SUSTAINED RURAL DEVELOPMENT: EXTRACTIVE FOREST RESERVES IN THE NORTHERN PETEN OF GUATEMALA

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1.0 Introduction

The Foreign Assistance Act of 1985 requires that a Country Development Strategy Statement or other country plans implemented by the United States Agency for International Development (USAID) integrate provisions for conserving biological diversity with development planning (USAID 1985). This report addresses these provisions by focusing on the current harvesting, collecting and marketing -- extraction -- of two species of Chamaedorea sp palm, harvested from the forests of the Petén. The palm leaves, exported to Europe and the US in the hundreds of millions of stems annually, are used as a backing in flower arrangements. This industry employs thousands of individuals and provides an important source of off-farm cash income, yet the forest and important associated ecosystem services, such as nutrient and hydrological cycling and biodiversity, remain intact. Additionally, the forest provides other non-timber forest products that, in sum, constitute a portfolio of extractive products. These botanical resources include ornamental and medicinal plants, latexes fruits, nuts, construction materials and many other species that can be extracted sustainably, provide an economic value for existing forest and rational to conserve the forested ecosystem upon which these products depend.

To more clearly understand how to maintain and improve methods of sustainable management, this analysis of Chamaedorea sp palms focuses upo resource stock and ecology, volume and value of trade, and other factors which influence the sustainability of the resource. Further, extraction Chamaedorea sp is placed within the "development landscape" of the Northe Petén by comparing the benefits of xate extraction to those of milpa

agriculture. Lastly, based on analysis of the factors affecting xate harvesting sustainability, we make recommendations for improvements in current management practices.

This analysis is prompted by Guatemalan efforts to conserve the valuable resources and biodiversity of the Northern Petén's forests, particularly the efforts of the Comisión Nacional del Medio Ambiente (CONAMA) and the Centro de Estudios Conservacionistas (CECON), and Dr. James D. Nations.

2.0 Premise of the Study

Within the past few decades two-thirds of the Central American forest have been destroyed or degraded (Nations 1984). The department of the Petén is no exception. In the past 20 years this forested region has been the focus of increasingly rapid agricultural frontier expansion and logging activities. Consequently, rates of forest conversion have increased, with 30 to 50% of forest cover eliminated since World War II. The social, economic and ecological consequences of such forest conversion are cause for concern and prompt the investigation for alternatives that will ensure the welfare of growing rural populations (OTA 1984). A large region of forested land still exists, however.

In 1986, Guatemalans affiliated with CONAMA and CECON drafted and presented to the National Assembly a Protected Areas Law which includes several large areas in the Northern Petén (Figure 1). Our study is intended to compliment this effort.

We base our analysis upon the following premises:

1) Permanent social organization and economic development that will meet the needs of rapidly expanding populations ultimately depends upon the ecological viability of the region's primary productivity. This productivity is two-fold: one, agricultural, a function of soil fertility and soil management technology; and two, forest regeneration, a function o conservation (i.e. sustained use) of both timber and non-timber resources.

2) Alternatives to forest conversion exist and, when considering

questions of sustained, long-term social benefits, may be the most efficient and equitable form of land use. These alternatives center upon the extraction of several botanical resources. Additional benefits result from the maintenance ecosystem services such as hydrological and nutrient cycles, and the preservation of biodiversity.

3) There is a growing consensus that the opportunity to maximize social welfare as expanding populations impinge on tropical forests is being squandered: forests are undervalued while agriculture of questionable sustainability is implemented in the wake of deforestation (Hecht 1988, Ma 1988, Myers 1988).

4) It is not argued that all forested areas should remain intact. Giver soil infertility, however, it appears that valuable extractive economies that maintain forest canopy over large regions offer land uses that will improve rural welfare. Extractive economies can form an important component to economic development in the Northern Petén.

3.0 Background

3.1 Physical Environment

The Petén is the northernmost department of Guatemala. With an area of 35,842 km2, it comprises 35% of the national territory (Latinoconsult 1974) and has nearly 60% of the forest cover (Nations 1984). Ecologicall the Petén is part of a bioregion that extends both north and west into Mexico and east into Belize. The mean annual temperature is 26.6 C and

precipitation ranges from 1700mm to 3000mm, increasing from north to south. These conditions favor the closed-canopy, predominantly evergreen, broadleaved forests over much of the region. Precipitation is highly irregular from month to month and seasonal, with the rainy season occurring from May to December. Approximately 13% of the Petén is savanna, located primarily in the south and east (FAO-FYDEP 1966).

Limestone forms the bedrock of the Petén, so karst topography is ubiquitous. Soil characteristics include the prevalence of iron-poor Latisols: clay-rich, nutrient poor and shallow profiles that are not desirable for agriculture and very susceptible to fertility losses upon forest removal (Stevens 1964). Soils throughout the Petén are dominated b classes V-VIII under the U.S. Soil Conservation Service Land Capability Class System utilized by the 1966 FAO/FYDEP resource study of the Petén. Soil classification in the north is exclusively V-VIII. Soils under this classification are generally not suited for cultivation, while classes VI-VIII pose extreme to severe limitations to agricultural activities (Brady 1984).

A second classification system for Guatemala (SGNPE, INAFOR, IGN 1980) considers four soil categories: A--cultivatable land, B--cultivatabl land with limitations, C--lands for forest use and permanent cultivation (tree crops), and D--land for forest use and national parks. Class D soil represent 54% of the Petén, class C 28%, class B 18%, and no class A. Almost no class B soils exist in the Northern Petén.

3.2 Human Environment

Historically, human activity in the Petén has depended upon the primary productivity of the land, both soils (agriculture) and forests (timber and non-timber products). Current economic activity is still dominated by agriculture and extraction of forest products. In strict terms of monetary value, timber mining is the most valuable activity at present, followed by milpa agriculture (cattle, corn, beans), with the extraction of Chamaedorea sp. third. Extraction of chicle, the latex of Manilkara zapota, has historically played an important role in the region.

Regional political and economic power has always been concentrated in the Flores-Santa Elena-San Benito urban area, where the economic influence of contractors that bring forest products to market and the Empresa Nacional de Fomenta y Desarrollo Económico del Petén (FYDEP) are based. This latter organization, established in 1958, has the authority to regulate all forest extractive industries and to sell land. Since the inception of FYDEP, the demographic, economic and political environment of the Petén has changed significantly (Schwartz 1977). This is well illustrated by the marked expansion of roads between population centers, for access to stands of tropical hardwoods, and, more recently, for petroleum exploration.

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Figure 1: Population Curve[1]

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[1]-- All Tables and Figures are attached as an appendix for this draft

Current rates of colonization are thought to be as high as 250 people per day. Population data is presented in Figure 2. The majority of these people are coming from the highlands, the south coast and the dry southeast, all regions ecologically different from the Petén. Hence, the colonists bring with them different agricultural technologies and cultures that may be ill-adapted to the marginal soils of the Petén (Dr. Norman Schwartz[2]--pers. comm).

The two distinct forms of economic activity, forestry products and agriculture, have intensified in response to increased population. The expansion of the agricultural frontier has been accompanied by sharply increased fires, mostly in regions that correspond to areas of heavy colonization along roads (Figure 2).

Both exploitation of forest products and agriculture persist in response to economic demand, desire for economic security, and cultural tradition, often with the same individuals involved in both sectors. Hence, social boundaries between harvesting forest products and cultivatin the land are diffuse. However, the two activities are mutually exclusive on the same land. Deforestation eliminates use of forest resources. The schism was neatly summarized by one informant's observation, "The colonist come in, they do what they know how to do. They are standing next to a xate palm or a pimienta gorda tree but they know how to plant corn so they burn the forest and plant corn."

Figure 2 illustrates the location and extent of a proposed national park and extractive reserve system for the Petén, part of a new Protected

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[2]-- Professor of Anthropology, University of Delaware. Dr. Schwartz has conducted research on land use in the Petén for 20(?) years.

Areas Law. The law designates restricted land-use classification of several areas, emphasizing the region north of 17 10' N latitude. Forest conservation of this area is in accordance with the 1966 FAO-FYDEP study recommendation that, given the poor soils of the region, the best land-use is forestry.

Current conservation efforts are restricted to four biotopos managed by CECON, Tikal National Park and a series of small archeological sites. Fairly large and growing populations exist within the proposed protected areas yet large areas of forest are for the present, after decades of extractive activities, intact.

The future status of the Protected Areas Law has yet to be decided. FYDEP is in the process of liquidation and will be insolvent by spring of 1989. Additionally, Instituto Nacional Forestal (INAFOR) has been recentl disbanded. While the proposed law would create an Instituto de Areas Protegedas y Vida Silvestre, it is uncertain how political control and responsibility will be allocated among the new branches of various nationa institutions.

4.0 Model and Methods for Sustainability Analysis

4.1 Introduction and Definition

To provide a framework for analyzing the sustainability of a given extractive activity, it is first necessary to understand the general concepts of sustainability and develop a good working definition. One suc definition is as follows:

> Sustainability [is] the indefinite survival of the human species (within a quality of life beyond mere biological survival) through the maintenance of basic life support systems (air, water, land, biota) and the existence of infrastructure and

institutions which distribute and protect the components of these systems (Livermann et al. 1988).

Clearly, this definition is human centered. Yet the harvesting of xate is ultimately a human activity, so a complete sustainability analysis will incorporate not only ecological and biological information, but economic, social and institutional information as well.

4.2 Ecological Measurements

A sustainability analysis of any plant resource requires specific ecological data. At the most general level, geographic data are required which describe and delineate areas where the resource occurs. These data must be complemented with representative measurements of the biological resource stock in a variety of environments, particularly in areas that have been heavily harvested and areas where little or no harvesting has occurred. Also important are data that describe the general reproductive health and characteristics of the plants, floral biology, pollination biology, and the level of leaf production and cutting. Further, it is important to characterize the ecological niche that the plant occupies within the larger forested ecosystem. Some of these measurements and descriptions could not be conducted in the limited time frame of this project. They include measurements of the rate of leaf production, response of plants to various levels of defoliation and studies of floral and pollination biology. These longer term studies are highly warranted and will provide needed information about the long-term sustainability of xate harvesting.

In order to determine the ecological associations and measure the

biological stock of the various species of Chamaedorea collected in the xate trade, biological transects were established in several areas in the northern Petén, field investigations were done with two botanists, and interviews were conducted with individuals at all levels of the xate industry. The transects were established to quantitatively measure the number of plants, their heights, the number of leaves per plant, number of cut leaves, occurrence of inflorescences, and to qualitatively describe distinguishing features of individual plants and characteristics of the plots as a whole. These surveys were conducted on a series of small plots laid out at equal distances on several transects. Figure 3 indicates the locations of the transects. In establishing these surveys, we attempted t provide a representative sample of the heterogeneity of topography and forest canopy that is a natural part of the Petén.

Transects were established in areas of active xate cutting and in areas where the resource is officially protected from such activities, suc as Tikal National Park. In total, five transects, with 16 plots were established in areas of little or no protection from harvesting. Three plots were established in well-guarded areas of Tikal, as control or protected populations. In addition to sampling wild populations, we also sampled in an area of forest that is being actively managed as a plantatic for the production of hembra (C. elegans). The data are presented Table 1

4.3 Economic Measurements

Equally important in the sustainability analysis are measurements anc descriptions of economic factors. A market analysis must describe the structure of the market, the number of suppliers and consumers in the

various sectors, as well as costs and benefits associated with each of these sectors and with the market as a whole. Such an analysis provides important insights on the long-term sustainability of economic systems of forest extraction. Further, these analyses allow comparisons between forest product extraction and other economic activities, notably forest conversion for milpa -- slash and burn -- agriculture.

4.4 Institutional and Social Considerations

Institutions play a crucial role in effective management of any renewable resource, hence identification of existing institutions that regulate or affect xate harvesting is critical. If there is a lack of appropriate institutions, new ones must be recommended to fill particular niches.

Social considerations are also important, but in-depth collection of social data is beyond the scope of this study. However, the level and degree of local participation is one of the crucial elements in the ultimate success of a sustained-yield management scheme. Specifically, th perception of the resource (i.e. the role of the plant in local social organization), the contribution the resource makes to individual or household income and the opportunities the resource provides as a base for local or regional economic development all warrant significant additional research.

5.0 Results and Discussion of Sustainability Analysis

5.1 Ecological Measurements

5.1.1 Classification

There are at least three species of Chamaedorea collected on a regular basis in the xate trade. The term xate can refer to one species o Chamaedorea, specifically C. elegans (Emilo Quero[3] 1988, pers. comm.; Juan Jose Castillo 1988, pers. comm.) or it may refer to the various species collected in the trade as a whole. C. elegans may also be called hembra o chico palm. The second widely collected species is C. oblongata, commonl called jade or macho palm. A third species, C. erumpens (Quero 1988, pers comm.; Castillo 1988, pers. comm.) is also collected, though not in the quantities of hembra or jade. It is locally known as cambray. Photograph of pressed botanical specimens are shown in Figure 4.

Note that Chamaedorea palms hybridize readily. That is, two species may interbreed to produce a third species that contains traits of both species. At least 15 hybrids of Chamaedorea are recognized (Michael Balick[4] -- pers. comm 1988).

5.1.2 Ecological Setting

Preliminary analyses indicate that the various species of Chamaedorea occur in nearly the same ecological association, that of mature secondary or primary forest. The Chamaedorea species collected in the xate trade are all understory plants, rarely exceeding three meters in

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[3]-- Dr. Quero, Botanist at the Mexican National Botanic Garden assisted the researchers in the field.

[4]-- Dr. Michael Balick is a member of the Institute of Economic Botan of the New York Botanical Garden.

height.

The various species may be found in virtual monocultures or they may occur in close association with one another. In one instance, we found si species of Chamaedorea in the understory, within an area of 150 m2. The reasons for this range of associations probably depends on a combination c soil, topography, seed dispersion patterns, and microclimate differences. Standly and Steyermark (1958) note that C. elegans generally occurs below 1400 meters, while C. oblongata occurs below about 700 meters. All of our work took place below 700 meters.

It appears that the various Chamaedorea species depend strongly on a mature forest environment in which a high canopy provides both shade and high humidity. These conditions imply a low level of forest disturbance. Examination of hembra and jade grown in sunlight revealed pronounced yellowing and reduced size of the leaves as compared with shade-grown plants. In addition, investigations of forested areas that had been highl disturbed as a result of timber and fuelwood cutting and natural windthrow demonstrated that such areas are often unable to support substantial populations of Chamaedorea. The open canopy characteristic of such disturbed forested areas allows increased sunlight to reach the forest floor, which may, in turn, encourage the growth of herbaceous plants more characteristic of early secondary or pioneer growth forms. The various species of Chamaedorea do not appear to compete well with this type of herbaceous growth and, hence, are found rarely in areas of natural or anthropogenic disturbance (Quero 1988, pers. comm.).

5.1.3 Resource Base

Our surveys indicated that the average density of C. oblongata in areas with little or no protection is about 1640 plants/hectare (ha). The density of C. elegans in these same plots is about 1430 plants/ha. The average density of both species is thus about 3070 plants/ha. These figures contrast sharply with the densities measured in well-protected areas of Tikal National Park of 2570 plants/ha for C. oblongata and 5930 plants/ha for C. elegans. Measurements at a newly established plantation of C. elegans showed densities of nearly 23,500 plants/ha. Table 1 summarizes these findings.

TABLE 1

Population Density of C. **elegans** and C. **oblongata**

Protected Areas	
C. elegans	5933 plants/ha
C. oblongata	2570 plants/ha
Both species	8503 plants/ha
Non-Protected Areas	
C. elegans	1430 plants/ha
C. oblongata	1640 plants/ha
Both species	3070 plants/ha
Plantation	
C. elegans (only)	23,500 plants/ha

5.1.4 Ecological Sustainability Analysis

As part of the analysis, populations of both C. elegans and C. oblongata were broken down into five height classes, based on measurements from the base of the plant to the top of the longest leaf. These measurements provide basic information about the distribution of ages in various environments and demonstrate how various population characteristic are distributed throughout age ranges. Figures 5 and 6 display the distribution of plants in both protected and non-protected areas for C. elegans and C. oblongata. Of these four categories of plants, differences between protected and non-protected areas are most pronounced in populations of C. elegans.

Substantially higher numbers of plants occur in the smallest size group of the protected populations. This size class may be a general measure of regeneration and, hence, an indicator of the reproductive heal of a population. In studies conducted on understory palms in rainforest areas of Mexico (Piñero et al. 1984), the three smallest age groups (seedlings, infants, and juveniles) account for the largest number of individuals among the surveyed plants. Population dynamics in these populations are characterized by high mortality in the early ages and hig survivorship during reproductive age. While only one of the four categories of plants (protected C. elegans) demonstrates this pattern of relatively large numbers of young plants, it is difficult to draw conclusions about regeneration based solely on these data. More information, derived from longitudinal studies of controlled baseline communities, is clearly needed.

Examination of the number of cut plants by size class (Figure 7)

reveals that the ratio of cut plants to total plants in all four categorie steadily increases with size class. In addition, plants of C. elegans sho much higher levels of cutting than do populations of C. oblongata in all size classes, possibly reflecting the higher value of C. elegans. Interestingly, the ratio of cut plants to total plants is very similar for C. elegans in both protected and non-protected areas, indicating that supposedly well-guarded areas of Tikal still experience some cutting. The number of plants cut of C. oblongata is much higher in non-protected areas than in protected areas.

Much more striking differences are evident in the number of inflorescenses by size class for the four plant categories (Figure 8). In this case, the ratio of inflorescenses to total plants is significantly higher in the protected populations of C. elegans than in any of the other populations. The only other population that has a substantial number of inflorescenses is the protected population of C. oblongata. Note that the non-protected populations of C. elegans and C. oblongata exhibit both high ratios of cut plants and low ratios of inflorescenses. Conversely, protected populations of C. oblongata show higher ratios of inflorescenses and lower ratios of cutting. Protected populations of C. elegans show bo high ratios of inflorescenses and high ratios of cutting.

The ratios of cut plants and inflorescenses to total plants may be a good indicator of the ecological sustainability of a given level extraction. For example, in the study mentioned above experiments were done with Astrocaryum Mexicanum to gauge the effect of defoliation on reproduction, leaf production and leaf loss (Mendoza et al. 1987). In plants that had 1/3 of the intermediate age leaves removed, leaf productic

increased or remained virtually the same in all age classes. Complete defoliation was highly detrimental to leaf production in all but the most mature plants. The effect of varying levels of defoliation on reproductio (i.e., the ability of the plant to produce flowers) was also significant. Some levels of defoliation actually increased levels of reproduction, whil other intermediate levels did not significantly affect the reproduction. Complete defoliation drastically reduced the probability of reproduction.

While it is difficult to draw exact parallels between data on A. Mexicanum and Chamaedorea sp, the work on A. Mexicanum nonetheless demonstrates that there is a significant effect of defoliation on understory palms. Of particular importance is the fact that it may be possible to partially defoliate A. Mexicanum without harming reproductive and leaf production potential -- and, in some cases, increase both leaf production and reproduction potential. In turn, this information implies that it is possible to harvest an understory palm at a sustainable rate without damaging the overall population. This information also shows that complete and severe defoliation has marked affects on the ability of plants to reproduce, grow and survive.

While our studies cannot show the precise effects of defoliation on these important population characteristics, they can point up some areas that deserve attention. For example, though it is not clear why high rate of flowering and cutting coexist in Tikal, it is clear that rates of flowering are very low outside of protected areas. It is also clear that population densities of both Chamaedorea species are significantly lower i non-protected areas than in protected areas and that levels of regeneratio appear low in non-protected areas. We believe that these low levels of

regeneration and flowering are indices of nonsustainability. Longitudinal studies of the effects of defoliation on growth, reproduction and survival of Chamaedorea sp are warranted. Indeed, such studies constitute the logical next step in determining the ecological sustainable levels of Chamaedorea sp harvesting.

5.2 Market Supply

In the following discussion, the term xate will be used to designate all commercial species. Where the two main types of product must be distinguished, the market names jade and hembra will used.

5.2.1 Regions of Production

Chamaedorea sp. palms exist throughout the Petén. Based upon interviews and an earlier study (Sagastume 1987), highest plant densities and extractive activities are concentrated in the north. The regions of Carmalita, Uaxactún, Dos Lagunas, El Naranjo and Paso Caballos are all recognized as centers of production. Melchor de Menchos, Yaxá, Dolores an Poptún also produce xate but of both lower quality and volume. A larger leaved species of Chamaedorea, possibly C. tepijilote, is harvested in the region of Cobán in Alta Verapaz.

5.2.2 Supply Structure

The market for the extraction of xate began in November of 1960 when floral importer and wholesaler in the state of Texas, USA developed a

market for the green leaves to be used in floral arrangements.

Figure 9 is a general schematic of the extraction and delivery of processed xate to the consumer.

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FIGURE 9: MARKET STRUCTURE

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Harvesting of xate leaves occurs year-round, though the volume and price varies with international demand. It is estimated that there are between 5000-6000 xateros. The number is variable, depending upon the demand for xate and availability of other work. For example, some milpa owners will supplement their income by harvesting xate twice a year, once in August and once in February, both times when milpas require little tending. Such diversity in income strategies is more the rule than the exception.

Xateros work for contratistas, the middlemen who, with a license to transport from FYDEP, organize the work camps and transportation network. Contratistas transport to the warehouses of exporters, who prepare the pal for export. There are currently seven exporters, each with a warehouse fo receiving, processing and shipping the xate.

The camps range in size from 10 to 30 men. A median range appears to be 18 men. The camps are permanent and often old, being originally used b chicleros. Interviews indicate that about 120 camps are distributed throughout the Northern Petén, over an area of approximately 12,000-14,000 km2. Each camp is used for various lengths of time, depending on the

harvesting potential. The same camps are used for the extraction of chicle and allspice, as well.

The xatero works for a period of time that ranges from a few days to two months, entering into and exiting from the forest when his financial objectives have been met and when other activities, such as planting and harvesting of milpas, require his presence.

Xateros harvest the leaves of xate with a single blade knife. Palm leaves are cut near the main stem of the plant. The xatero walks rapidly from one plant to the next, leaning and dodging, quickly cutting one leaf after another, breaking an occasional twig to mark where he has been. He places the leaves in a grain sack that has been modified into a large slin hoisted over one shoulder.

After a day's collecting, which begins at dawn and ends at mid-day (5:30 am-12:00 pm), the xatero returns to camp and bundles his harvest into manojos, or handfuls. Each manojo is approximately 55 leaves. Two manojos comprise one field grueso, or about 110 leaves. The xatero is pai by the contratista. Subtracted from his wages are the costs of food and any supplies (boots, cigarettes, liquor) advanced to the xatero. The xatero's camp food, a diet of rice, beans, tortillas, coffee and sugar, is sold to the xatero at a considerable markup of 500-1000%: the xatero pays Q4.00-5.00 every day for food. The food is prepared by a camp cook, generally a woman. She is payed by the xatero on a daily basis.

The manojos are stacked where they await the arriero, the muledriver, and his team of mules. The mules are the property of the contratista and the arriero is in his employ. After unloading the food and supplies he ha brought for the camp, the arriero packs the xate into a large burlap bag,

protecting the leaves with the larger leaves of the escobo palm (Crysophil argentea). Each bag contains anywhere from 3000-5000 leaves, depending or whether the contents are the smaller, lighter hembra or the larger, heavie jade. The arriero must also see to the mules' diet, which consists of th bark, leaves and fruit of the ramón tree (Brosimum alicastrum). This diet is supplemented with an injection of vitamins and antibiotics on a weekly basis.

Xateros may not necessarily make use of camps because there are regions where xate can be harvested near good roads. In this case, small stores or individual's houses serve as collection points where the contratista can collect the leaves. The contribution this makes to the market volume is thought to be small: areas near good roads are often over-harvested or converted to milpa. It is common knowledge that in recent years xateros have had to venture into increasingly remote areas.

The bags are dropped off at a transfer point to be picked up by the contratista. He then delivers the bags to one of two warehouses of exporters in Santa Elena and San Benito, or trucks or flies the bags to o of five warehouses in Guatemala City.

In the warehouses the xate is sorted by women called selecionistas, and packaged for export by empacadores, usually men. Imperfect leaves are discarded. Commercial quality leaves are of a relatively uniform size, color and have no holes or blemishes. Imperfections arise from blotches, insect herbivory, fungus damaged leaves, and leaves that are too large, to small, or discolored. The volume of leaves thrown out is large, ranging from 45-65%.

The good leaves are then bundled into finished product manojos. Eact

manojo of selected leaves officially contains 30 leaves of jade and 40 leaves of hembra, but the real numbers are closer to 23 and 35, respectively. The manojos are then laid overlapping on a wide strip of paper and rolled into a paquete, or package. Each package is comprised of 25 manojos of jade and 40 manojos of hembra. The package are then stored in large refrigerated rooms at 4 C.

The time between cutting the leaves in the forest and refrigeration i generally less than six days. The paquetes are shipped by truck and boat in refrigerated containers. They are sent unrefrigerated by plane. Most traffic to Europe is by plane and to the U.S. by boat.

Once the bundles of leaves arrive in the U.S. they are held by U.S. Customs. A broker for the importer, licenced by Customs after providing a $10,000 bond, arranges both the permits and the inspection for each shipment by USDA employees. Once inspected for pests and cleared by the USDA agent, the shipment is approved by Customs agents and released from the government warehouses to the broker. If pests are found, which is usually not the case for the low risk Chamaedorea sp leaves, the shipment is fumigated by methyl bromide for up to 72 hours. This eliminates the pest problem but generally destroys the shipment.

The palm leaves are then shipped, usually by refrigerated truck to regional florist wholesalers and ultimately to individual floral shops. The leaves are likely to be found in every floral shop in the U.S. They are used principally in floral arrangements for weddings and funerals.

5.2.3 Plantations

Plantations have been developed by a few individuals in recent months. The forest canopy remains undisturbed. The herbaceous level, a few of the smaller diameter understory trees and the very common escobo palm are all removed. Hembra plants collected in the wild are stocked at density of between 20,000 and 30,000 per hectare. Insect herbivory is controlled through the application of pesticides, liquid fertilizer is sprayed on the leaves, and damage to leaves is minimized by careful weeding. The quality of the leaves are higher and the harvesting costs dramatically lower; net profits are potentially great, though the success of the plantations has yet to be measured. Benefits include a higher productivity of land, maintenance of forest canopy and the potential for agroforesty systems. Costs center on a potentially dramatic shift in the structure of the extractive economies in the Petén as plantations may provide a more reliable and lower cost supply of the leaves, and out compete large-scale harvesting of wild populations. Another cost centers on the removal and exhaustion of natural stands of plants from the forest. Further discussion on the plantations is given below.

5.3 Demand and International Market Characteristics

5.3.1 Volume

Demand changes over the year. Highest demand for hembra occurs from January to April, culminating with Easter. Demand for jade increases in

autumn and drops again in the spring. The demand for both products is lowest in July, August and September.

Almost all of the leaves from Guatemala enter the U.S. through Miami by both plane and boat, though a small amount (<1%) enters through New Orleans. The U.S. demand for xate is also satisfied by lower cost Mexican trade, which enters the U.S. by truck through Texas. The volume of imports into the U.S. from both countries are shown in Table 1. USDA does not distinguish between species; imports are lumped under the Chameadorea sp. European imports from Guatemala, dominated by a preference for the more expensive hembra, is difficult to determine. Several countries purchase the leaves, primarily Holland, Germany, Italy and Switzerland. Estimation of volumes becomes more difficult as these several countries buy both directly from Guatemala and from U.S. importers that resell both Mexican and Guatemalan leaves. U.S. importers form Guatemala and exporters to Europe estimate that Europe is currently purchasing 58,000,000 leaves annually from Guatemala.

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Table 2: U.S. imports from

Guatemala and Mexico

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Guatemalan trade represented 17% of the U.S. market in 1987. As one large importer stated, Mexican greens are "cheaper and of higher quality", possibly because there are several large jade plantations in southern Mexico. Reliability problems exist with the Mexican trade, however, as th

informant stated that the Guatemalan exporters have a record of "less failures". Another importer echoed this comment but was quick to point ou several supply problems exist in Guatemala. These opinions likely result from certain ecological and pricing problems within the industry. First, productive regions are lost as colonists convert forest to milpa. Second, pricing mechanisms that favor quantity over quality result in over harvesting. This overharvesting makes productive regions increasingly remote. Transportation costs rise.

5.3.2 International Value of Trade

Given an international price paid by importers of $0.013/leaf for jade and $0.015/leaf for xate, the net value of exported Chameadorea sp a a source of foreign currency for Guatemala can be estimated. It is necessary to make two simplifying assumptions. First, as it is impossibl to know the percentage of exports of each species, we assume 80% of the U trade is jade and 20% is hembra. Second we assume all of the European trade is hembra. Based upon interviews, neither of these assumptions is unreasonable. This results in exports worth, in 1987, $1,845,185.00. Based upon IMF data (1988), this comprises 0.4% of Guatemalan foreign currency earnings.

5.3.3 Competition

The floral market preference is for something that is green, something that does not wilt rapidly and something that can be transporte

in high volume, quickly and cheaply. Hence, the xate trade is vulnerable to competition from other plant species. Concern was expressed by Guatemalans that leatherleaf fern (Rumohra adiantiformis), which is also used in floral arrangements, will come to dominate the market. Leatherleaf has an advantage: it is currently cultivated in plantations. The production from South Florida was worth $64 million in 1985 (Hortscience 1985). There are currently 2 small plantations in Guatemala that produce an unknown volume of leaves for export. Discussions with individuals in the floral market in the U.S. indicates that this competition is not serious. The two products satisfy different uses: leatherleaf is used widely for floral arrangements; xate is used almost exclusively for weddings and funerals, particularly the latter.

5.3.4 Prospects for Increasing the Market Share of Guatemala

Market development must overcome three principle obstacles. First, supply constraints, due to poor infrastructure, past overharvesting and habitat loss must be addressed. Second, demand constraints could be overcome by increasing the market size. Small sample shipments have recently been sent to Japan, which represents a potentially very large market. Third, demand constraints in the U.S. result primarily from the competition of cheaper Mexican trade.

5.4 Employment Benefits

The 5000 to 6000 xateros have access to 46 to 73% of the gross

benefits, depending on seasonal price fluctuations. Other gross benefits within Guatemala are outlined in Table 4.

The employment levels within the xate industry may be as high as 8,000 individuals. Many of these people are heads of households; most, if not all contribute to household income. Importantly, for many individuals, xate provides one important source of cash income. For example, in the town of Chunya (formerly San Miguel), which lies within the biotopo San Miguel/La Palotada, of 83 heads of households, 35 work seasonally cutting xate (pers. comm.--letter to James Nations from Norman Schwartz). The specific contribution of xate harvesting to cash incomes is not known but thought to be substantial. Households vary and the degree to which individuals exploit xate as a wage source depends upon the contribution of other household members to maintaining milpa, finding other sources of income such as harvesting allspice, etc.

In July, 1988, a time of low international demand, it was reported that fully 2,000 xateros were out of work (Prensa Libre). This is not surprising as the demand for xate is cyclical. Many xateros and contratistas shift production to allspice extraction--ripe at this time--and other forest products.

5.5 Legal Perspectives

From harvesting to exportation of the leaves from Guatemala a series of taxes and licenses are involved. The municipality from which the xate is harvested receives Q2/100 pounds ($0.80). FYDEP receives a tax of Q5/100 pounds ($2.00). Both taxes are paid by the contractor, though often

the volumes are under-reported. Contractors are required to have a licence issued by FYDEP to transport the xate from specific regions. In 1987, FYDEP issued 716 licenses, though there exist only 100-120 contractors, roughly corresponding to the number of camps in the Petén.

Both species of Chamaedorea, C. elegans and C. oblongata, are not listed under the Commission on International Trade in Endangered Species o Flora and Fauna (CITES), an agency administered by the United Nations Environmental Program (UNEP). Hence, there exist no international agreements on the traffic of these species.

For entry into the U.S. both species are subject to inspection for pests by the USDA Animal and Plant Health Inspection Service (APHIS), subunit Plant Protection and Quarenteen (PPQ), under Congressional Law 7CFR 319.74. Inspection officers of APHIS-PPQ inspect 2-7% of each shipment for pests before the shipment is released to the importer, as described above.

6.0 Other Benefits and Costs

The forests of the Petén in general have substantial additional natural resources in the form of plants, animals and timber. While xate currently appears to be the most valuable non-timber forest product, there are many other non-timber forest products of lesser, but nonetheless significant, value. These products include chicle, allspice, quano palm (Bactris sp.), escobo palm, ramón, mimbre (classification uncertain), Dioscorea sp., and numerous medicinal plants, among other products. Game animals such as Tepesquintle (Agouti paca), deer (Odocoileus virginianus

and Mazama sartorii), wild pig (Tayassu sp.), turkey (Agriocharis ocellata and other animals may also be considered non-timber forest products. Further exploitation of mahogany (Swietena sp.), tropical ceder (Cedrea odorata) and other important hardwoods may be possible and sustainable on long rotation basis. Taken in the aggregate, these products provide a diverse resource base which actively exploits the inherent diversity of tr forest, maintaining the integrity of the larger ecosystem and insulating the human collector from the perturbations caused by outside market fluctuations and attacks of pests and diseases on various products.

This discussion of other benefits of extractive reserves touches onl briefly on some of the more important products of the tropical forests of the Petén. There is much additional research that remains, particularly with respect to classification, ecologically-based sustainability analyse and exploration of the market potential for numerous forest species. More research is needed for the integration of these sustainable systems of forest utilization with the growing agricultural populations of the Petén.

6.1 Chicle

Chicle is one of the major forest trees in the bioregion which stretches from the Yucutan through the Petén south into Alta Verapaz, eas into Belize and west into Chiapas. Like many of the products mentioned above, chicle trees are found in association with the same type of mature secondary or primary forest which xate prefers. Chicle trees may reach diameters exceeding two meters and attain heights of over 30 meters (Wagn

1964). These trees are "tapped" by chicleros in much the same way as rubber trees are tapped, in order to obtain a latex that is processed to form the base for chewing gum and a variety of medicinals. Each tree, on average, yields approximately 1-3 kg and must recover for five to eight years prior to being cut again. Due to variations in climate, chiefly rainfall patterns, the latex is available only from July through January i the northern Petén.

The stand density of the chicle trees varies greatly. Schwartz (pers comm.) reports stand densities as high as 50 trees/ha, though averages are 15/ha. Critically important, however, is the fact that with each round of tapping, 5-15% of the tapped trees are killed. Prior to the shift in demand patterns away from natural latex to petrochemical latexes, stocks o trees were being significantly reduced. This, combined with the fact that the trees are very slow growing (Lundell 1937), suggests that any sustained harvesting regimes must be carefully regulated.

Chicle is collected chiefly in the municipios of Flores, San José, San Andrés, and Melchor de Mencos. Chicle has been collected commercially in the Petén since at least the 1880's (Soza 1970) and reached a peak of production in 1947, with about 2,227,000 kg produced. Levels of productio in the 1980's have hovered between 136,000 and 273,000 kg per year. Price during this time have averaged about $4.15 per kg of chicle, f.o.b in Guatemala City (Gremial 1988). The market for chicle has traditionally been the United States, although this has changed recently, with Japan buying a majority of the product. Apparently the demand for Guatemalan chicle has suffered as a result of competition from the lower quality Brazilian chicle, a highly variable external market and the lack of a

uniformly high quality product free of various impurities. Additionally, natural chicle must compete with synthetic substitutes which, though of lower quality, taste and consistency, nonetheless are consistently uniform and free of impurities (Banco de Guatemala 1981).

The production and marketing of chicle is controlled by FYDEP, which buys the entire production, licenses the various contractors (there were eleven licenses granted in 1987 (FYDEP archive 1988)), and levies taxes on the product. As of 1981, at least 900 persons per year were employed in the production of chicle, though this figure may rise as high as 2000 or 3000 persons temporarily and during years when 900,000 to 1,400,000 kg are harvested (Banco de Guatemala 1981). Interviews with officials in FYDEP indicated that the material cannot be stored for more than a few months, s the organization cannot stockpile the product as a hedge against market fluctuations.

Between 1952 and 1975, when the market was particularly strong, the Bank of Guatemala granted credit for the exploitation of chicle. After 1975 it was up to the individual contractors and FYDEP to finance the industry. However, in 1980, credit again became available through the Banco de Desarollo Agricula, in the amount of $213,000 (Banco de Guatemala 1981).

While chicle continues to be extracted from the forest in significant quantities, both FYDEP data and various workers in the industry indicate that the industry is either in decline or in a state of quiescence. In many ways, this situation mirrors that of the decline in rubber tapping in the Amazon Basin at the end of the last century (Hecht and Schwartzman 1988). Furthermore, this decline clearly illustrates the notorious

volubility of the market for raw materials produced in tropical forests and, hence, underscores the benefit of a portfolio of non-timber forest products.

6.2 Allspice

Another important product gathered from the year to year is allspice or pimienta gorda. This species, like chicle, is a common forest tree but occupies the middle canopy, rarely exceeding 20 meters in height (Wagner 1964). Pimienteros collect the green fruit by scaling the tree with espalones (climbing spikes), and cutting off the fruit-laden branches. This activity begins in mid-July and continues for about two months. The regions near Sayache and Las Cruces produce substantial quantities of allspice. Recently great concern has been raised as new immigrants to the region are not skilled at climbing trees. The result has been an increase in mortality as trees are cut down in order to harvest the canopy fruits (Fernando Mora[5], Carlos Estrada[6]--pers. comm. 1988). Allspice exporters indicated that current market prices were about $1.00/kg dry weight for th product in August 1988. The contratistas are paid $0.26-$0.28/kg of green fruits--three kg of the green fruit are required to produce one kg of drie seeds. Additionally, the bodega owner must pay a tax of $0.09/kg dry weight to FYDEP, with an additional tax of 4% of the export value going to the national government. One exporter estimated that Guatemala will expor

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[5]-- Fernando Mora is an exporter of xate.

[6]-- Carlos Estrada is an exporter of allspice.

about 1,136,364 kg this year to the United States, Holland, Germany, China and the Middle East. In 1986, 394,578 kg, with a value of about $230,000, were exported (Gremial 1986). Virtually all of the product produced in th country is exported. Guatemala currently has approximately 30% of the international market, trailing Jamaica, which benefits from plantation production.

The collection of allspice takes place during cyclically low demand i the xate market, i.e., during summer months in the US and Europe. Additionally, chicle gathering occurs during periods of lesser demand for xate. As a result, many of the same people who collected xate also climb pimienta gorda and chicle trees to extract the products they have to offer

Additionally, many contratistas who primarily haul xate will also haul allspice and chicle when the demand for those products is high. Even the same campamentos are used for these extraction activities.

6.3 Ramón

Many of the campamentos used by people involved in extractive activities are only accessible by mule. Mules haul supplies such as food and water into the camps and haul the products out to roads, where contractors load the materials into trucks. These mules, when they are i the forest, are fed nearly exclusively on ramón trees, specifically the foliage and bark. Thus, these trees provide an important, though difficult to quantify, input to the various extractive industries. Studi conducted by Peters and Pardo-Tejeda (1982) indicate that the foliage is surprisingly high in protein and other essential nutrients needed by both

humans and animals. This same study also demonstrated that the nut of the tree is very high in proteins necessary for human nourishment and contains nearly all of the essential amino acids. Although ramón seeds were an important food source in pre-Columbian times, the current level of human consumption is quite low. Ecologically, the trees are a very common mid-canopy species, occasionally reaching 30m in height and occurring in densities of up to 240 trees/hectare (Wagner 1964).

6.4 Mimbre

A commonly occurring plant on many of the larger forest trees is a vine, locally called mimbre or arpon (identification uncertain). When stripped of its outer bark or sheath and dried, the inner core provides an excellent cane-like material for making furniture, baskets and other products. The uses and appearance of the vine closely parallel the rattan (Calamus sp.), a very important and highly developed non-timber forest product of Southeast Asia. Though not heavily harvested at this time, dried mimbre brings $2.20/kg in Guatemala City. Exports in 1986 were 10,530 kg, valued at about $11,000 (Gremial 1988).

6.5 Dioscorea

Another commonly occurring vine in the forest is Dioscorea sp. A member of the yam family (Dioscoreaceae), this plant is distinguished by a large rhizome or root-mass which can attain weights of 70 kg or more. The rhizome, which is primarily above ground, contains a variety of alkaloids

and other biologically active materials. The most notable of these alkaloids is diosgenin, a steroidal sapogenin and a key ingredient in the birth control pill (Heywood 1985). As well, the plant plays an important role in traditional medicine (Michael Balick[7] 1988-- pers. comm). This plant has been extensively collected in Mexico, perhaps over collected (Hermilo Quero 1988 -- pers. comm.), and may represent a significant sourc of revenue if careful controls are placed on the exploitation of this slow growing plant. Officially, Dioscorea cannot be exported, however data available from the Guatemalan government show that small quantities are nonetheless exported. For example, in 1985 1,123 kg of Dioscorea with a value of about $4,900 was exported from Guatemala. Though the total value is low, the per unit value of over $4.00/kg is quite high. It is possible that the restriction on exportation applies only to live plants and not to materials which are not viable for propagation.

6.6 Medicinals

The forests of the Petén undoubtably contain additional stocks of plants with biologically active components. Soza (1970) alone mentions 4[illegible] plants with medicinal uses that are commonly found in the Petén, but given that he offers only the common names, it is not clear what, if any, commercial value these plants may have. Many local people will use these plants instead of commercial medicines, so the benefit of not having to b[illegible] expensive commercial drugs must also be considered. The classification a[illegible]

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[7]Michael Balick is a member of the Institute of Economic Botany, The New York Botanical Garden.

uses of medicinal plants in the Petén deserves much additional research.

6.7 Tourism

Tourism is vital to the economies of Guatemala and the Petén alike. In 1987 alone, 43,403 tourists went to Tikal, 12.3% of the visitors to Guatemala. Considering that the 350,000 tourists to Guatemala generated $101.6 million in 1987, tourism in the Petén is a very important industry indeed (INGUAT 1988). It is possible to provide a value for resources lik Tikal with econometric analysis. Such analyses could also be applied to the growing number of forest areas that attract tourists. There are companies in Santa Elena and other parts of the department that specialize in adventure and nature tourism, an industry that depends on the existence of forested habitat.

6.8 Ecosystem Benefits and Services

There are critically important benefits--at both a regional and globa level--to leaving large areas of forest intact. Several authors (Hecht ar Schwartzman 1988, Myers 1988, OTA 1984) note that preservation of biodiversity, maintenance of hydrological regimes, protection of soils against erosion, and protection against possible changes in local and global weather patterns are major ecological benefits of maintaining fores cover. Though they elude economic quantification, these benefits may be c over-riding importance to the region's ecological and economical productivity. Social benefits include the maintenance of the region's

inherent soil fertility and abundance of botanical resources which provide a diversity of employment opportunities. It is also possible that extractive systems act as a barrier to the establishment of land tenure systems that concentrate land control in the hands of a fewer number of large scale economic actors (May 1988).

7.0 Comparison of Different Land Uses

Both economic and ecological criteria are used in evaluating the net present values (NPV) of several types land use in the Petén. The NPV is the value of benefits minus costs for a predetermined number of years, al years evaluated in the present day. In this discussion, NPV is also calle land rent. We compare three land-uses: forests as an extractive reserve for the production xate; milpa agriculture; and an hembra plantation.

Net benefits in each case are derived assuming current management regimes. Land rents will be increased with improved seed varieties and soil management technologies, increased infrastructure and education, increased stocking densities of extractive products, etc. This model allows for no future improvements. We also assume that prices are constant. The time horizon for our analysis is infinite, that is, we assume that the NPV is based on a stream of benefits forever.

7.0.1 Discount Rate

The current discount rate in Guatemala is 9% (IMF 1988). The discou rate is equivalent to the real rate of interest and derived from knowing

the nominal rate of interest (the interest on a bank account) and the inflation rate. We change the discount rate to show the effect different discount rates have on NPV, calculating the NPV at 5%, 9% and 15%. This i done to show the dramatic changes in NPV with changes in the discount rate

An important effect of a high discount rate is that long term investments become more expensive relative to short term investments. The end result is that some renewable resources may be exhausted and long-term sustained development based upon these resources is no longer an option. Conversely, at a lower discount rate, the NPV increases: higher value is placed on returns to land uses in the future. People will make longer-ter investments, recognizing the sustained yield of a resource to be of higher value. For example, at a lower discount rate, individual milperos will likely see value in cutting less forest because they are effectively eliminating future gains in cash income from extractive products and use-value of many forest products.

7.1 Milpa

The short term contribution of forest cutting and burning--'slash and burn'--to soil fertility and agricultural productivity has been extensivel described elsewhere (Nye 1960). A more apt phrase for milpa agriculture i the Petén may be "land rotation cultivation" (Carter 1969). A milpa farme generally makes use of a larger area of land, rotating areas under fallow and cultivation so as to maximize productivity over time, harvesting two crops a year, the rainy season crop being substantially larger than the dr season crop.

Urrutia (1967) investigated the effect of corn production on soil fertility in Uaxactún, north of Tikal. His data substantiate the generall accepted idea that continuous cropping exhibits productivity declines within very few seasons. The nutrient base held in forest biomass and released through burning declines quickly, weed invasion competes with growing space and pests attack crops. As well, the percent organic matter (%OM) in the calcareous clay-rich soils of the Petén is relatively high (>7%). This provides important control over desired soil characteristics, particularly soil structure and capacity to hold nutrients for root uptake and plant growth. However, OM rapidly decomposes as forests are cleared and soil temperatures are increased by direct sunlight. The loss of soil om is reported by several authors (Urrutia 1967, Carter 1969, Cowgill 1962). Productivity declines are often great and by the third year the plot is no longer productive enough to be extensively worked. Urrutia (1967) documents a decline in corn production of 67% within three years. This datum comes from a milpa cleared from 10 years of forest fallow.

To maintain agricultural productivity on a given area of land, 1-3 years of cropping is followed by a fallow period that allows for soil regeneration under forest regrowth. It follows that an increase in the intensity (e.g. close plant spacing) or number of subsequent years of cropping requires a longer fallow period. It also follows that a shortens fallow period intensifies productivity losses without adequate agricultural technologies such as NPK inputs, pesticides and herbicides. Often, shortened fallow periods are the result of increased population densities and pressure for increased productivity per hectare.

For evaluating the NPV of milpa agriculture the following parameters

are necessary. First, average fallow period is 6 years, this after 2 year of cropping.

Second, the net value of first year corn harvests is reported as $54.00/ha by BANDESA. We assume that second year harvests are diminished by 30% and, ignoring fixed and variable costs, place the value of this harvest at $38.00. The actual decrease in harvest volume from year to yea is highly variable; decreases of up to 50% are common (Schwartz--pers. comm.). The dry season is a time of lower productivity; many agriculturalists turn to the forest as a source of income and put less labor into milpa production. Hence, we ignore the cash value of the dry season harvest.

Third, we assume a decrease in net productivity with each cycle. We will model diminishing soil fertility as a decrease in harvest value from cycle to cycle at 0% and 5%. That productivity declines occur is very likely; the exact rate at which they occur is unknown. Actual losses ma be higher or lower.

Finally, the time horizon is infinite. The NPV is based upon the return to cropping corn 2 years out of 8, forever. The data are summarized in Table 4.

7.2 Xate

The value of a commons resource is equal to the gross revenues received from harvesting the resource minus the costs of doing so. Xaterc harvest on average 20 grueso's each day. Each grueso has 110 leaves. The value paid by the contractor is $0.24 and $0.60 per grueso, respectively.

Given that the xatero's costs are food and transportation and annualizing the cost of a machete, boots and a harvesting knife, he spends no more than $2.00 each day. This yields an net value to the resource of $0.127/gruesc jade and $0.50/gruesc hembra.

Natural densities of Chameadorea sp. palm that have been diminished by years of harvesting are on the order of 3000 plants/ha. Each palm yields leaves annually. We assume two scenarios, one with no further plant mortality, and one with 5% mortality each year. We make the simplifying assumption that one half of the species are hembra and one half are xate. The NPV of land used exclusively for the harvesting of xate is presented in Table 4.

7.3 Plantation

Based on the establishment of a plantation for the higher value hembra, the NPV of one hectare of forest can be greatly increased. The owner of one such plantation discussed his costs and benefits with us. Costs include transporting wild populations from the forest to the plantation site, clearing the understory in preparation of planting, insecticides, weeding and harvesting. The benefits include greatly increased land value, the increased quality and value of controlled growin environments, and the potential for agroforestry (discussed below). The NPV under each of the three discount rates is present in Table 4.

7.4 Agroforestry Potential

The hembra plants only utilize the first meter of space, plus they require dense shade. The entire sub-canopy and canopy are available for producing a variety of plant products, including timber. The owners of th plantations we visited were quite well aware of this and spoke of adding a variety of tree crops and valuable hardwoods. The long rotation times of the latter become feasible when understory production provides an economic justification of forest canopy. All of the non-timber products mentioned in this report could be stocked within such a forest system.

7.5 Costs of Maintaining Forests

The major costs of maintaining land exclusively for forest uses are equal to the opportunity costs of not being able to exploit the land for agriculture, ranching or large-scale lumber harvesting. Whether or not these costs outweigh the benefits of forest conservation constitutes a ver complicated analysis, one subject to great political debate. The partial analysis above does begin to indicate the relative costs of various land-use regimes, but even this analysis must be conditioned with a variety of assumptions. An important study (Hecht and Schwartzman 1988) in which th value of an extractive reserve was compared with the land value under both agricultural and livestock uses indicates that the extractive reserve has the higher net present value (NPV).

7.6 Integrative Overview

The comparative economic analysis done in this report is a useful exercise in evaluating the NPV of land as a source of cash income under three different land uses. Conclusions about land use based on Table 5 should be guarded, however, as what is not included far outweighs what is presented. For milpa agriculture, no consideration has been given to important benefits such as non-market production of food, farm animals or the importance of land as a capital asset in an changing economic environment. For natural forest stands with xate, no consideration is mad of the many valuable botanical resources currently or potentially harvested. Nor is much attention given to the forest's role in stabilizin climatic regimes, water and nutrient cycles and as habitat for great biodiveristy. Finally, for the plantation, agroforestry potential was mentioned but not evaluated. In each case the potential for human ingenuity in increasing production is great. This is also excluded from our analysis. Nonetheless, we have demonstrated relative value of land use, albeit narrowly defined. And in the process, we have suggested several important features of the region's ecological and economic structure.

It is in this sense our analysis has merit: the thorough consideration of the economic landscape, the natural resource landscape, c the institutional landscape that attempts to oversee the former two must integrate both forest and people.

Wilken (1977) points to several ecological benefits of forests for agriculturalists. The forest provides fuelwood, fodder, mulch, and

building materials, is the source of soil rebuilding fallow, regulates environmental services, and as is the focus of this report, an important source of cash income. Wilken presents several examples where forests are valued by farmers as important sources of farm inputs in both Guatemala ar Chiapas, Mexico. Schwartz (pers. comm.) mentioned the expressed desire of many Petén farmers to possess a plot of forest for the many uses described above, particularly as a source of xate.

These points of view contrast sharply with traditional perceptions of rural agricultural development in forested regions that have undervalued forest resources. Forest is eliminated both by colonists unfamiliar with the forests economic potential and by institutions that provide credit. the Petén, BANDESA, one important source of credit, provides money for forest clearing. FYDEP recognizes land ownership and titling in the cases where forest has been cleared. Colonists from the south of Guatemala bri with them a concept of land use restricted to milpa agriculture. When newcomers do participate in extractive economies, often improper harvesti techniques kill productive species. Such perceptions of the development landscape are ill-founded, ecologically non-sustainable, and economically inefficient.

The ecological sustainability has been discussed. Economic inefficiency arises from diminished productivity of potentially sustained use of economic resources--in this case the resources are agricultural soils and forest products, both forms of capital potentially being exhausted. Again, however, the rate of exhaustion is not known; it is known only that such decreases in productivity are likely and should be guarded against.

Returning briefly to the premises for this report, we suggest that th extractive products of the Northern Petén, particularly xate, provide an important base for sustained economic activity. Further, we suggest that maintenance of large regions of forest canopy is essential for future rura welfare. That the preservation of forest habitat is necessary for the preservation of biodiversity is obvious. Toward this end we make several recommendations, focusing primarily upon xate but embracing the larger development landscape.

8.0 Recommendations

I. Protection of Productive Regions. Economic yields from the forest depend upon forest protection. USAID should provide political support for the proposed Protected Areas Law and the efforts of COMAMA and CECON. Without the protection and institutional structure provided by the law, promoting any management recommendations that protect xate (and, by association, biodiversity and one form of sustained economic development) will be difficult.

II. Integrated Agency Management. USAID can greatly increase the assistance given to Guatemalan conservation and development efforts:

A. Create a position within USAID/Guatemala Office of Rural Development that focuses on the Petén. In order to effectively coordinate USAID efforts to promote human welfare and the protection of biodiversity, this position should emphasize the following responsibilities:

1. Act as the liaison between USAID and international NGO's and Guatemalan governmental and non-governmental organizations working in the Petén.

2. Focus upon the development of the forestry sector for a sustained yield production of timber and, with specific attention to the guidelines below, assist in sustaining and increasing non-timber forest product production.

3. Place great emphasis upon the potential problems of continued expansion of population into regions of infertile soils. Specific emphasis should address extension services, soil management and other agricultural technologies, credit, the Guatemalan role in providing infrastructure for sustained community development, and the careful identification and elimination of factors of non-sustainability, particularly the continued destruction of forest resources.

B. Institutional support should be given to the proposed Instituto de Areas Protegidas y Vidas Silvestre. Upon the successful passing of the Protected Areas Law, this agency will have the prime responsibility for managing both timber and non-timber forest resources of the Northern Peté

Support may include providing technical assistance and/or funding for the following:

1. Determination of Resource Stock. Economic, ecological and socia valuations and classifications of other types of non-timber forest products (chicle, allspice, medicinals, wildlife, tourism, etc.).

a. At the very least, determination of resource stock is necessary

for the establishment of controlled exploitation zones. Such land u classification will require quantification and mapping of both timbe and non-timber resources. Both field work and aerial photographs wi be needed.

b. A thorough analysis of resource stock, the level of extraction and identification of factors of nonsustainability (overharvesting, improper harvesting techniques) are necessary for establishing long-term management criteria. We have laid the groundwork for such an analysis for xate in this study, and this model can easily be applie to other resources.

c. The identification and elimination of market inefficiencies is a important role of government institutions. Harvesting of poor-quality leaves in the xate industry is one example of a market inefficiency. Steps taken by government bureaucracies to eliminate this problem are discussed below. Such regulatory policies constitute the primary role of government in promoting the sustained use of forest resources.

d. Evaluate the benefits of enhancing natural stand densities of forest products with artificial plantings.

2. Integration of people and the forest.

a. Management organization that accommodates local populations, biological sciences and the institutional structure of a government bureaucracy is not easy (Hough 1988). In the end, the local people with vested economic interest in forest resources are the forest managers. These individuals or entities include a cooperative of xateros (discussed below), and individuals involved in either

transporting or exporting non-timber forest products. Meetings or an other efforts to communicate institutional intentions to local populations, and in turn modify these intentions based upon local needs and desires is essential.

b. Provide financial support for the University of San Carlos/Santa Elena program in forestry and natural resource management. The curriculum is very strong but the new institution is short on money for instructors, literature and field work. Additional support could come from supporting visiting faculty to assist in program developmen and instructing. Individuals from this program are likely candidates for forest management in the Northern Petén.

C. Several international organizations have become interested in the Petén (World Wildlife Fund-US, International Union for the Conservation of Nature, Conservation International). USAID management burdens can be reduced by enlisting the experience and effort of these organizations. It is important that Guatemalans coordinate any foreign assistance. International organizations should be particularly interested in research that will substantiate the development of an integrated management plan fo the forests.

D. The forest reserve system proposed for the Northern Petén is compatib with the Biosphere Reserve System of UNESCO. Efforts should be made to include regions of the Petén within the biosphere reserve system.

III. Measures for Sustained-yield management of Xate

A. Cooperatives. The establishment of cooperatives, for both xateros an contratistas, is essential to any future wise management of the xate. Bo forms of cooperatives have been formed in the past specifically for the

purposes of protecting the resource but have failed due to a lack of resources for communication over great distances and the serious limitations of illiteracy. Cooperatives will provide representation to the government in setting management objectives. They will also make possible several of the recommendations listed below.

B. Eliminate destructive harvesting. Such practices as cutting poor quality leaves, cutting all the leaves on a plant, cutting the meristem an uprooting the entire plant must be reduced. There are two basic methods. First, a system of inspectadores/selectionistas working in the camps would ensure that the xatero harvests only high quality leaves. These inspectadores could be older, experienced men who can no longer easily harvest xate, but who understand the process well and command the respect of the xateros. Second, cutting quality instead of quantity requires financial incentives and/or disincentives. The xatero must be paid well for good leaves selected in the field, before cutting. The resulting reduction in leaf volume and weight, most of it the 40-60% waste, cuts transportation and processing costs. The source of a higher wage to the xatero would come from these savings. The contratistas are paid for quantity as well. Hence the incentives must come from the exporters; the motivation comes from the ability to continually supply high quality leave to the international market, an ability that is not likely to continue under current pricing and management regimes that reduce plant populations

C. Concessions. Develop a system to assign rights to a particular area o forest for the extraction of xate to be administered by the Instituto de Areas Protegedas y Vidas Silvestre. By establishing such a system, personal responsibility for the resource--and future profits--is enhanced.

eliminating the tragedy of the commons problem that is currently occurring

D. Nurseries. Nurseries provide for the enrichment of natural forest areas with seedlings of xate. This can occur in areas already overharvested or in small private forest holdings. The enrichment of natural stands or plantations provides strong fiscal incentive at the loca level to preserve habitats by increasing forest value.

IV. Research Priorities

A. Xate

1. Ecological.

a. Longitudinal studies in a variety of controlled environments for the purpose of determining the effect of defoliation on growth, reproduction and survival of Chamaedorea sp.

b. Studies of floral and pollination biology to more clearly understand the reproductive ecology of xate.

c. Studies of the rate, degree and geographical extent of hybridization among Chamaedorea sp throughout the Petén. Identifying variability in such plant qualities as leaf growth and size allows f: high quality hybrids to be developed.

d. Large-scale mapping of the forest environments in which xate occurs, for the purpose of more accurately determining the overall biological resource base.

2. Economic.

a. Evaluation of the contribution to cash income of the xate harvesting to the small scale agriculturalist. This will provide an analytical base for policies that promote a mosaic of forested and

agricultural lands.

B. Landscape Development

1. Development of integrated management schemes for both timber and non-timber products that allow both types of exploitation to coexist, while exploiting the large biodiversity of the tropical forest.

a. Baseline ecological studies on the sustainability of agricultural expansion in the Petén.

b. Baseline social studies on the dynamics of agricultural expansion (productivity over time, colonist failure/success, problems of health education, credit infrastructure, market infrastructure) predicated o both the prediction and, thereby, avoidance of serious social problems, and for the identification of alternatives to short-term, ecologically and economically destructive activities.

c. Diversification of agricultural systems to include agroforestry ar tree crops.

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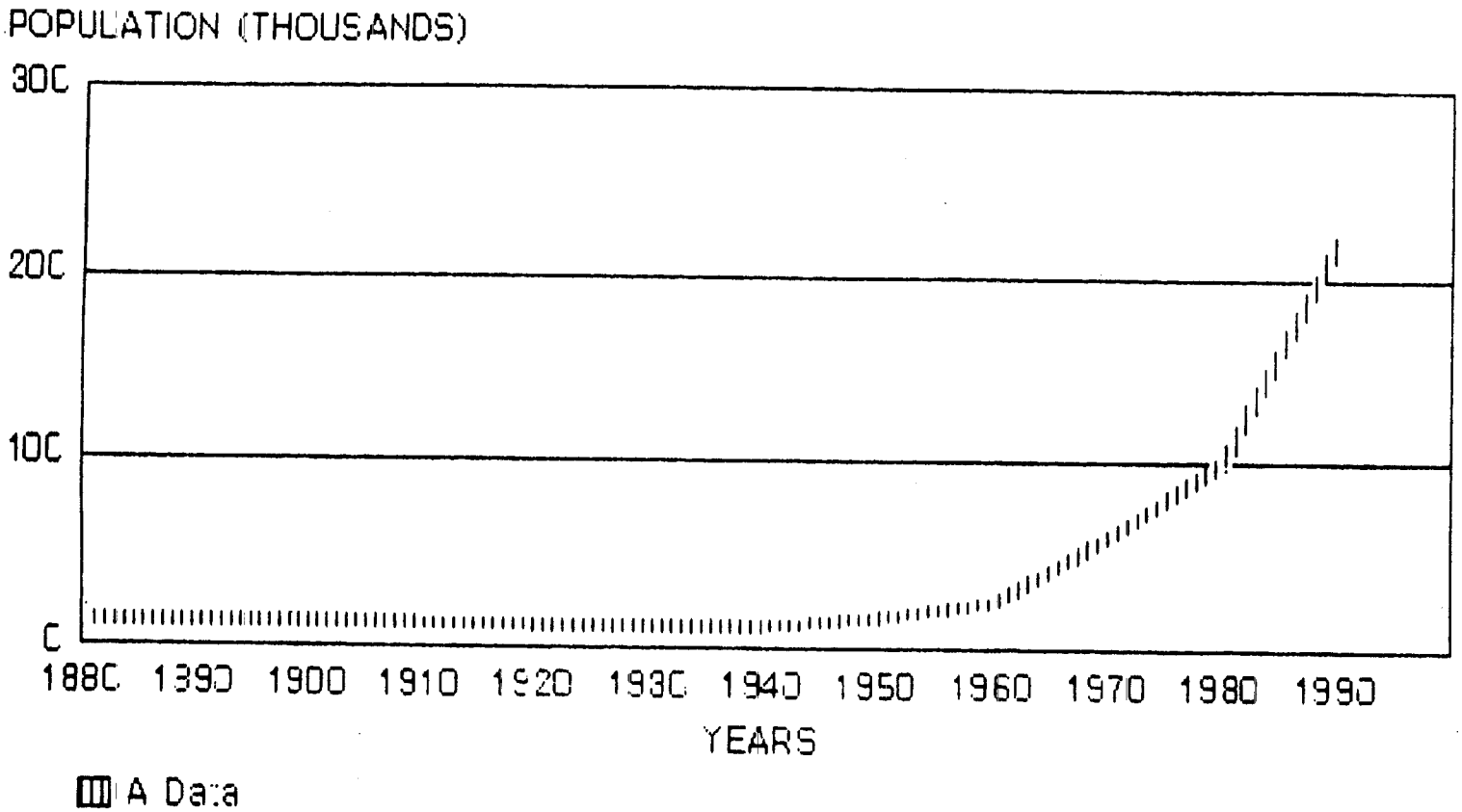
FIGURE 1. POPULATION GROWTH IN THE PETEN: 1880-1988



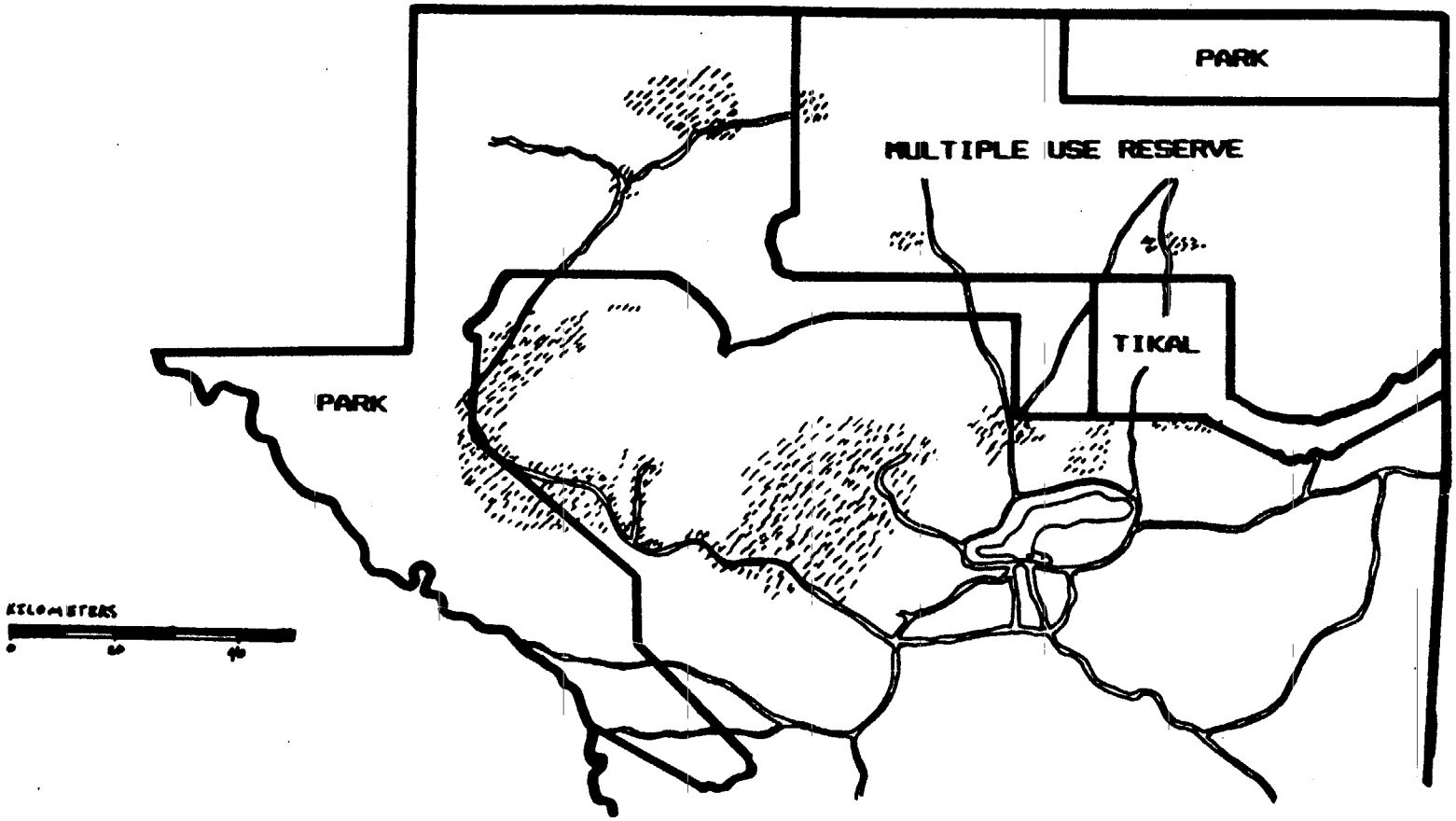


FIGURE 2.

Park and multiple use reserve system proposed by the Protected Areas Law and existing system of major roads. Stipling indicates areas of forest fires in 1987. Adapted from original map by Santiago Billy, Science Advisor, Comición Nacional del Medio Ambiente.

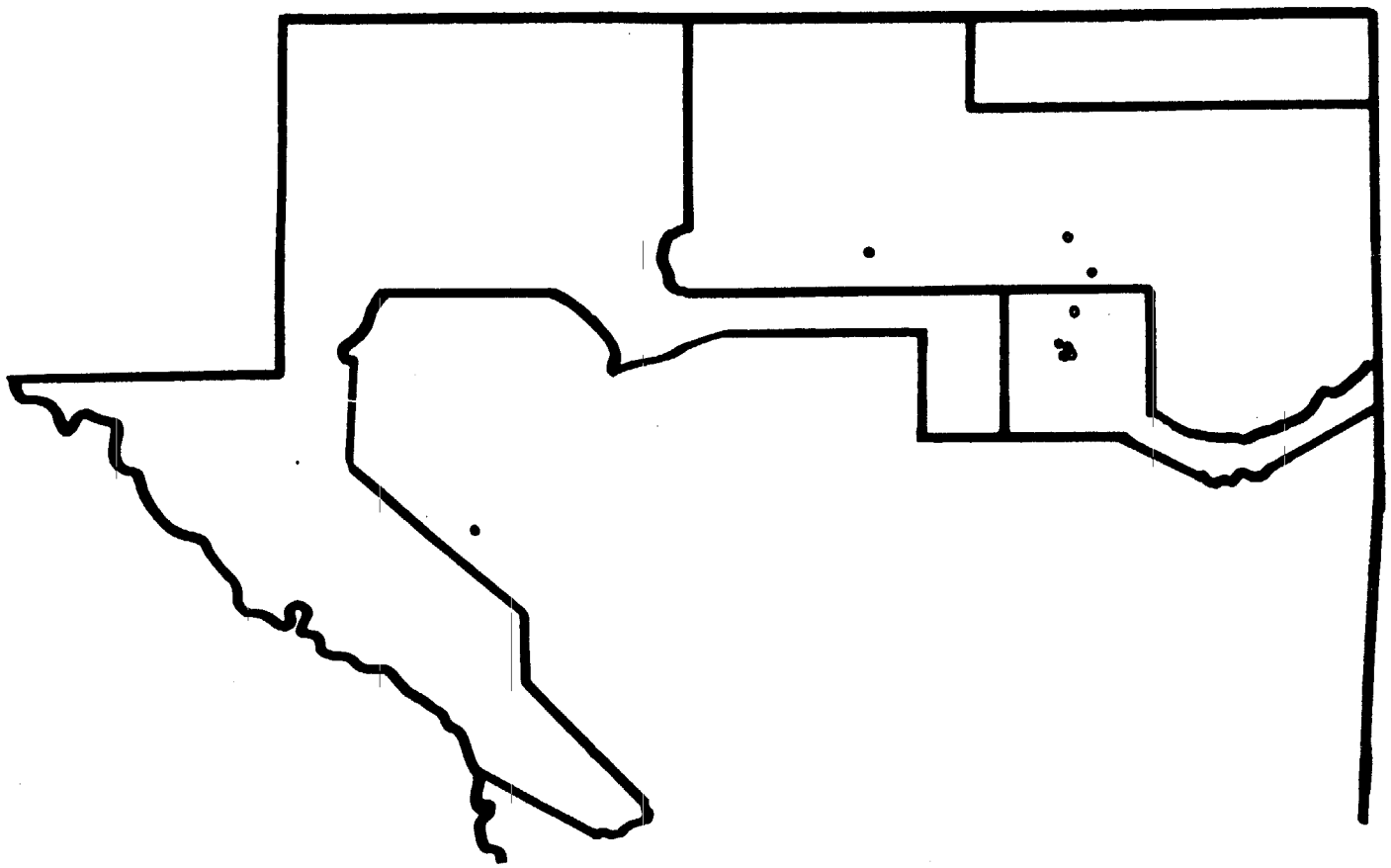


FIGURE 3.

Location of transects for ecological studies.

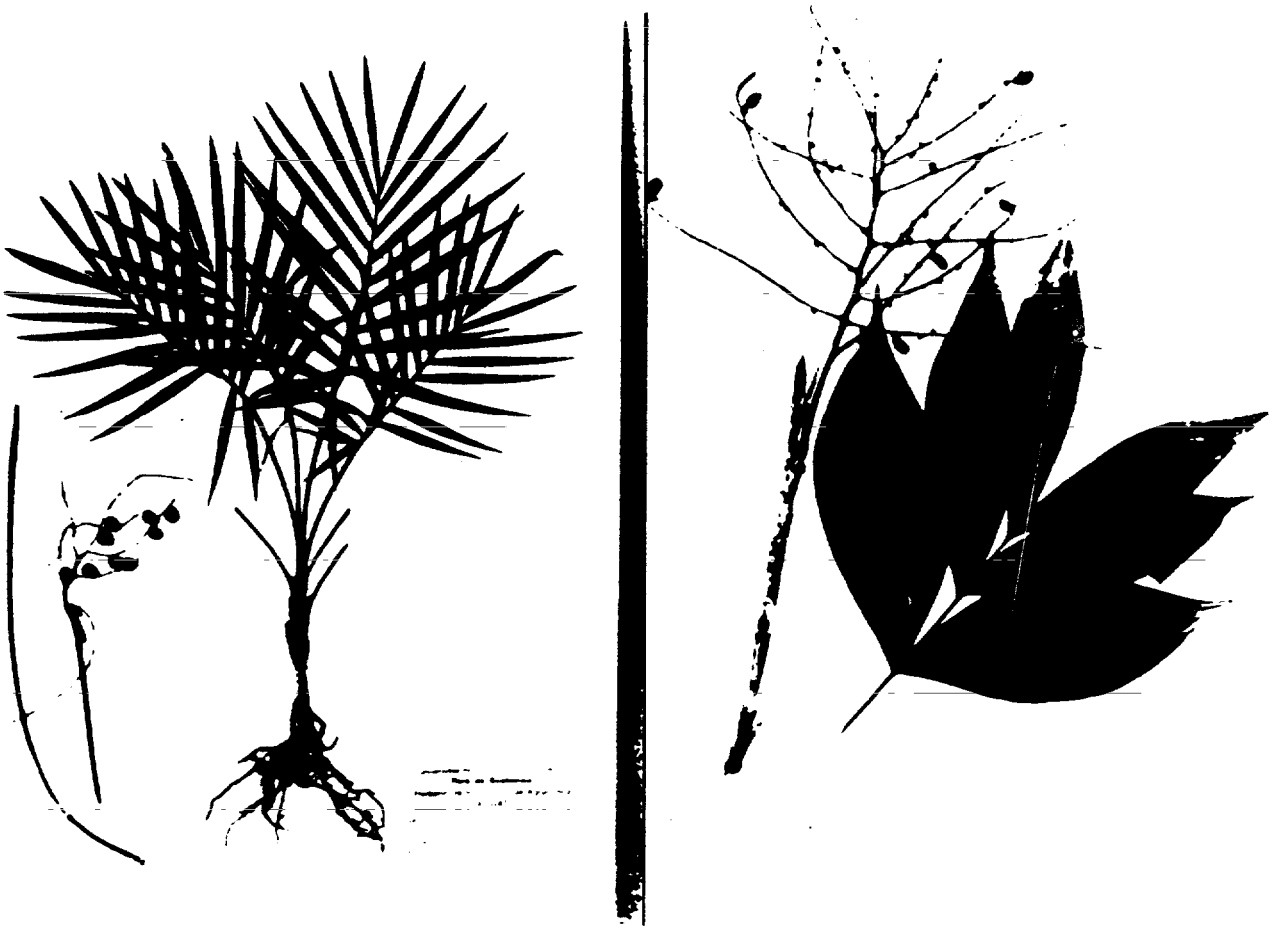


FIGURE 4. BOTANICAL SPECIMENS OF CHAMAEDOREA ELEGANS (LEFT) AND CHAMAEDOREA OBLONGATA (RIGHT)

FIGURE 5.

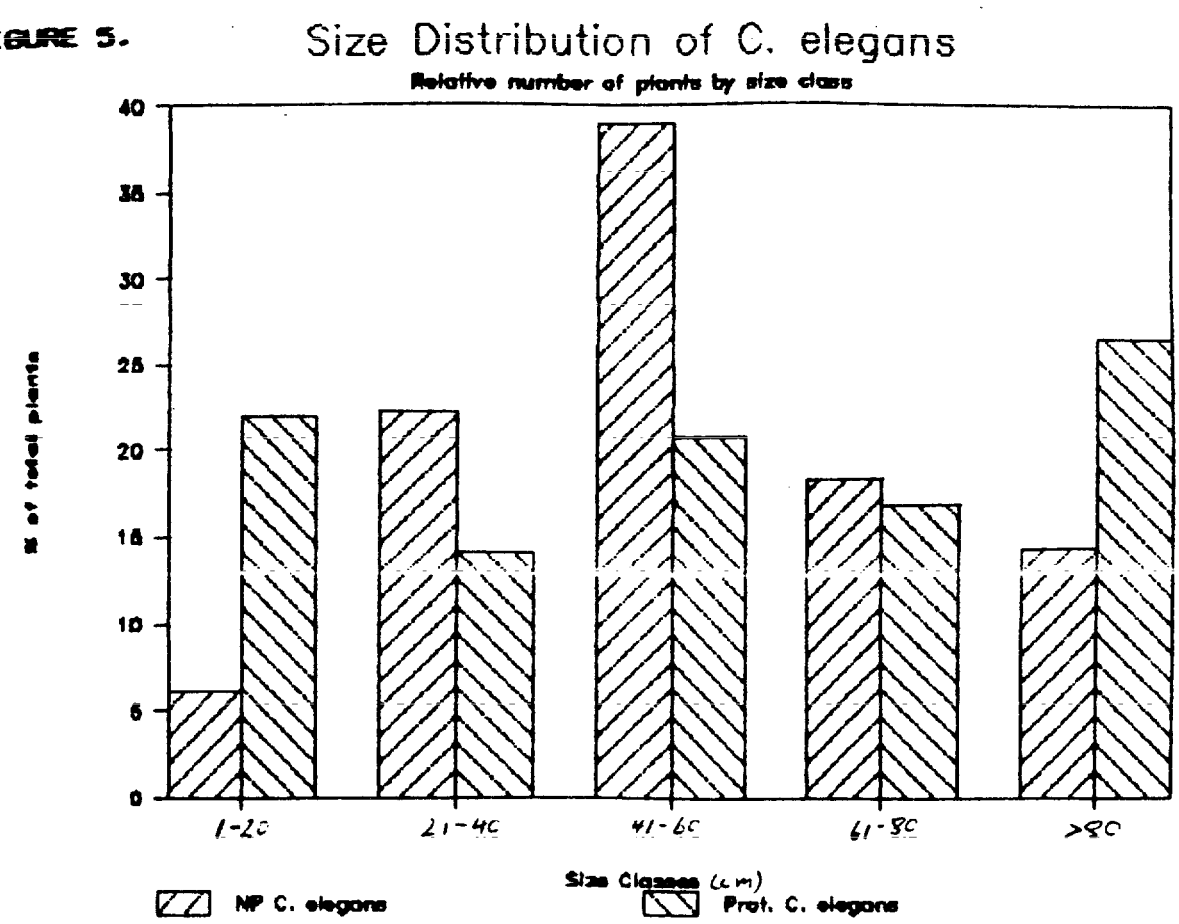


FIGURE 6.

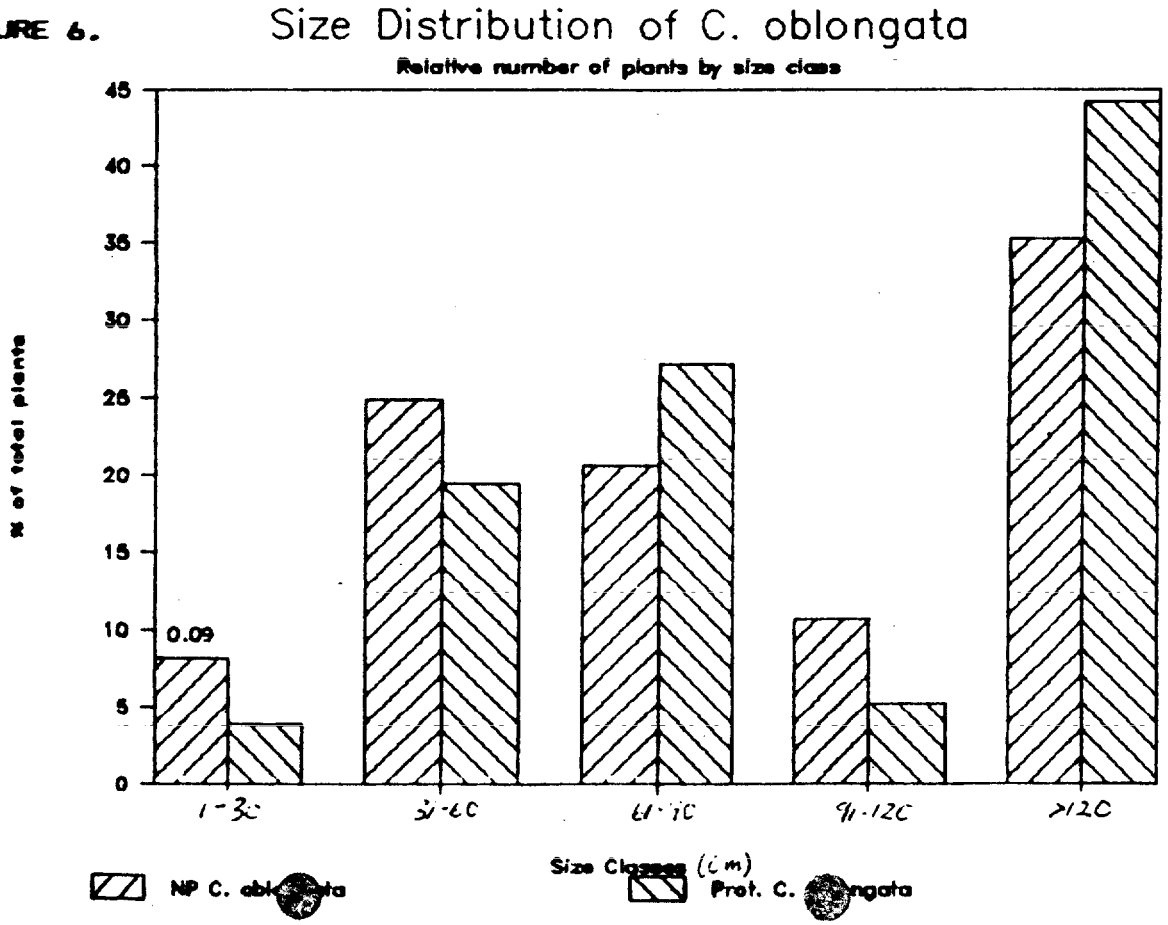


FIGURE 7.

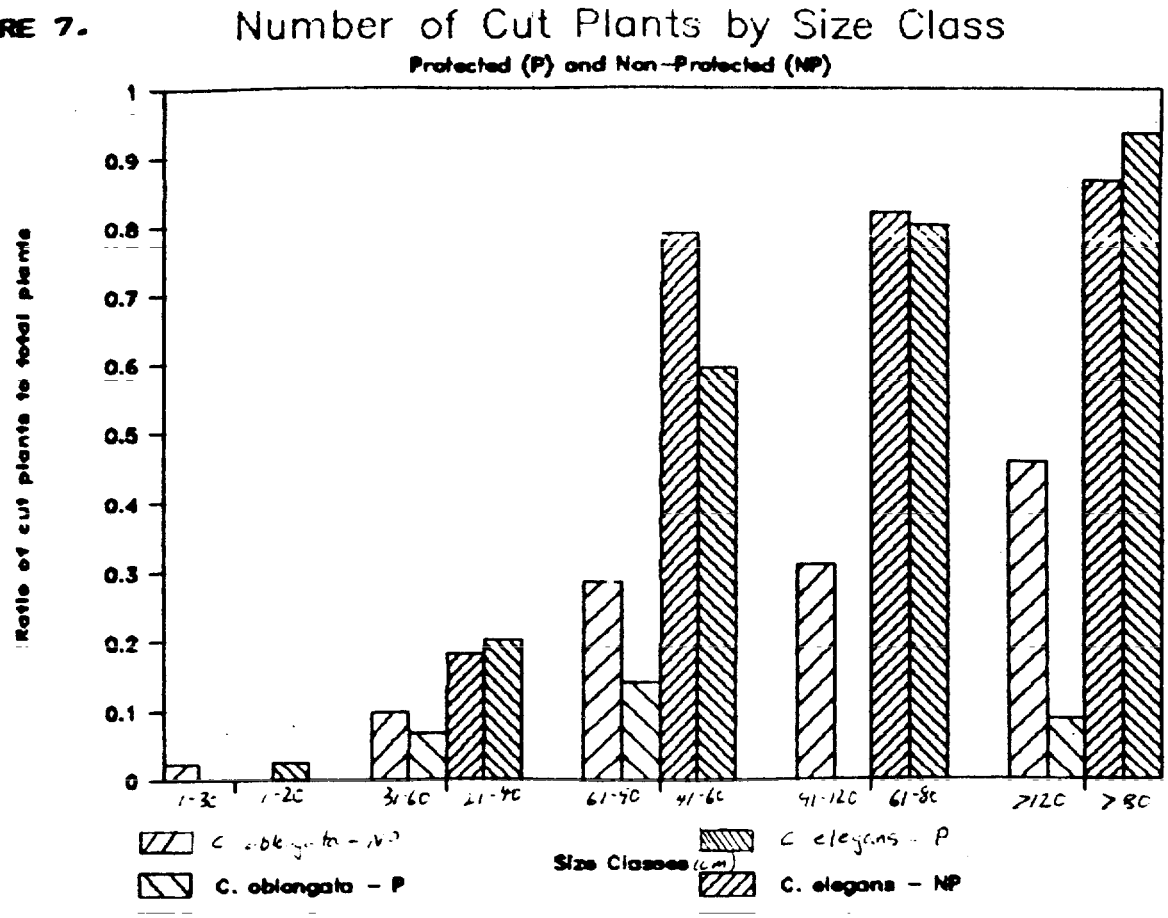


FIGURE 8.

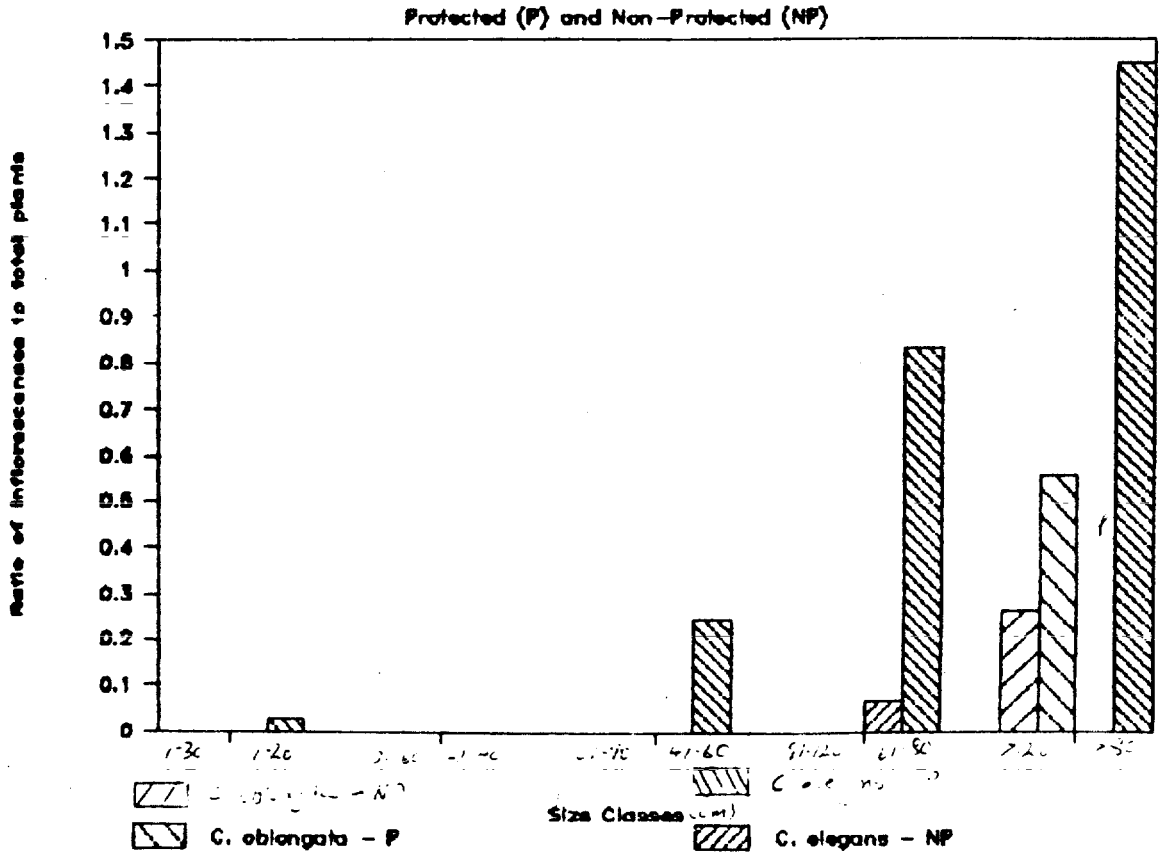
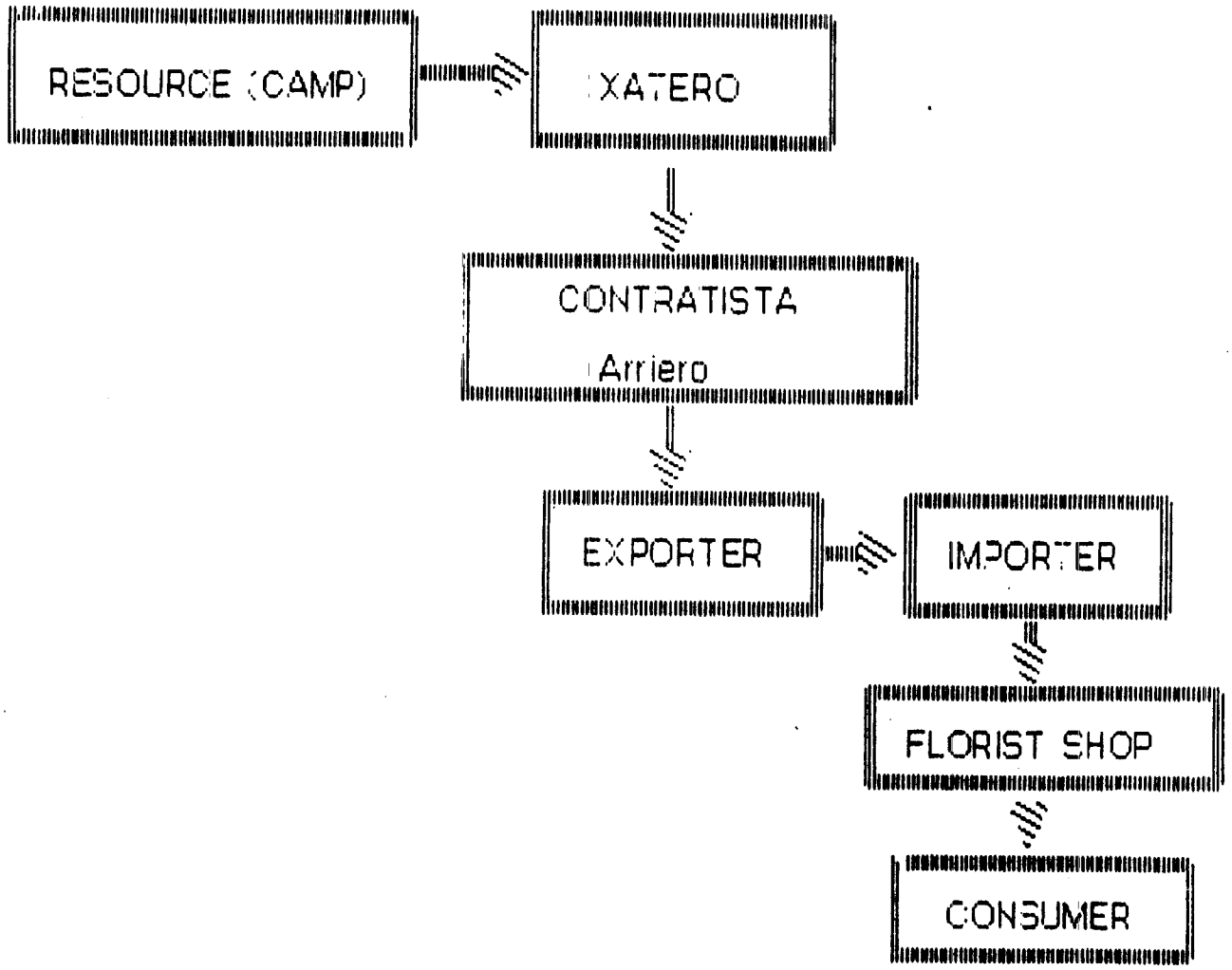


FIGURE 9. GRAPHICAL REPRESENTATION OF THE MARKET FOR XATE PALM



U.S. IMPORTS AND GUATEMALAN SHARE OF MARKET*
(in million of stems)

Year	Guatemala	% share	Mexico	% Share
1979	165.4	37%	275.8	63%
1980	107.5	27%	287.4	73%
1981	77.6	23%	254.6	77%
1982	72.9	23%	246.8	77%
1983	25.8	11%	216.6	89%
1984	31.5	12%	233.3	88%
1985	53.0	15%	290.0	85%
1986	40.0	11%	314.0	89%
1987	72.8	17%	350.0	83%

* Source: F&V Market News. Washington, D.C.:USDA.

TABLE 3. GROSS BENEFITS

Entity	Xatero	Contratista	Exporter
# in Market	5-6000	120	7
Production Unit			
jade (# leaves)	110	110	55
hembra (# leaves)	120	120	70
Value (Quetzales)			
jade	0.50-0.70	0.80-1.00	1.08-1.56
hembra	1.40-1.60	1.70-1.90	1.91-2.50
Gross Profit *			
jade	46%	19-28%	26-36%
hembra	64-73%	12-17%	11-24%

TABLE 4.

COMPARATIVE ECONOMIC ANALYSIS: XATE EXTRACTION, PLANTATION AND MILPA AGRICULTURE

Net present value of different land-uses

Discount Rate	Milpa Decline (%/cycle)	NPV (per/ha)	Xate Extraction Mortality (%/year)	NPV (per/ha)	Plantation
5%	0%	$406.87	0%	$684.00	$7,062.58
	5%	$163.44	5%	$342.00	
9%	0%	$172.53	0%	$380.00	$3,406.56
	5%	$129.51	5%	$244.30	
15%	0%	$123.83	0%	$228.00	$1,356.87
	5%	[illegible]08.42	5%	$[illegible]1.00	