
Pine Forest	39,513	18,975	48.0	20,539	52.0
Hardwood Forest	13,311	3,537	26.6	9,774	73.4
Agri-culture	16,682	5,775	34.6	11,086	65.1
Fallow (shrub)	6,531	2,750	42.1	3,781	57.9
Other	1,381	419	30.3	962	69.7
TOTAL	77,598	31,456	40.5	46,142	59.5

The population of Las Lajas was 14,840, in 1978, constituted by some 2,473 families. Thirty-two percent of the families had no agricultural land. The main occupation of the heads of families was in subsistence farming (36%), followed by salaried labor (32%), coffee-growing (12%), domestic services (5%), and finally, forestry (1.6%). Per capita income was far below the national average (which is the lowest of all the Central American Region) and the subsistence level was even lower for those living in the forest (58).

Las Lajas had one very efficient circular sawmill, whose average annual consumption of sawlogs was 25,000 m^3. The following table denotes the annual allowable cut for the management unit.

TABLE 2.1.2. AVERAGE ANNUAL HARVEST VOLUMES (MINIMUM LOG DIAMETER = 15cm), 1981-1995

	Final Harvest		Thinnings (*)		Total Vol.
	(Ha)	(M^3)	(Ha)	(M^3)	(M^3)
1981-85	1,025	40,358	509	3,930	44,288
1986-90	1,025	53,012	930	9,990	63,002
1991-95	1,025	62,072	2,391	26,020	88,092
TOTAL FOR 15 YEARS	15,375	777,210	19,150	199,700	976,910

Reforestation, amounts to an average of 1012 ha/year. Forest management activities include: final harvest, thinnings, reforestation (plantation), fire protection, and all other support activities, such as road building and maintenance. A 45-year rotation age has been estimated for Las Lajas.

Investments required in harvesting and utilization, for the 45-year period, are estimated to be $1,496,500 and the average annual cost of management amounts to $390,710/year, for all management activities except harvesting (final or intermediate). These costs are considered in the estimates of net benefits.

The available volume without management is 1,644,427 m^3 for final harvests over 45 years, of log grades I, II and III, greater than 25 cm. at the small end (average = 37,036 m^3/year). The available volume with management (including plantations and commercial thinnings) is 6,409,485 m^3 (average = 142,433 m^3/year), indicating a net increase, due to management, equal to 4,742,865 m^3 in the 45-year rotation.

The model proposed includes the organization of the forest population into forestry cooperatives that will carry out and utilize all thinnings; that will tap trees, 4 years prior to final harvest, for rosin production; and that will have capital participation in a rosin-processing plant located nearby. In addition, other private investors (including the cooperatives themselves) will participate in the larger sawmill(s).

Net benefits from sawnwood production are estimated at $21.15/$m^3$ of sawnwood; $60.15/barrel of rosin ($28.87 if

* Includes conversion harvests.

if the cooperatives did not participate in the rosin-processing plant), and the generation of more than 32,000 man-years of employment (not including industrial employment).

Based on the above parameters, discounted at a 12% rate, the present net worth of the project for its first 45-year rotation is estimated to be $2.2 million; its benefit/cost ratio, 1.54; its average annual net benefit, $261,200; and its internal rate of return, 19.6%.

Interestingly enough, the distribution of the present net worth was very positive for the sawmill owners and the social forestry groups, but quite negative for the public sector (who is the investor in forest management). This situation was due to the low valuation of timber stumpage ($6.00/m^3). In order to recover its investment, the stumpage price had to be no less than $12.00/m^3 (without a positive return). Thereby showing that plantation and management investment can have an adequate return only if stumpage prices are high enough to ensure this, and/or, if the investor also participates in the benefits of industrialization. This is indeed the reason why plantation and management investors generally are motivated by the fact that they are also owners of forest industries (e.g., Weyerheuser Corp. Georgia Pacific, Louisiana Pacific, and large forestry corporations in the U.S.). Otherwise, they may be motivated by fiscal incentives set by governments that want to encourage reforestation by the public sector and to pay for it.

The distribution of the present net worth of the Las Lajas project is as follows (12% discount rate) (58):

Present net Worth for:		Amount
- Sawmills		$1,492,437
- Social Forestry groups		$2,425,482
- Thinning utilization	$1,549,666	
resin production	$ 875,816	
- Public sector		-$1,754,924
Total Present Net Worth		$2,162,995

As a whole, however, taking into consideration the employment generation, as well as the present net worth destined to social forestry groups (keeping in mind that the shadow price of labor, of $1.25/man-day, in the agricultural activity in 1980, has already been taken into account, in the analysis), the distributive impact of the project, on low-income, rural groups, is considerable.

3. Costa Rica

There are two interesting case examples in Costa Rica. The first is a newly financed (by IBD) program on the Agricultural Center of Turrialba which may be of interest for those cases where the land owner has no financial resources to establish plantations, but is willing to dedicate some land to them, and when those who have the money to invest, have no land to establish plantations. The second case is perhaps the best (and the only one in the Region) example of how to solve the cash-flow problem for timber growers, particularly, the farm-tree grower.

3.1 Centro Agrícola Cantonal de Turrialba (60)

This is a project for the Agricultural Center that is financed by the Interamerican Development Bank (I.D.B.) The forestry component is one of five components of the project whose primary objective is to improve the standard of living of low-income, small producers and farmers of the area, providing them with adequate financing for projects leading to production diversification.

The five components of the project are: forestry plantations, macadamia plantations, fisheries development, beehive and honey production development, and cheese production. (The last component is directed exclusively to a cheese producer's cooperative and not really a part of the diversification objective.)

- Forestry component: The Center has its own nurseries and would provide each beneficiary with the required seedlings and species. The farmer would plant them in his land and care for the plantation, as agreed in a reforestation contract with the Center. (This is further explained later).

- Macadamia plantations: The Center would also provide each beneficiary with the required seedlings and it owns a processing plant which would sell the processed macadamia to a larger macadamia concern.

- Fish production: The beneficiary would be provided with growing stock and he can sell the fish back to the recently installed cannery in the Center.

- Beehive production: The Center provides the beneficiary with the nuclei required and it would provide its distribution center for direct sales.

The objective of the forestry component is to provide the small farmer the financial and technical assistance that will permit them to establish plantations of fast-growing species (pine and eucalyptus). The expected products would be, primarily, sawlogs (which would be sold to sawmills), pulpwood (which would be sold to the mechanical pulp plant in Turrialba), poles and posts (which would be treated in the wood treatment plant at the Center).

The expected costs involved would be $393/ha for the plantation; $94/ha for replanting and clearing the 2nd. year; and $42/ha for clearing the 3rd. year. The expected income would be $254/ha from the first thinning, year 6; $871/ha from the second thinning the 11th year; and $3,694/ha from the final harvest at age 16.

The areas designated as marginal lands, either because of their slope, their productivity, or their accessibility, would be dedicated to this activity, and crops (vegetables and grains) may be grown between trees for the first two years of the plantation.

The proposed mechanism to develop this component consists of a contract between the small farmer and the Center. The contract stipulates that the Center will provide the seedlings, the materials, tools and other resources, required to establish the plantation, while the small farmer provides the land and his labor. The Center would pay him for his labor. The contract also stipulates the distribution of the benefits from the plantation (income) whereby 60% of the total income generated by the plantation goes to the Center and 40% to the small farmer.

This type of arrangement can be of great interest in countries like Costa Rica, where the great majority of forest industries are not forest or forest land owners. Their participation in industrial plantations can be assured by some similar scheme. (This Consultant had the opportunity to explain the system to interested industries and already in the Province of Limón two contracts have been signed. These contracts are three-way contracts, between the

"money man", the plant producer, or technical know-how person, and the land owner).

The estimated internal rate of return, at a 12% interest rate, for this component, is 52%; with 60 beneficiaries in the first stage (60).

3.2 Forestales Paso Llano (59)

North of Heredia, in San José de la Montana, lies a 270-hectare farm that was started some 70 years ago as a dairy farm. Due to its elevation (above 1,700 m) and the fact that most of the area had been previously deforested, the owner found there was a need to establish some windbreaks in order to protect the pastures and the soil. The species used for this purpose was Cupressus lusitanica and the windbreaks were established 2-3 lines deep.

After World War II, the windbreaks that were established were 12-15 lines deep but none of these row plantations were submitted to management practices, until 1976. Some of the oldest ones, however, were harvested, starting in 1970.

In 1976, all plantations were inventoried and a management plan was developed with the primary objectives to make the best use of the soil productivity and to provide an adequate cash flow for the development of the farm, on a continuous basis (59). However, they found that the cypress lumber had no demand in Costa Rica since it was an unknown species in the national market. As a result, the farm found itself in need of opening new markets and, to do so, they established a sawmill (2,500 m^3 round-wood consumption capacity) and a furniture plant with its own outlet. Today, only 6 years after establishing the sawmill, cypress profiles and furniture have a well-established demand, and their prices are extremely competitive.

Since the beginning of its integral development (1976), they have invested heavily in pasture and cattle improvement and reforestation, as well as in the above-mentioned industries. Today, the farm has 50 ha of new plantations (the oldest of which is 7 years old), 40 ha of overmature windbreaks; 30-40 ha of natural, humid, mountain and cloud forest; and some 100 ha of improved pasture, dairy centers and other constructions. The overmature windbreaks are being harvested following an ordered liquidation system, from which some 1500 m^3(r) is harvested and

placed at the mill. Today, the establishment of new plantations follow appropriate land-use criteria, rather than following the old wind-break approach. As such, the plantations (which are established at a rate of 6-8 ha/year) are now industrial plantations in relatively large blocks, on all terrain over 20% slope. This forest cover, and the ones foreseen for the next two years, will complete the new blocks they need that will also function as protectors of the included pastures, eliminating the need for the windbreaks. Within the next two years, they expect to have completed the development program for that farm.

Because of the numerous log defects inherent to round-wood from windbreaks, the utilization methods of the sawmill (smallest utilization diameter = 15 cm) require the use of short and random lengths. Aggressive marketing has created an attractive demand, in construction, for these lengths, as short as 80 cm, for wall paneling. Normally, sawmills in Costa Rica find it extremely difficult to sell lumber that is less than 2 meters long, because their price discount for these lengths is generally only 10%. This sawmill, however, offers a 50% price discount, from normal lengths such that, for building contractors, who may have to spend $8.00/m^3 in increased materials and labor costs, can save $85 for every 10 m^3 of lumber in short lengths. As such, the sawmill has an excellent yield in cypress lumber (53%) and its sales are absorbed by a lumber wholesaler (80%) and by their furniture plant (20%).

Fence damage on windbreaks is another source of reduction in volume yields/ha, since the first 1.2-meter logs are damaged. For this reason, they have started a joinery plant that uses all this raw material.

Since the original investment, to start the development of the farm (which they needed to finance), all additional investments have been self-financed from the income generated by the farm and its industries. The farm income alone amounts to $89,000 (gross)/year from the dairy production and $52,100/year (net) from industrial roundwood sales. Net income from the sawmill could amount to $60 - $70,000/year. In addition, the farm and its industries generate employment to more than 120 laborers.

Their plantation costs are $625/ha (including re-planting, fencing, and clearing) for years 1 and 2. The mean annual increment, for the estimated 26-30 year rotation, varies between 14.5 and 26 m^3/ha/year for their different site classes. Thinning can begin to produce industrial roundwood since age 8, as fuelwood (which they sell to a limestone plant and to a coffee-processing plant, nearby).

The combination of intensive dairy farming and the utilization of an overmature resource in the farm has not only permitted an adequate cash flow but it has even provided enough to allow self-financing for their forestry and agricultural improvements.

They expect to have the farm in its expected form in the next two years, when they will start a similar development in another farm (200 ha) they own nearby. This other farm has no mature plantations on it but it has some natural forest, which they expect to use in the same fashion, allowing that farm to self-finance its development (dairy and cypress plantations). Their expectations envisage this farm to be completely developed in 7-8 years.

There are numerous possibilities for farm forestry plantations of this type in almost every country in the Region. The cash flow problem of plantation forestry can be significantly improved, if not solved, using a combination of mature timber utilization and agricultural production. Even in the case where farms are too small, the promotion of cooperatives, or any kind of joint venture among small farm owners, can go a long ways to making this possible.

X. MARKETS, PRODUCTS, PRICES, AND CONSTRAINTS TO TRADE

1. Markets, products and prices

1.1 World tendencies

The global tendencies in the international markets show a promising trend. World population is rapidly increasing and will rise from its present level of 4.5 billion to 6 billion at the end of the century. Meanwhile, the depletion of the world forests is increasing at a more rapid rate than their recuperation by means of plantations and the majority of the traditionally exporting countries (as are the Scandinavian countries) have already run out of available lands to increase their forest areas.

Tropical hardwood forests have increased their participation in their conversion of products for world markets. Massive exploitation of this resource began in Africa but exports from this continent have decreased, as its more accessible forests have been exploited and its regional demand has increased.

Increased competition of tropical hardwood forests began 10 years ago in the Far East. Countries in that part of the world prohibited their roundwood exports, or regulated it through quotas or taxes, encouraging, at the same time, the establishment of new industries with sizeable incentives. These countries have been able to win a large share of the world market in plywood, veneer, sawnwood and furniture parts. However, it is estimated that in another 5-10 years, this competition will be drastically reduced when their more accessible forests become exploited.

Latin America, in general, has a small participation in the markets for tropical forest products. Between January and May, 1983, Latin America participated in world tropical forest products markets with a 2.4% in the plywood markets, 11.7% in veneer markets and 8% in the sawnwood markets. Latin America has a comparative disadvantage with other continents in the fact that it generally has a larger variety of species and that a great proportion of its forests have a more difficult access. On the other hand, many of its species have an attractive aspect and, especially Brazil, has demonstrated that Latin America can compete well in the tropical forest products markets.

The market composition of forest products has had a tendency to change. While wood-based panels had an 11% participation in total consumption in 1963-1964, FAO estimates their participation to be 32% by 1994. Within the wood-based panels, great changes have also taken place. While veneer and plywood had 55% of this market in 1964-1969, predictions estimate their share will drop to 36% in 1994 and, conversely, fiberboard and particleboard will gain this difference in their share, up to 64% by 1994. Nonetheless, although plywood's share of the market will drop, the comsumption of veneer and plywood will double in the next 10-year period, according to FAO estimates.

Demand for sawnwood has also suffered a structural change. Developed countries (the largest importers) have discovered greater advantages in importing furniture parts and other semi-manufactured products than in importing simply sawnwood. Increased freight rates have been mainly responsible for this, in addition to the fact that, for labor-intensive products, labor costs in developing countries are lower than those in importing countries.

Natural coniferous forests are, in the long-run, insufficient to satisfy the demand for construction-grade plywood, sawnwood and long fiber for pulp. These natural forests have been gradually decreasing in importance while fast-growing plantations have been increasing in importance. Their wood products are not as attractive as those from natural, old-growth forests but technological development, oriented to waste and lower-quality species utilization, has made them more esthetically acceptable, by the use of adhesives for products with good mechanical properties and by the use of melamines that improve their appearance. These are products that are generally lower-priced and it must be kept in mind that, especially in developed countries, there is always a good share of the market that still prefers the beauty of natural, old-growth timber products.

1.2 Intra-regional trade

Chapter VIII of this report shows the overall expected deficits in the CA/P Region. Nicaragua and Guatemala may appear as possible net producers but with a tendency to deplete their forests before the end of the period (1984-2010). The same holds true for most countries in the Region, with the exception of Honduras.

This means that intra-regional trade has good perspectives in the medium and long-run, primarily for Honduras. This is particularly true considering the potential medium term deficits in coniferous products in Guatemala, El Salvador and Nicaragua. In the short-run, foreign exchange restrictions in most CA/P countries will remain as the major obstacle to intra-regional trade.

In the short and medium run, the fluctuations in regional demand may be somewhat high, denoting that risk or uncertainty may be also somewhat high. This uncertainty may be reflected in price. This, added to the deficits foreseen, increase the expectations that prices will continue to rise in the medium run.

Estimated demand elasticities, as defined in the country analyses, are shown in Table 10.1. In the expectation that GDP growth in the Region will be positive, as predicted by the countries in CA/P, there can be an expected increase in per capita consumption and an increase in total apparent consumption of mechanical wood products.

Overall, the expectations for an increased intra-regional market development are good in the medium and the long run.

TABLE 10.1 ELASTICITY OF DEMAND IN THE REGION

Country	Demand Elasticity[1/]
Guatemala	1.00
El Salvador	1.96
Honduras	0.86
Nicaragua	2.58
Costa Rica	1.40
Panamá	0.95

1/ As a function of changes in GDP.

1.3 Extra-regional trade

Although the region may have a deficit in the long run, it will have export markets outside the region in the short run, for some countries, in the medium run for others and in the long run only for Honduras. Besides, it is important that intra and extra-regional markets be developed to maximize the potential of

utilization of existing natural forests and to establish future products for industrial plantations. It is within this context that the following sections examine the potential for exports from the CA/P Region.

1.3.1 Pine sawnwood products, markets and prices

The CA/P Region's pine lumber, namely from Guatemala, Honduras and Nicaragua, has had established markets in the U.S., the Caribbean and Europe. Despite the demand contraction in these markets and the fact that CA/P countries have, in addition, lost part of their share in, particularly, the Caribbean markets, there appear to be good possibilities of opening non-traditional markets, such as Mexico and Japan (See Table 10.2).

Average FOB buying prices, for some markets and qualities, are shown in Table 10.3 (hard or yellow pine lumber from the CA/P Region is sold as pitch or yellow pine and generally follows Southern Pine Inspection Bureau Grading Rules, from the southeastern U.S.). It must be noted that prices, in general, for Common 12 and Better are lower than competetive prices and could be improved.

TABLE 10.2 TRADE IN CONIFEROUS SANWOOD FOR SOME REGIONS AND COUNTRIES, 1982 (7)

Region/ Country	Imports 1000's M3	Exports 1000's M3	Balance 1000's M3	Observ. on Market Devlmt. for CA/P
Europe	25,575	20,818	-4,757	Deficit covered mainly by Canadá & USSR.
U.S.A	21,188	3,818	-452	Deficit covered by Canadá. Poss. for specialty products.
México	453	1	-452	Excellent possibilities
Bahamas	31	-	-31	Poss. are not so good
Barbados	46	-	-46	Certain possibil.
D. Republic	75	-	-75	Very good possibilties
Jamaica	73	-	-73	Very good possibilties
Martinique	25	-	-25	Very good possibilties
Trinidad/Tobago	110	-	-110	Very good possibilties
Venezuela	208	-	-208	Fluct. market but generally good possibilities

TABLE 10.3 AVERAGE FOB PRICES FOR EXPORT CONIFEROUS SANWOOD

Market	Market	Avg. Price
Japan	Timber blocks, 11 common	$339
Venezuela	Timber blocks, 12 common	140
Caribbean	Timber blocks, 12 common	144
Japan	Special, 100% heartwood	424
Japan	50% heartwood	360
Japan	SAP, 100% Sapwood	297
General	No2 Common and Better, rough	140
General	No2 Common and Better, dressed	153

1.3.2 Hardwood lumber products, markets and prices

Historically, hardwood lumber exports from the CA/P Region have never amounted to much.

Planned production in relation to the probable consumption of the Region does not indicate a capacity or a capability to substantially increase exports in the medium run.

U.S.A

For the last 20 years, imports have fluctuated between 0.5 and 1.3 million m^3 with a slight tendency to decrease due to the increased preference to substitute sawnwood with semi-processed or processed products. One-third of its imports come from Canada and more than one-half of its tropical hardwood lumber imports originate in Brazil, the Philippines, Malaysia, Indonesia and Singapore. The only two countries from the CA/P Region that export hardwood lumber, in the form of processed, semi-processed and manufactured products, are Guatemala and Costa Rica.

The possibilities for exports of Swietenia, Cedrela, and Virola, and a few other species are good. Possibilities for lesser known species are better if they are in the form of specialty products such as furniture parts, mouldings, moulded skirtings, wooden beadings, short lengths, friezes for flooring, handles and perhaps pre-cut lumber for pallets.

The Caribbean

Trinidad-Tobago

Imports of hardwood lumber products have increased in the last few years and, presently, fluctuate betwen 74 and 96,000 m^3/year. There are tariff barriers for processed products.

Barbados

Its imports in this category fluctuate between 9 and 15,000 m^3/year. This country has shown interest in mahogany, cedar and Callophyllum species.

Dominican Republic:

Hardwood lumber product imports add up to 10-12,000 m^3/year. They consist of:

Mahogany, 55%, from Peru, Guatemala, Honduras, mainly; Cedar, 10%, mainly from Honduras;others 35%, for the last five years, from 12 countries.

Europe (excluding the U.S.S.R.):

Hardwood lumber products' balance of trade for Europe is negative by some 3 million m^3/year. It is expected that these will rise considering that its production cannot expand on the basis if its own forest resource and that roundwood imports are diminishing due to restrictions in the exporting countries.

Of the 4.7 million m^3 of imports, in 1981, 7% came from Canada and the U.S., 92.5% came from Southeast Asia and Africa and only 0.5% from Latin America, namely, Brazil. Nevertheless, there has been an increase in the imports of processed and semi-processed products.

In general, there are good perspectives for exports to Europe of the better-known hardwood species, such as Swietenia. Cedrela, Virola and Dalbergia. Other species have to be introduced, which implies efforts in both time and money (see Section 2.1 of this Chapter).

The overall average price of hardwood lumber products, in 1981, was $253/$m^3$, CIF , and $219/$m^3$, FOB.

Price levels are extremely variable. The same species may have different prices, depending on color, figure and appearance (for example, the Nicaragua mahogany does not have the color intensity of the Bolivian mahogany). Taking into account the different markets for the CA/P Region's hardwood lumber products, their expected prices could be:

TABLE 10.4 EXPECTED HARDWOOD LUMBER PRODUCT PRICES (FOB) FOR THE CA/P REGION

Product or Species	Observations	Expected FOB prices
Dalbergia retusa	100% hardwood, clears	$2,500/m^3
Mahogany	FAS	$510-636/m^3
Tabebuia sp.	FAS	$244/m^3
Cedrela spp	FAS	$360-424/m^3
Other, for furniture	-	$250/m^3
For construction use	-	$190-210/m^3
For pallet stock	-	$90-110/m^3

Well-sanded mouldings for lesser-known species and for common dimensions (such as 1" x 1-1/2" x 40-1/2"), in the U. S. and Europe, average about $200/m^3, but may go as high as $300/m^3 for more difficult dimensions.

Sanded broom handles average the following prices, per 1000 units, FOB:

7/8" x 27"	$130
7/8" x 48"	$145
1-1/8" x 60"	$350

These prices are good, considering they are generally products made from sawmill solid waste.

For furniture parts and profile stock, prices/m^3 are generally double the price of the original sawnwood price. However, each case must be studied in order to take into account losses, production costs, packaging costs, etc.

1.3.3 Sleepers (ties), markets and prices

World production of wooden sleepers has decreased from 9 million to 4 million m^3, mainly due to the increased duration of treated ties and to their substitution by reinforced concrete ties. World imports are around 1 million m^3 (25% of production).

The majority of countries have a highly irregular import trade; they have their preferences for certain species; they are conservative and generally use bid systems for their purchases. It would be difficult for most CA/P Region countries, which are not traditional sleeper exporters, to enter into the world market.

The U. S. has a favorable balance of trade in these products, and Europe has traditional suppliers, which are generally ex-colonies. There are more concrete possibilities for exports to the Caribbean, particularly Cuba, which is one of the world largest importers of sleepers, at an annual rate of 70 - 90,000 m^3.

The possibilities for treated (particularly, with creosote) pine sleepers are much greater. Honduras and Guatemala are the only two who have these possibilities in the short run.

According to FAO statistics (5), the average world price, in 1981, was $152/$m^3$, FOB, but with great variations. Cuba registered an average price, CIF, of $198/$m^3$, but, considering average freight rates, it would be equivalent to $150/$m^3$, FOB.

1.3.4 Plywood, products, markets and price

World consumption is presently some 40 million m^3/ FAO (6) estimates that this consumption will double in the next decade, in a market composed of 40% construction plywood, primarily of coniferous species, and 60% decorative plywood. Of the present world consumption, 7% consists of imports. In general, the CA/P Region has a large number of species of medium density, that are apt for decorative plywood manufacture. Their frequency of occurrence indicates possibilities of a relatively high volume of production. There are some good experiences in plywood manufacture and some well-established markets. The best markets are described below:

U.S.A

The U. S. has an average annual production of 15 million m^3, constituting 40% of the world production. Its exports are in the order of

0.4 million m^3 (mainly construction, softwood plywood) while its imports, in the last five years, have fluctuated between 1 and 2 million m^3, 90% of which came from tropical forests. Its main suppliers are Korea, Taiwan and the Philippines.

The Caribbean

In general, imports in the Caribbean countries are significant:

Trinidad-Tobago has imports that average 41-42,000 m^3/year. The bulk of its imports consists of 3/4" plywood with phenol adhesive, for exterior doors.

Barbados has a strong tendency to significantly increase its imports, having increased them from 16,000 m^3 in 1979 to 39,000 m^3 in 1981 and 1982. The preference in this market is for high quality and marine plywood.

Cuba has an average import volume of 29,000 m^3 per annum but there is no information on its composition.

Dominican Republic's imports have fluctuated between 3 and 12,000 m^3/year. These imports consist of construction plywood from the U.S. and regular grades from Surinam, Taiwan and Hong Kong. Some imports come from Honduras, Costa Rica and Belize.

Jamaica has large fluctuations in its plywood imports, which, in the last five years have been between 5 - 33,000 m^3/year.

Stiff competition, in the Caribbean, can be expected from hardwood plywood from Brazil and Colombia, primarily.

Europe

Consumption, in the last six years, has varied between 4.8 and 5.8 million m^3 per annum, with a tendency to increase.

Production has fluctuated between 3.6 and 3.8 million m^3, with a tendency to decrease due to

the insufficient supply of domestic roundwood and the increasing difficulties in obtaining it from fewer and fewer roundwood exporters.

Exports from Europe have been around 1.4 million m^3 but the balance of trade has been negative, averaging about 1.5 million m^3. 22% of the imports have consisted of softwood construction plywood from the U.S. and Canada and 28% has been tropical hardwood plywood from Asia, primarily, from Korea, Singapore, Malaysia, Taiwan, Indonesia and the Philippines.

Regional CA/P Markets

The only countries that have production facilities, in the CA/P Region, are Honduras, Nicaragua, Costa Rica and Panamá. Of these, only the first two countries have the raw material to manufacture softwood plywood. The deficits found in Guatemala and El Salvador can provide some measure of regional trade. These deficits are sure to increase in these two countries, as well as in Honduras and Nicaragua in the medium run. The deficit in Honduras is primarily for hardwood plywood, and in Nicaragua, it will surely be in softwood plywood.

Mexico

Consumption increased, on the average, 11.2%/annum, between 1970 and 1980, reaching a level of 307,000 m^3 in 1981. Production satisfies the demand for softwood plywood and has a surplus export of about 5,000 m^3 per year. Imports, primarily consisting of hardwood plywood, have fluctuated between 5-10,000 m^3/year. Although there are very good market opportunities for the CA/P Region in Mexico, stiff competition can be expected from Ecuador and Perú.

Comparative price levels are shown for S. Korean plywood prices, CIF, Europe, and Costa Rican, FOB, prices in Table 10.5.

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TABLE 10.5 COMPARATIVE PLYWOOD PRICES FOR AB PLYWOOD, 1983

Thickeness (mm)	CIF Price from S. Korea ($/m^3)	Costa Rica FOB Prices ($/m^3)
4	$548	$607
5	605	-
6	-	489
9	-	374
12	542	359
15	538	346
18	514	340

Considering freight rates to Europe, Costa Rican prices are highly competitive, even too low, in the larger thicknesses. Fifteen percent export subsidies permit this, but, even without them, the prices are competitive with South Korea, in Europe. Costa Rican prices are less competitive in the Caribbean, where Brazil and Colombia have a comparative advantage. On the average, however, the CA/P Region can be competitive in the more important markets.

1.3.5 Decorative veneer, markets, and prices

World production of veneer is in the order of 48 million m^3, of which some 1.6 million m^3 enter into the international trade markets. However, not all of this volume corresponds to decorative veneer, since the statistics also include veneer destined for corestock use (a good way to use lesser known species). It is estimated (7) that some 1 million m^3 consist of decorative veneer.

Studies have shown that North America and Europe account for 60% of world imports. Nevertheless, there is a world-wide market for decorative veneer and of certain importance, one can single out Arab countries that import decorative veneer for doors and quality furniture.

Different parts of the world have different and varied tastes for color and figure and, for this reason, it is common to find that an exporting country has 30 different client

countries. There is a significant re-export business in decorative veneer. In general, decorative veneer is considered a raw material and, as such, is subject to hardly any import tariffs. In addition, this is generally suchan expensive product, that trans-oceanic freight rates become less important and it can even allow double handling and shipping, something that cannot be said for the generality of forest products.

It has been observed that as economic growth occurs, there is more of a tendency to use decorative veneer as a cover for particle and fiber boards, although melamine overlaps are cheaper substitutes. A large number of CA/P Region species can provide excellent decorative veneer when cut radially (some) or tangentially (the majority).

Intensive promotion and good prospects seem to be advisable in México, the Caribbean, the U.S., Europe, the Arab countries, and Japan.

Decorative veneer has large variations in price and CIF prices can vary from $700/m^3$ for Eucalyptus globulus to $5000/m^3$ for "morado" (2mm) from Bolivia. For CA/P countries, a level of $1000/m^3$, CIF, is reasonable to expect, in Europe. Considering container rates, and other costs, this would mean an average FOB price of some $800/m^3$.

1.3.6 Medium-density fiberboard (MDF), market and prices

For the use of a large species mix, of smaller diameters and for logging or milling waste, MDF manufacture offers excellent opportunities. This also holds true for small plantation stock that can allow better utilization of early thinnings, within certain technical limits.

World production of MDF is around 3 million m^3 of which 50% is produced in the U.S. This is a relatively new product so statistics on world trade are not yet available, and the price level is relatively low. However, the MDF is partly substituting particle and fiber boards which enter the world market with 5.6 and 2 million m^3, respectively.

The U. S. does not offer good export potential for MDF producers, considering its own production and low prices. Venezuela and México are starting their own production.

The Caribbean islands may offer good perspectives but these are difficult to quantify because MDF is a new product and only intensive promotion may allow this market to develop.

There are some European countries whose consumption is greater than their production. However, it is reported that there will be an over-production of MDF, with the construction of new plants, in Yugoslavia, Spain, Italy and Ireland.

With the exception of Egypt, that has tariff barriers, and Tunisia, that is building its own MDF plant, Arab countries offer good perspectives. On the other hand, stiff competition can be expected when Asian plants (in construction or planned) begin exporting.

MDF prices have not been established. A 1982 study reports prices, at plant site, of $\$195/m^3$ (and equivalent FOB prices of $\$220 - 230/m^3$); while FOB pric s in Scandinavia were $\$225/m^3$, in 1983.

1.3.7 Particle-board, market and prices

World consumption of particle-board has increased, from 19.1 million m^3, in 1970, to 41.1 million m^3, in 1980. Consumption is expected to increase in the future, not only due to increases in population, but also because particle-board has been increasing its share in sawnwood markets and in other wood-based panel's markets.

Particle-board is the type of product that can be manufactured almost anywhere in the World as a wood-based panel or on the basis of fibrous waste from agricultural industries. For this reason, it is not surprising to find that only 14% of the world production enters into the

import/export markets, the majority of which is met by neighboring countries or countries within some sort of common market or trade agreement.

Competition to supply particleboard-defficient markets is very stiff. There are better possibilities tc export boards covered withsome sort of decorative veneer. Europe, however (and an increasing tendency in most other markets), tends to import only the decorative veneer to cover its own particle- board and to find an improved market for its own particleboard production.

Latin America

Particleboard has had some problems in Latin America. Production of bagasse-based panels has not had the success that was expected and mixed tropical wood-based panel production has had economic and technical problems. Despite these problems, production and consumption have greatly increased in the 1970-1981 period:

TABLE 10.6 PARTICLEBOARD PRODUCTION AND APPARENT CONSUMPTION IN LATIN AMERICA IN 1970, 1981. (1000's M^3)

Item	1970		1981	
	1000 M^3	%	1000"s	%
Production	383	100.2	1,494	97.2
Imports	11	2.9	87	5.7
Exports	12	3.1	44	2.9
Apparent Consumption	382	100.0	1,537	100.0

The statistics show that foreign trade of particleboard is limited in Latin America and that production projects should be mainly based on internal markets. From the CA/P Region, the possibilities to enter the large European or U.S. markets, are all very reduced. Improved possibilities are present in México and within the CA/P Region, itself, particularly, Honduras, Guatemala, El Salvador and the Caribbean. Consumption in these countries is not very large nor does it show any tendency to increase or decrease. A combination of reasonable prices, good quality and, particularly an

intensive promotion, can make it feasible to expect a possible 20,000 m^3/year export market and a 10% annual increase. This, however, can be covered already by the existing production capacity of Costa Rica alone.

TABLE 10.7 POSSIBLE EXPORT MARKETS FOR CA/P REGION PARTICLEBOARD PRODUCTION

Count.	Produc.	Imports	Exports	Consump.	Bal of Trade	%	Observations
	- Thousand of Cubic Meters -						
Mexico	335	30	-	365	-30	0.9%	Strong increase Various projects Deficit covered by Andean Group
Venezuela	35	43	-	78	30	48.9%	Large unused inst. cap.
Costa Rica	25	-	1	24	-	-	Good poss. for market develop.
Honduras	-	-	-	-	-	-	Old plant, high prices.
Guatemala	4	-	-	4	-	-	Good mkt. dev. opportunities
El Salvador	-	1	-	1	1	100%	Closed plant
Panama	-	-	-	-	-		Good poss. to devel. market.
Cuba	4	-	-	4	-	-	Low per capita consumption
Barbados	-	2	-	2	2	100%	Historical imp. up to 4000 m^3/yr
Dom. Rep.	-	3	-	3	3	100%	Hist. imp. up to 32,000 m^3/yr
Trinidad Tobago	-	-	-	-	-	-	Hist. imp. up to 8,000 m^3/yr
Other Caribb.	-	5	-	5	5	100%	Hist. imp. up to 1,000 m^3/yr per Island.

Due to the world-wide economic slumps, particleboard prices have been quite low and they are expected to remain so over the next few years. The following table shows import and export prices for 1980 and 1981.

TABLE 10.8 IMPORT/EXPORT PRICES FOR PARTICLE BOARD, 1980=1981 ($/m^3)

Region/Country	Imports		Exports	
	1980	1981	1980	1981
World	199	183	190	176
Europe	211	189	199	182
U. S.	110	116	114	141
Latin America	183	147	-	-
Venezuela	147	147	-	-
México	171	193	-	-
Dom. Rep.	125	110	-	-
El Salvador	228	228	-	-
Martinique	201	201	-	-
Dutch Antilles	198	198	-	-
Trinidad-Tobago	407	447	-	-
Surinam	-	-	200	209

The above table shows that:

- The difference between import and export prices is very small, which, in turn, shows that most trade occurs over short distances.

- For those potential CA/P markets, within or outside the region, the probable export price, for CA/P producers, could be around $210/m^3, which, on the average, could mean $175/m^3, FOB.

2. Constraints to marketing development and trade

2.1 Species mix

It has been mentioned before, that the tropical forests of this continent have a wider variety of species than those of any other continent. The harvesting and use of this highly variable species mix is therefore more limited in its extent of probable known species.

The poor utilization standards of the commercial volumes standing in the CA/P Regions' hardwood forests, are primarily due to this variable species mix that contains such a high proportion of unknown or less known species. In addition, the lack of use or promotion of shorter lengths, specialty products and other log qualities, combined with high logging and transportation costs, add to the poor utilization of the commercial volume that is actually cut.

The poor use of less known species is primarily due to a lack of aggressive promotion in the domestic, regional or extra-regional markets. FAO (2) estimates that there are few technological difficulties that may hinder the utilization of less known species. An FAO study (2) shows, in summary, that these technological characteristics are very similar, in general, for many of the lesser known species as for the most known woods. Table 10.9 shows the proportion of better and less known species that belong to the different ease-of-use categories (A = excellent; B = good; C = poor) for the most important utilization properties. This analysis was done for 211 least known species compared to the 172 most used species of tropical America.

TABLE 10.9 COMPARISON OF UTILIZATION PROPERTIES OF 211 LESS KNOWN SPECIES WITH THOSE OF 172 BETTER KNOWN USED SPECIES IN TROPICAL AMERICA
(In Percent of Total Species)

Prop/Ease of Use	Most Used Species			Less Known Species		
	A	B	C	A	B	C
Workability	92	8	-	90	10	-
Contraction	19	59	22	4	78	18
Finish	98	2	-	98	3	-
Resistance	8	63	29	9	69	22
Durability	10	45	45	7	21	72
Log Form	72	28	-	49	51	-

The table above clearly shows that there is hardly any significant difference in these proporties between the most and the least used species. The comparisons were made based on published technology research that has been done on the 383 species. Therefore, at least for these species, there is no technological constraint that could limit their introduction into domestic, regional or extra-regional markets. The major

constraint for this is the lack of aggressive promotion and marketing techniques.

Besides imaginative use of common names (e.g. Philippine "Mahogany", African "Mahogany", etc.), domestic use can be promoted through the use of displays, direct outlet sales and sample promotions. In addition, regional or extra-regional promotion to introduce new species may be done by some or all of the following measures:

- Sending small samples along with the complete description of their technological properties and end-use possibilities. An estimate of the "sure volume" that can be supplied per year, should also be established with a high degree of certainty. In general terms, any species offered should not have a certain volume of less than 6,000 m^3/year.

- If there is any interest expressed, the sales representative may ask for a 10-30 m^3 samples to serve as a trial for potential clients. If the trials are successful, the sales representative may negotiate volumes and prices.

The introduction of a new species may take an average of two years and certainly not all trials are going to be successful. Nevertheless, given the rise of consumption and demand for mechanical wood products in the CA/P Region, large efforts should be directed towards a greater utilization/ha of productive forests to ensure an extended uselfuness that will permit the establishment of and the transition to industrial farm forestry.

2.2 Quality and volume assurance

A well-known obstacle to marketing development of CA/P Region wood products is the history of poor performance of supplies in terms of quality, volume and delivery assurances. This is particularly true of extra-regional markets, and it may take some time to overcome these fears through strict compliance with quality and marketing norms.

2.3 Trade barriers

Despite the great expansion and liberalization of international trade in the post-World War II era, the world economy still has a number of trade barriers in the 1980's. International trade in forest products,

whose participation is of great importance for the industrialization process of developing countries, is no exception to this situation.

Notwithstanding the strong reductions in duties and tariffs of developing countries' imports, as a result of multilateral commercial negotiations, under the General Agreement for Tariffs Trade (GATT), the still present trade barriers that still subsist cannot be understimated. Table 10.10 shows some comparable average tariffs applicable to forest products for some countries and regions.

TABLE 10.10. AVERAGE TARIFFS APPLICABLE TO FOREST PRODUCTS (Source: UNIDO, 1983)

Country	Products from Developing Countries	Products from Developed Countries	Products from Socialist Countries
Austria - logs	0.1	0.3	0.7
- primary prod.	0.2	7.0	2.2
- secondary prod.	6.8	20.5	18.6
Canada - logs	0.0	0.1	0.0
- primary prod.	6.1	2.5	7.7
- secondary prod.	6.5	12.6	10.3
Japan - logs	0.0	0.0	0.0
- primary prod.	7.4	0.2	1.9
- secondary prod.	4.8	4.3	4.6
OECD - logs	0.0	0.0	0.0
- primary prod.	1.9	0.8	0.8
- secondary prod.	1.5	1.7	3.2
U.S.A. - logs	0.0	0.0	0.0
- primary prod.	5.6	0.4	7.3
- secondary prod.	1.7	2.4	2.3

A number of factors combine to create, in the tropical forest sector, of the CA/P Region, a situation from which most developing countries are striving to escape, namely that of being predominantly suppliers of raw materials to the more developed countries, and dependence on these countries for supplies of more highly processed products. This inequity includes, in addition to the obvious imbalance in unit values between the two trade flows, exposure of the exporting countries to the insecurity surrounding the relatively higher fluctuations in prices which afflict raw materials, and the tendency for terms of trade to move against them.

The importance of export markets, in view of a potential shortage of raw material in the CA/P Region, is the ever-present need for foreign exchange earnings and the potentially higher priced products which may increase significantly the profitability of plantation forestry.

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SCOPE OF WORK

Purpose

The consultant will prepare a technical report on demand for wood products from plantations in the Central America/Panama region, for use by ROCAP in the preparation of a project to support forestry research, development, and training.

Specific Tasks:

The consultant will include in the report, the following indicators or factors of wood products demand:

a) Description of macro-level market trends for the major categories of wood products, relying at least on published data for per capita consumption by income group, population growth, and per capita income trends. The market information shall exclude fuelwood.

b) Supply trend data for wood products from natural forests, plantations, and imports. Estimates should be made of the remaining supply of commercial wood from traditional sources (natural forests), and predictions should be made of unmet demand in the short, medium and long term as a result of depletion of natural forest.

c) Identification of export possibilities for wood products produced from man-made plantations (including linear, agroforestry, and farm forestry plantings), including possible markets and producers. This should focus on intra-regional, U.S., and Caribbean markets, and identify major constraints to participation in these export markets.

d) Identification, through case examples, of types of wood production which offer high welfare gains (e.g., products which create high labor requirements for primary and secondary processing, plantations which would result in land productivity improvement, wood products for low-cost housing, etc.).

e) Identify the major land types and areas potentially available for tree planting.

The consultant should work very closely with the ROCAP Regional Forestry Advisor and the CATIE Renewable Natural Resources Departament, especially the Economist.

Travel to Honduras, Guatemala and Panama will be necessary to collect data and obtain information from national institutions and the country representatives of the ROCAP/CATIE "Fuelwood" project.

Duration fo the Contract

The consultant shall work during the period August 15-September 30. The Final Report (3 copies) shall be presented to ROCAP, in English or Spanish, no later than October 15, 1984.

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