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Maya Mopan farmers in southern Belize face socio-economic hardships, persisting environmental constraints, and an unfavorable political climate that has prevented land tenure stability on reservation lands. This thesis describes the agricultural practices of a group of Mopan farmers and examines farm-site diversification and its relationship to ecological knowledge, out-migration, agricultural markets, and indigenous political systems. I also examine how modernization, religious conversions, and the Mopan's introduction into a capitalist economy have led to a decline in cultural practices and the augmentation of non-traditional behaviors among the younger generations.

Data were obtained during my fieldwork in the Cayo and Toledo Districts of southern Belize from June-November, 2002. I conducted informal interviews with farmers and NGOs, engaged in participant observation techniques, documented 17 diversified Mayan farms, and formulated a self-administered questionnaire that was given to 38 students in the San Jose Village School. Additional data was acquired through voluntary work in farmers' fields and from available anthropological and agricultural literature.

The results of this study indicate that Mopan farmers have diversified their farming systems by adopting new crop varieties, developing more sustainable agricultural techniques, increasing the production of cash crops, and adjusting their traditional labor systems. These findings are significant because they demonstrate ways in which farming

communities throughout the tropics can improve their environments and economies amidst the influences of modernization, unsustainable development, and discriminatory government policies.

# The Benefits of Diversified Agricultural Systems Among Maya Mopan Farmers in Southern Belize

By
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Derek M. Hofbauer, Author

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# The Benefits of Diversified Agricultural Systems Among Maya Mopan Farmers in Southern Belize

## 1. Introduction

The Mopan Mayas have a long history of occupation in the lowland areas of Guatemala and Belize. The Mopan's knowledge of local environments and traditional agricultural systems has enabled them to become a distinct and growing contemporary indigenous group throughout areas of southern Belize. Mopan farmers utilize shifting cultivation techniques (slash-and-burn, slash-and-mulch) and agroforestry systems for sowing crops in their tropical environment. Staple crops such as corn, beans, rice, squash, peppers, tomatoes, and cacao were once cultivated primarily for subsistence purposes; however, traditional Mopan agricultural and labor systems have changed in the past 20 years in response to deforestation, growing markets, a cash economy, development pressures, and new educational and employment opportunities.

Mopan communities in southern Belize face many socio-economic and political concerns as they fully integrate into a contemporary Belizean society. Modernization and the influence of Protestant religious groups have led to a decline in traditional practices in Mopan villages. In addition, discriminatory government policies have left the Mopan with no legal rights to reservation lands they depend on for agriculture, hunting, and gathering non-timber forest products. Recently introduced development projects and unsustainable logging activities further threaten these resources that are vital to the preservation of the Mopan's culture and economy.

Can agricultural diversification help Mopan farmers to overcome many of these socio-economic, political, and environmental constraints? Agricultural diversification strategies have often been overlooked in Belize as a necessary tool for sustainable development. Recent literature (Anaya 1998; Steinberg 1998, 2002; Wilk 1991) concerning the Mayas in southern Belize has focused primarily on land-rights issues, uses of forest resources, cacao farming, household economies, and the influences of modernization. Researchers have yet to comment specifically on the importance of diversification strategies to Mayan farmers. The purpose of this study is to provide data that examines the possible benefits of diversified agricultural systems to Mopan communities. The findings in this paper provide a detailed analysis of diversified Mopan agricultural and labor systems, followed by a discussion as to how these systems can help alleviate many of the problems that indigenous Mayan groups face in southern Belize.

Data for this study was collected with predominately Maya Mopan farmers in the Cayo and Toledo Districts of Belize. My research methods consisted of participant observation technique and informal interviews with both the younger and older generations in Mayan households, as well as with members of non-governmental organizations (NGOs). While working on 17 diversified Toledo Mayan farms, I recorded information concerning household labor resources, cultivation techniques, types of crops planted, animals and livestock, and other income generating activities. I also administered a survey to 38 Mopan students in San Jose Village to obtain additional information regarding family labor resources and farming strategies, as well as the educational and occupational objectives of the younger generation.

I focused on southern Belize as my primary research area because the Mayas who live there face growing pressures from the outside world. Their struggle to obtain land rights, conserve forest resources, and preserve a traditional agrarian way of life draws many parallels to other marginalized farming societies throughout underdeveloped countries. Thus, cross-cultural comparisons are an important component of this research. Examining the causes and effects of socio-economic, political, and environmental changes within tropical smallholder communities allows for a greater understanding of why Mopan farmers have diversified their agricultural systems.

This thesis is presented in 12 chapters. Chapter two covers the ecology and history of the study region, as well as land-rights issues that pertain to Mayan populations in the Toledo District. Chapter three includes a literature review of sustainable agricultural systems, agroforestry practices, and cacao cultivation in the humid tropics. Methods and delimitations are discussed in Chapter four, which is followed in Chapter five with a thorough description of agriculture, labor systems, and cooperative farming groups in the study region. Chapter six provides a description of cacao cultivation by the Mayas in southern Belize, as well as crop damage incurred from Hurricane Iris in 2001. Socio-economic concerns such as cultural changes, out-migration, and ecotourism ventures are presented in Chapter seven.

Ecological theories are discussed in Chapter eight to explain how modernization, agricultural intensification, religious conversions, political associations, and environmental changes have affected the Mopans' traditional agricultural and labor systems. Chapter nine lists the data that was accumulated on 17 diversified Mayan farms, which is followed by a discussion section in chapter 10. Chapter 11 provides an analysis of the survey that was administered to 38 Mopan students in San Jose Village and Chapter 12 includes the conclusion and recommendations.

## 2. The Study Region

Traditional Mayan agricultural techniques have evolved over thousands of years to meet the demanding ecological conditions found in tropical and sub-tropical forests throughout Central America. The Mopan's original homeland was in the San Luis Peten region of Guatemala; however, many Mopan families migrated across the border into British Honduras (present-day Belize) during the 1850's to escape socio-political and environmental problems. The San Luis Peten region and new settlements in southern Belize share a similar geography and climate; thus, Mopan farmers had few difficulties adapting to their new surroundings.

When the Mopan established villages throughout British Honduras, they had an unrestricted access to forest resources. This changed, however, when the British Honduras government began exploiting timber resources in Mayan occupied areas. Reservation areas were established during the 1920's, thereby restricting the Maya's access to agricultural areas and non-timber forest products. Eighty years later, discriminatory government policies towards the Mayan land tenure in the Toledo District still exist. The Mopan and other Mayan groups have recently gained the support of NGOs and legal agencies to defend their land rights case against the Government of Belize.

### Pre-Columbian Mayan Lowland Occupations

Pre-Columbian Mayan populations flourished in the lowland tropical areas of Belize, Guatemala, the Yucatan, and parts of Honduras and El Salvador during the Middle Preclassic Period (1,000 – 300 B.C.) up until the collapse of their civilizations in the Late Classic Period (600 –900 A.D.)(Willey 1987). The Mayas relied on a swidden (shifting cultivation) system of agriculture for the production of maize, which was a highly valuable and sacred plant. Beans, squash, peppers, and cacao were also cultivated in *milpas* (diversified cornfields) or in kitchen gardens. It has been suggested by archaeologists (Harrison and Turner 1978) that the swidden agricultural system alone could not support the population densities that were found in the Maya's urban centers (up to 200 people per square kilometer). Lowland Mayan populations most likely intensified their agricultural production through the following methods: "short-fallow *milpas*, made possible by various techniques of crop rotation, companion planting or intercropping, hand weeding, mulching, and fertilizers; multiple annual cropping; kitchen-garden farming; the production of diverse crops, including root crops and tree crops (especially the ramon nut); terracing; and raised-field farming, either along active streams or near still water" (Willey 1987:98). The development of these agricultural techniques enabled the Mayas to produce a surplus of agricultural goods, which resulted in the formation of important political, economic, and religious centers throughout many areas of the lowlands.

Although agricultural intensification allowed the Mayas to develop complex city-states and urban centers, it may have also led to the collapse of their civilizations during the Late Classic Period. Population pressure, declining soil fertility, erosion, and the over-exploitation of forest resources were all thought to have contributed to the Maya's demise, along with other variables such as socio-political organization, warfare, natural disasters, disease, trade, and religion (Willey 1987). Willey (1987) indicated that there were four major causes for agricultural problems in lowland Mayan societies. He noted first that the expansion from prime agricultural areas had eventually led to more demanding agronomic techniques (soil erosion, fertility measures, and wetland cultivation). Cultivating additional lands had also contributed to the over-exploitation of forest resources and game animals. Second, the shortening of fallow lengths may have contributed to increased weed and pest infestations, as well as plant diseases. Next, periods of drought and excessive rainfall combined with the possibility of natural disasters such as hurricanes could have resulted in major crop losses. Finally, Wiley mentioned, "The variations in population distribution and in agricultural production made increasingly necessary augmentation in the capacity and network of food storage and distribution" (Willey 1987:46). In other words, the Mayas' changing agricultural systems had a far-reaching effect on population growth, subsistence patterns, and trading networks throughout the lowland areas (Willey 1987).

The collapse of the Mayan civilization did not fully disrupt traditional agricultural activities. Mayan groups who remained in the Central American lowlands during the era following the Late Classic Period still engaged in swidden agriculture and continued to rely on forest products and wild game for subsistence. During the sixteenth and seventeenth centuries, warfare and disease brought about by the Spanish Conquest dramatically reduced Mayan populations. The Mayas survived through this period of colonialization and slowly repopulated areas throughout Mexico, Guatemala, Belize, and Honduras.

## The Toledo District in Southern Belize

In *Household Ecology,* Wilk (1991) provided an excellent historical ethnography of southern British Honduras (British Honduras became Belize after independence in 1981). The Chol Mayas were perceived to have been the original inhabitants of British Honduras before the Spanish Conquest. The Spanish attempted to exploit the Chols as a labor source on plantations, but they often resisted by fleeing into the jungle. Early reports from European travelers indicated that indigenous groups (presumably the Chol Mayas) inhabited the Temash and Moho river valleys in southern British Honduras between 1677 and 1867 (Thompson 1972; Swett 1868). It is assumed that the Chol Mayas intermarried with other Mayan ethnic groups who migrated to Belize in the 1800's.

Wilk also described in detail the development schemes that were initiated by the British to exploit forest resources for agricultural expansion and timber. Between 1839 and 1859, a large percentage of mahogany trees in the Toledo District were extracted and exported back to Europe. After the market collapsed, the logging companies invested in plantation agriculture, which eventually failed due to a lack of reliable labor resources and poor infrastructure within the Toledo District (Wilk 1991).

During the 1850's, groups of Mopan and Kekchi Mayas migrated from Guatemala into British Honduras to avoid forced labor, land pressure, and high taxation (Steinberg 2002; Wilk 1991). The Mopan left the San Luis Peten region of Guatemala and started new villages across the border in Pueblo Viejo and San Antonio. The Kekchi Mayas occupied lands in the Alta Verapaz Department in Guatemala, but some men and women migrated to San Luis Peten and intermarried with the Mopan. A group of Kekchi Mayas was also brought over from Guatemala by the Cramer family in 1881 to serve as laborers on a large cacao and coffee plantation in San Pedro Sarstoon. Soon afterward, other Kekchis left Guatemala and established villages in San Pedro Columbia, Aguacate, and in other areas of southwestern British Honduras (Wilk 1991).

In 1924, the colonial government set up the reservation system for each of the recognized Indian villages in Toledo (Wilk 1991). This system did not allow the Mayas to own land, nor did it allow the recognition of communal land rights. The Mayas survived economically by participating in wage labor, raising pigs, and selling crops such as cacao, coffee, bananas, and copal incense to local villages and cities to the north (Wilk 1991).

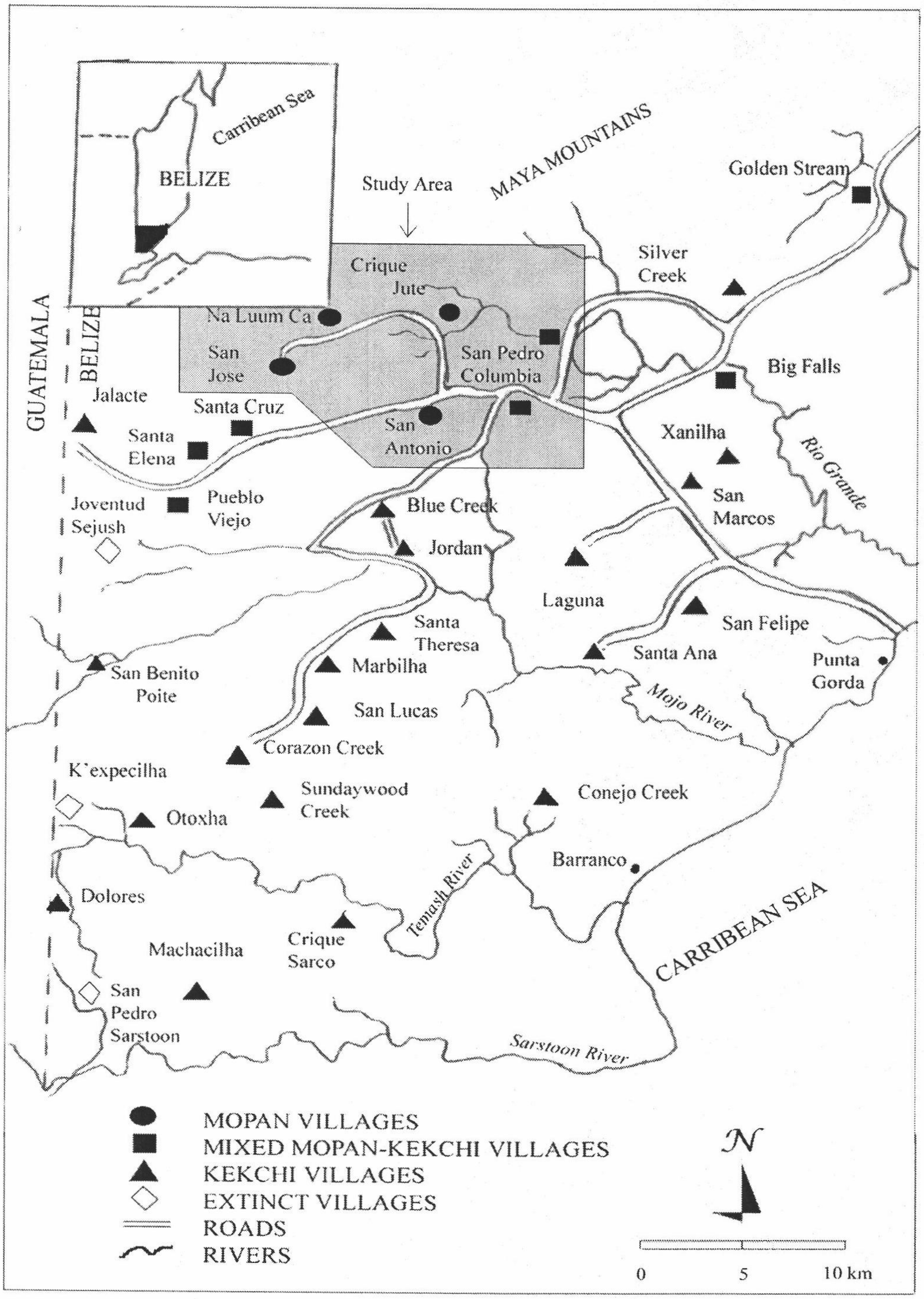
During the 1960's, a highway was constructed connecting Punta Gorda with northern Belize (Wilk 1991). This resulted in further migrations for some Kekchi and Mopan groups who were seeking new farmlands and employment opportunities. The new settlements were located in Big Falls, Indian Creek, and Golden Stream, all of which border areas of pine savannah (Wilk 1991). Government development projects increased after the completion of the Southern Highway, and large sections of land were sold to foreign investors for timber and cattle production. These projects failed due to high maintenance costs and inaccessible markets. During the 1980's, large banana and citrus farms were established along the highway. These plantations allowed men and women from rural Toledo villages to pursue seasonal wage employment (Wilk 1991).

Of all the development schemes that have come and gone in the Toledo District, intensive rice production is perhaps the most significant in terms of regional and national economies. Small farmers in Toledo produce between one-third and one-half of Belize's national consumption (Wilk 1991). Modern equipment and technological packages were subsidized to Toledo Farmers, which enabled them to clear large sections of land, cultivate it for four years, and let it fallow for eight to 10 years (Wilk 1991). In 1980, some Mopan and Kekchi farmers living in northern Toledo villages developed an organized and profitable system of mechanized rice production. They formed a grain-growers cooperative and utilized traditional labor groups to grow a few hundred acres of rice for export (Wilk 1991). The success of rice farming in Toledo has encouraged the government to continue to invest in extension services and technological packages that are orientated to small farmers (Personal communication, Chris Nesbitt, 9-27-02).

The town of Punta Gorda has the highest population density in Toledo, which is comprised mostly of Mopan and Kekchi Maya, Creole, Meztizo, Garifuna, East Indian, and British and American ex-patriots. Mayan men who live in Punta Gorda often work as wage laborers, shopkeepers, or in the tourism sector. In the rural sections of Toledo, over 15,000 Mayas reside in the 24 villages that were established throughout southern Belize (TMCC 1997). The development of shrimp, banana, and citrus farms along the Southern Highway has allowed Mayan men to find seasonal employment. The Mayas who wish to remain in their villages year-round earn wages through cash cropping, selling animals and livestock, shop keeping, and by participating in ecotourism projects. Although basic costs of living can often be met through these income-generating activities, Mayan villages still have high rates of poverty and insufficient educational systems. The Maya Atlas mentions the following:

> The Mayas of Toledo are faced with numerous, severe socio-economic and political problems. The educational system is woefully inadequate, and consequently the illiteracy rate of the Mayas is the highest in the country. The Mayas are often called the 'poorest of the poor' in Belize, with government statistics indicating that the average annual family income is only US $600 per year.
> (TMCC 1997)

Figure 2.1
Mopan and Kekchi villages in the Toledo District




Redrawn from Wilk (1991:58)

Table 2.1
Population of the Toledo District by Ethnicity
Source: Belize Population Census 2000, Central Statistical Office

| | 2000 | 2000 | 1991 | 1991 |
|---|---|---|---|---|
| **Ethnicity** | **Total** | **%** | **Total** | **%** |
| Total | 23117 | 100.0 | 17486 | 100.0 |
| Black/African | 5 | - | - | - |
| Caucasian/white | 155 | 0.7 | 143 | 0.8 |
| Chinese | 12 | 0.1 | 8 | 0.0 |
| Creole | 1226 | 5.3 | 1003 | 5.7 |
| East Indian | 1452 | 6.3 | 1381 | 7.9 |
| Garifuna | 1539 | 6.7 | 1751 | 10.0 |
| Maya Kekchi | 10585 | 45.8 | 7122 | 40.7 |
| Maya Mopan | 4525 | 19.6 | 3825 | 21.9 |
| Maya Yucatec | 19 | 0.1 | 41 | 0.2 |
| Mennonite | 125 | 0.5 | 15 | 0.1 |
| Mestizo/Spanish | 3384 | 14.6 | 2080 | 11.9 |
| Other | 69 | 0.3 | 117 | 0.7 |
| DK/NS | 21 | 0.1 | 0 | 0.0 |

Table 2.1 shows total populations and ethnic diversity in the Toledo District over a 10 year time period. In the 2000 census, Kekchi and Mopan ethnicities made up 65.4 percent of the total population, which is almost a three percent increase from 1991. Kekchi Maya, Mestizo/Spanish, Mennonite, and Caucasian populations are the only other ethnic groups to have increased in population during the 1990's. Maya Mopan populations experienced a decline of 2.3 percent from 1991 to 2000. This trend may suggest an increase of out-migration in Mopan villages, which may be attributed to increased development along the Southern Highway. In 2002, the population of San Jose Village was around 650 persons. This number has remained steady throughout previous years despite a relatively high birth rate in the village (Field Notes, 10-21-02).

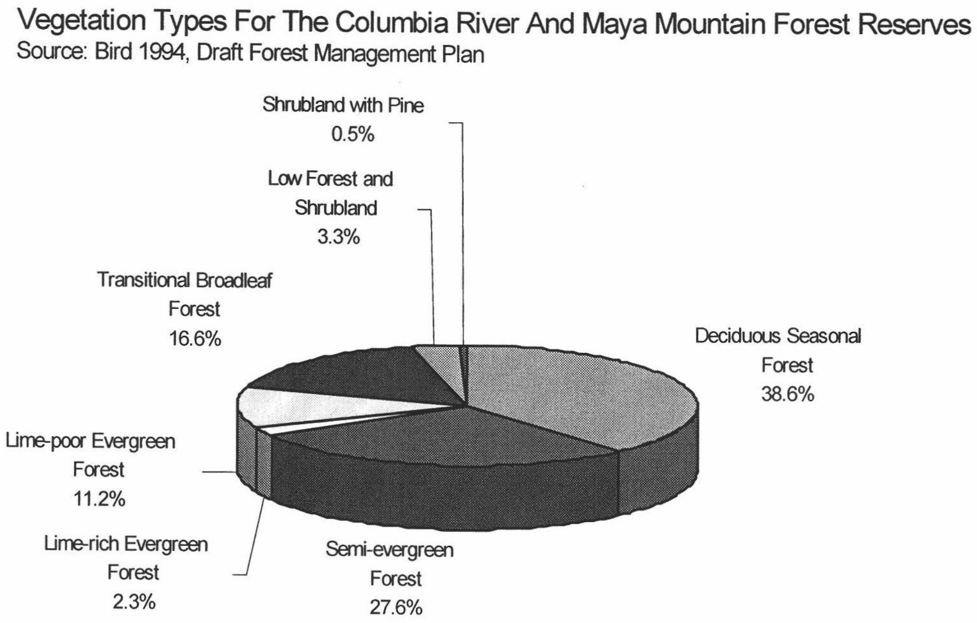
## The Ecology of Southern Belize

The Toledo District in southern Belize stretches from the southern coast up to the Maya Mountains and borders Guatemala to the West. Within Toledo, land is categorized into two provinces - upland and lowland (Wilk 1991). The elevation in the

Toledo District is less than 1000 m and Mayan villages lie in areas that are lower than 400 m (Wilk 1991). Rainfall is ample, with up to 180 inches annually, and the rainy season lasts from June through December (TMCC 1997). The ground formation in the uplands consists mostly of limestone with a layering of calcareous sandstone, shale, mudstone, and tuff (Wilk 1991). Soils are relatively fertile and consist of silica, sandstone, and clay (Wilk 1991). Upland soils produce good drainage, which makes them well suited for the cultivation of cacao (Steinberg 2002), fruit trees, and annual crops such as corn, beans, and rice.

The lowland tropical environment of southern Belize supports a diverse broadleaf evergreen forest that is one of the last remaining continuous sections found throughout Central America. Mature forests contain many species of valuable hardwoods such as mahogany, teke, cedar, and rosewood. There are also many different species of palms, orchids, *helconias*, and other plants that are used by the Mayas for medicine, food, and building materials. Some of the animals that are found within Toledo forests include gibnut (*Agouti paca*), collared peccary (*Tayassu tajaca*), red brocket deer (*Mazoma americana*), great currasow (*Crax rubra*), coati (*Nasua narica*), armadillo (*Dasvnus novemcinctus*), raccoon (*Procyon Iotor*), and numerous species of birds (Steinberg 1998).

Figure 2.2




## Land Tenure Policies in the Toledo District

Much of the Toledo Maya's land-base lies on reservation or Crown lands (Steinberg 2002). Mopan and Kekchi farmers typically cultivate their crops within the reservation boundaries; however, they depend on forests located outside of reservation areas for hunting animals and gathering medicinal plants, herbs, and building materials. The Mayas have no legal claims to this area, and development and logging practices threaten the livelihoods of communities that border these reserves (Wilk and Chapin 1989).

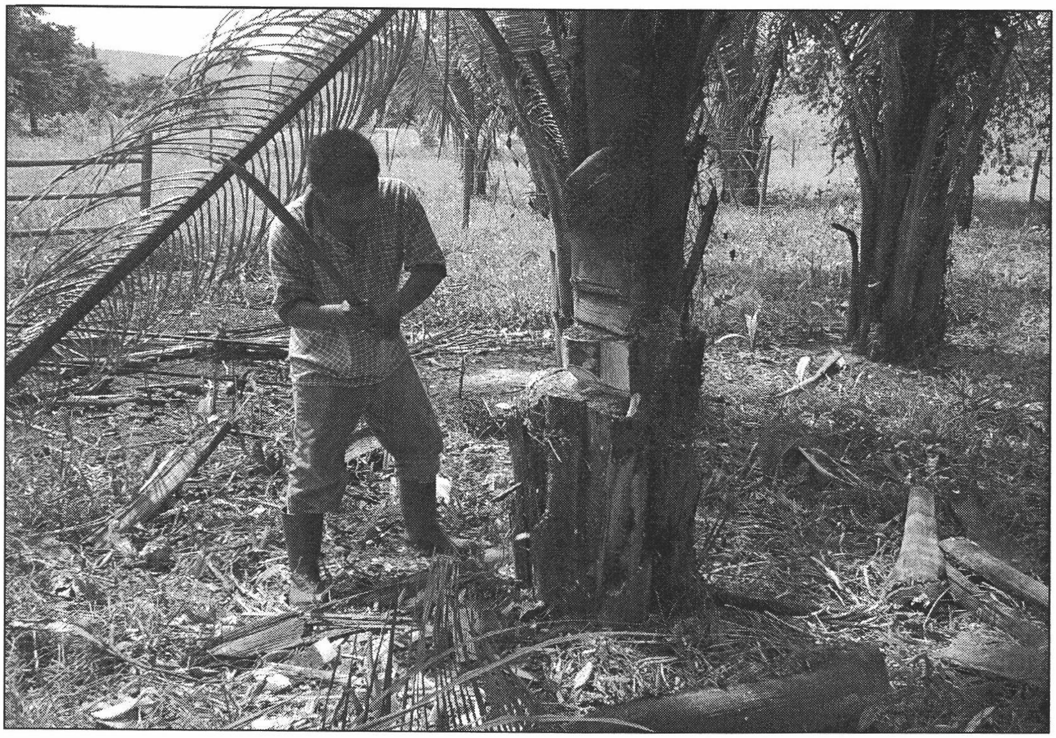


Figure 2.3. A Mopan farmer harvests a cohune palm tree for its edible inner layer.

Figure 2.4. The Mopan's future success is largely dependent on their ability to secure their land tenure and retain access to important forest resources.

Steinberg's research (1998) focused on the Mopan's changing culture and environment, as well as their political affiliations with the Government of Belize (GOB). He noted, "In its relationship with the Maya peoples of southern Belize, the government practices an inconsistent, if not discriminatory, policy in terms of incorporating the Maya's cultural-ecological activities into management plans for the protected areas that indigenous people use" (Steinberg 1998:132). Furthermore, Wilk (1991) has stated that in the Toledo District, "the legal system of land tenure is confusing and contradictory, and operates pragmatically through continuing negotiation and the exercise of political power" (Wilk 1991:87).

The Belizean government has a long history of selling land that borders reservations to foreign corporations for the extraction of timber products (Wilk 1991). In order to counteract the government's direct control over reservation lands, the Toledo Mayas have been engaged in a lengthy legal battle with the GOB for a freehold title to a five hundred thousand acre land base (TMCC 1997). This title would help to ensure that reservation lands could not be sold, developed, or logged without first consulting Mayan leaders. It would also help the Mayas in their struggle to prevail amidst a foreign economic system (TMCC 1997).

Since 1993, the GOB has issued logging concessions on 500,000 acres of land to more than seventeen different logging companies, none of which are Mayan owned (TMCC 1997). The largest of these concessions, which includes over 159,000 acres in the southern part of the Toledo District, belonged to a Malaysian company known as Toledo Atlantic International. Another 24,000 acres located in the Columbia Forest Reserve was granted to another Malaysian company called Atlantic Industries Limited (TMCC 1997). The GOB granted these concessions without the consent of the Mayan peoples. The Mopan have since become more organized with the help of the Toledo Maya Cultural Council (TMCC) and have initiated in a legal battle with the GOB to stop the granting of such large concessions to foreign companies. Responding to this issue, Steinberg wrote the following:

> The inability of the Mopan to have any input concerning logging in the Columbia Reserve has demonstrated to them that they have very little legal control over lands within their cultural-ecological sphere of influence. Logging is a rallying issue through which the Mopan hope to galvanize support for land reform and the establishment of an indigenous homeland in the Toledo District. These are the focal points of the Toledo Maya Cultural Council (TMCC), an indigenous organization comprising Mopan and Kekchi Maya from southern Belize...The TMCC is calling for a halt to logging in the Columbia Reserve and for recognition by the Belizean government that the Maya should gain legal title to lands they farm and to forests in which they hunt and collect non-timber forest products.
> (Steinberg 1998:134)

The Toledo Maya Cultural Council (TMCC) was formed in 1978 to address issues pertaining to the Maya's economic, social, and cultural activities (TMCC 1997). The TMCC also helps Mayan communities to secure land tenure and oppose development and logging operations that degrade forests and threaten Mayan economies. On November 29, 1996, The TMCC filed a lawsuit against the Belizean government challenging the granting of the Malaysian logging concessions in the Toledo District (Anaya 2003).

The Mayas believe that they possess certain rights to these lands due to their aboriginal uses and land tenure systems. Expert reports in the lawsuit showed that "modern Kekchi and Mopan have perpetuated a tradition of Maya land use and occupancy in the Toledo territory within the framework of land tenure patterns characteristic of Maya society since pre-contact times" (Anaya 2003). Because the Mopan and Kekchi can trace their roots to early Mayan occupants in Belize, they were able to use the doctrine of aboriginal rights to support their case. According to this common law doctrine, indigenous rights to lands are based upon historical land-use patterns or occupancy (Anaya 2003). Article 27 of the Covenant on Civil and Political Rights states the following:

> Land and resources are important to indigenous cultures both intrinsically and instrumentally: intrinsically insofar as land and other natural elements, and the activities directly related to them such as hunting and gathering, are themselves part of the matrix of beliefs and behavioral patterns that establish group identity; and instrumentally insofar as a land and resource base provide the geographic space or economic means for an indigenous culture to survive.
> (Ayana 2003)

In 1997, the TMCC joined together with the Indian Law Center, the Toledo Alcaldes Association, the GeoMap Group, and geographer Bernard Nietschmann to produce a Maya Atlas that illustrated land-use patterns among the Mayas of southern Belize (TMCC 1997). The Maya Atlas depicted areas in which the Kekchi and Mopan grow crops, hunt, and collect non-timber forest products. It also described the traditional cultures of the Toledo Mayas and how they are changing amidst a more contemporary Belizean society.

The Maya Atlas was instrumental in demonstrating historical land occupancy of the Toledo Mayas. On October 20, 2000, the Government of Belize signed a 10 Points of Agreement with Mayan leaders stating that, "The Maya people have rights to land and resources in southern Belize based on their long-standing use and occupancy" (Indian Law Resource Center 1998). Although this agreement does not designate land rights to the Maya, it does put Mayan leaders in a position to negotiate with the Government of Belize on future decisions regarding land use in southern Belize.

# 3. Sustainable Agriculture in the Humid Tropics

Agricultural intensification, farm-site diversification, and the establishment of agroforestry systems can help smallholders stabilize their land tenure and improve their local environments and economies. Promoting these systems has become a major initiative among NGOs and policy makers throughout underdeveloped countries. Many researchers (Alston et al. 1996, Belsky 1993, Godoy et al. 2000, Netting 1993, Shelhas 1996, Stone 2001, and Utting 1997) believe that improving sustainability in tropical agricultural systems can help offset the problems of deforestation, market integration, modernization, and discriminatory political systems that are commonly found in rural agricultural communities.

Cacao trees (*Theobroma cacao*) have become an important cash crop in the past 20 years due to a rising international market for chocolate products. These trees can be incorporated into a diversified agroforestry system that mimics a natural ecosystem. Thus, there are many environmental benefits associated with planting shade-grown cacao trees in tropical areas. New research on cacao trees has resulted in the development of hybrid varieties that produce outstanding yields when grown in low-shade conditions with adequate amounts of synthetic inputs. Although these cacao systems have helped to improve economic conditions in underdeveloped countries, they are highly susceptible to pest infestations and diseases because they lack the high levels of diversity that are found in traditional shade-grown agroecosystems.

## Agricultural Intensification Among Smallholders

Since Ester Boserup's *The Conditions of Agricultural Growth* (1965), anthropologists have raised many questions as to how population pressure, available technologies, markets, and labor resources affect agricultural practices in rural farming communities. Boserup's hypothesis stated that an increase in population size often resulted in the intensification of agriculture (Stone 2001). As populations rose and land became scarce, smallholders had to rely on increased labor and new technologies to intensify their agricultural production (Boserup 1981). Although Boserup's theory on rising 'Population Pressure on Resources' (PPR) holds true for many non-industrial agrarian societies, a few anthropologists (Stone 2001, Netting 1993, and Brookfield 2001) have written about other factors that contribute to the intensification of agriculture.

Netting (1993) examined the intensification of smallholder agricultural practices by looking closely at the household unit. He concluded that the members of a household produce both subsistence and market oriented crops, provide an invaluable source of labor, and have some form of ownership or tenure rights to their land (Netting 1993). Although subsistence agriculture may provide a household with adequate food supplies, it is common for smallholders to engage in cash cropping to supply goods and services that cannot be produced at home (Netting 1993). Netting used an example of an indigenous farming group in Nigeria to illustrate his point. He claimed that the Kofyar began to cultivate cash crops because of a desire to enter into the market and ultimately improve their local economies. Social institutions such as ideology, reciprocity, food, and labor parties were also partly responsible for the Kofyar's intensification of farming practices (Stone 2001).

Netting also commented on the levels of labor that are required by a household for the cultivation of crops. Families must organize themselves into a cooperative unit in order to maximize their efficiency and "increase the number and importance of economic activities carried out in the household, and hence the centrality of the household as a social institution" (Netting 1993: 61). Not only must farmers rely on increased labor to intensify their agriculture, but they must also develop their skills, discipline, and social coordination to maintain a high quality of work (Stone 2001). During bottleneck periods when a large labor source is not needed on the farm, members of households may have an opportunity to seek off-farm employment. This option enhances the economic situation of the household by allowing for future investments on the farm.

Brookfield (2001) presented another example in which agricultural intensification is not solely tied to rising population pressure. Similar to Netting's remarks (1993), he noted that social systems have a large influence on agricultural production and efficiency because goods are often produced for ritual, ceremony, and other related social events (Brookfield 1972). An example of Brookfield's description of 'social production' can be found among Maya Mopan cacao farmers in southern Belize. Although high market prices are what drive most Mopan farmers to cultivate cacao, there are also social obligations for which cacao beans are used. For instance, a farmer must prepare the cacao beverage when he hosts labor parties, which are usually held during the planting and harvesting of corn and when building a new home. Some Mopan farmers also donate a portion of their cacao harvests to the church.

Agricultural intensification may also result in the adoption of new crop varieties and more sustainable cultivation techniques. Wilk (1991) described how Kekchi Mayan farmers have increasingly relied on the production of dry-season corn to cope with decreasing land availability and fallow lengths due to population pressure. The same holds true for Mopan farmers in the villages of San Antonio and San Jose. The Mopan have incorporated new corn varieties into their farming systems that shorten harvest lengths from five months to three months. This allows for the planting of an extra corn crop each year. In addition, tomatoes, cucumbers, and cabbages that were previously grown in kitchen gardens are cultivated (using hybrid seeds and synthetic inputs) in large numbers for markets in Punta Gorda.

Similar to the Mopan's adoption of hybrid plant varieties, Bourke (2001) noted how the introduction of food crops such as sweet and solanum potatoes, cassava, taro and maize to Papua New Guinea has increased agricultural productivity because they produce high yields on soils with declining fertility. The adoption of these crops also led to changes in agricultural practices and land use patterns. Villagers have shortened fallow lengths, extended cropping periods, and improved soil fertility maintenance techniques in an effort to grow the crops in a more sustainable fashion (Bourke 2001).

## Agricultural Diversification

Schelhas (1996) explained the different types of diversification strategies that often follow agricultural intensification. He indicated the primary reasons why farmers diversify their agricultural systems in the following excerpt:

> (1) Exploit environmental differences, including climate and fertility; (2) make better use of household labor throughout the year; (3) reduce risk from crop failure due to pests and from market instability; (4) take advantage of synergies of labor, nutrients, and micro-climate; (5) overcome the declining returns to labor of intensification by switching to or adding high value cash crops; and, (6) meet the full range of household needs for products, including building materials, fencing, and foods with different nutritional value.
> (Schelhas 1996:299)

Shelhas's comments on diversification are important for understanding how changing socio-economic conditions affect agricultural practices in smallholder communities. A traditional mixed cropping system (polyculture) is a well known diversification strategy that has been shown to reduce risks, improve the factors of production, increase total crop yields per unit of land, and evenly distribute household labor resources (Vandermeer 1990). Gliessman has noted, "Such systems are well adapted to use by farmers with limited access to economic resources and have evolved in response to the particular combination of cultural and environmental conditions of a region, often over long periods of time" (Gliessman 1984:161,162).

A study of diversified *milpas* among Mayan farmers has shown that mixed plant communities are beneficial to an agricultural system. The intercropping of corn, beans, and squash increases biological nitrogen fixation and helps to control harmful pests and insects (The Agroecology Research Group 1999). The large leaves on squash plants prevent excessive weed growth and also contain chemical compounds (natural herbicides) that are washed into the soil during rainfall (Wright 1984). Furthermore, increasing biological diversity within the agricultural system (planting more crops or rotating crops more often) makes it more difficult for pests to reach populations large enough to cause serious crop damage (Wright 1984) and also provides a household with adequate food, firewood, and medicine throughout the year.

The introduction of green revolution agriculture (monocropping using synthetic inputs) to smallholder communities has threatened the ecological balance that is found in traditional polyculture systems. Many of the traditional seed stocks that have evolved over thousands of years to specific ecological conditions have been replaced with new hybrid varieties. These varieties lack genetic diversity and are often unable to withstand extreme environmental changes such as droughts, excessive rainfall, and pest infestations (Wright 1984). In addition, hybrid seeds require the use of synthetic fertilizers and pesticides to ensure high yields. Traditional farmers who plant these seeds often cannot afford to purchase the associated chemical packages that are deemed necessary for a successful harvest. Thus, green revolution agricultural development schemes have primarily targeted wealthy farmers with ample amounts of land who can afford to take risks. Such actions have displaced subsistence farmers and increased social stratification in smallholder communities.

## Smallholder Adoption of Sustainable Agricultural Systems

Researchers and non-governmental organizations (NGOs) have become increasingly interested in promoting sustainable agriculture throughout underdeveloped countries to offset the negative effects of market integration, acculturation, population growth, economic development, and unstable land tenure that are often associated with green revolution agriculture (Utting 1997:17). The adoption of sustainable agricultural practices by smallholders has many social, economic, and environmental benefits to rural agricultural communities. Low input sustainable technologies such as the use of cover crops, leguminous trees, and integrated pest-management practices allow farmers to increase their yields without having to rely on costly hybrid seeds, chemicals, and mechanized equipment. Environmental degradation caused by deforestation, erosion, and pollution also becomes minimized as farmers learn to incorporate indigenous knowledge and low input technologies into their agricultural systems.

Smallholder adoption rates of newly introduced agricultural systems and technologies are influenced by security of tenure, wealth, and education (Godoy et al. 2000). Having secure land tenure enables farmers to invest more heavily into crop and tree production. Wealth contributes to higher adoption rates because it allows households to use accumulated assets (animals and livestock, land, vehicles, etc.) to use as collateral for the purchase of new technological packages (Godoy et al. 2000).

Education is also a major indicator of smallholder adoption rates. Research has shown that farmers in Latin America typically need more than four years of schooling before they feel comfortable in acquiring new technological packages (Bravo-Ureta and Ebenson 1994). Indigenous communities that lack the educational resources enjoyed by more affluent societies are often unaware of new farming techniques because of cultural differences and language barriers. Thus, it becomes harder for rural indigenous populations to become knowledgeable of recent agricultural innovations, credit opportunities, and market fluctuations (Godoy et al. 2000).

## The Benefits of Diversified Agroforestry Systems to Smallholders

Many agricultural researchers view a diversified agroforestry system as one of the solutions that may help to alleviate many of the socio-economic and environmental problems that plague small farming communities in tropical regions throughout the world. Trees in farming systems provide cash crops, firewood, year-round food supplies for households, and require low levels of labor for production (Belsky 1993). Farmers in West Africa leave valuable trees such as groundnut, cola, voacanga, and African jahogany to shade newly planted cacao trees (Duguma et al. 2001). In Cameroon, cacao is often intercropped with food staples such as maize, melon, and cassava. In addition, tree crops like mango, plum, guava, cola, orange, coconut, oil palm, rubber, coffee, and mandarin can be added to the system to increase ecological diversity and economic potential (Duguma et al. 2001).

The recycling of nutrients from the decomposition of leaf litter, pruned branches, and roots is one of the most important concepts in an agroforestry system (Buck, Lassoie, and Fernandes 1999). In this natural forest ecosystem, there is a closed nutrient cycling system that efficiently processes nutrients from the roots to the canopy. This system differs greatly from a modernized agricultural system where nutrient loss is extremely high. Farmers who face problems of declining agricultural productivity and land availability tend to rely more upon an agroforestry system for the production of subsistence and cash crops (Belsky 1993). For example, Mayan farmers in southern Belize plant nitrogen-fixing trees such as bri bri (*Inga edulis*), leucaena (*Leucaena glauca)*, and cabbage bark (*Andira inermis)* to provide shade and nutrients to organically grown cacao trees. They also plant many different species of fruit trees in their kitchen gardens and *milpas*.

Agroforestry systems have also been shown to help secure land tenure for poor farmers. Land that is planted with a permanent cropping system is less likely to be developed or encroached upon by other farmers. In southern Belize, cacao trees are regarded as a form of land tenure that can be passed down through many generations (Steinberg 2002). Large groves of citrus trees (orange, grapefruit, and lemon) also help to stabilize land tenure because they demarcate an individual's section of land (Personal communication, Justino Peck, 09-24-02).

Although risky, establishing agroforestry systems on reservation lands may ultimately help Mayan farmers secure their land tenure amidst discriminatory government practices. Historically, swidden farmers planted tree crops to reinforce land claims (Potter 2001). Dove (1993) discovered that rubber trees instituted a form of land tenure in West Kalimantan. Farmers in South Kalimantan planted coffee and candlenut trees when a pulp plantation threatened their agricultural lands (Potter 2001). Kekchi Mayas treat tree orchards as a form of private property that can be rented or sold (Wilk 1991). By planting vast tracts of cacao, citrus, and valuable hardwoods, the Mayas may become more successful in preventing the breakup of their traditional lands by the government. Mayer (1996) has referred to this strategy as "landscape capital," which is a means for villagers to assess and utilize important natural resources when threatened by development schemes. Mayan lands that are in permanent agricultural production (as opposed to short cycle *milpa* crops) contribute to local and national economies year after year; thus, they are less likely to be sold or developed by the government (Field Notes 11-03-02).

Another way that farmers can stabilize their land tenure is through purchasing a leased title to a specific section of land. In 2002, a Toledo farmer could lease his land at a price of US $1.50 per acre annually. Leasing land is an option for any farmer that can afford to do so; however, this does not guarantee any type of ownership of forest resources. Farmers typically lease land when they are planting permanent crops such as cacao, citrus, or valuable hardwoods; however, the trees that remain on that section of land are still considered to be government property. According to the government's forestry laws, logging concessions may be granted to outside parties for the removal of such trees (Personal communication, Thomas Coh, 11-18-02).

Recent literature suggests that stable land tenure among smallholders improves agricultural productivity because farmers with legal titles to their lands invest more heavily into farming systems (Alston, Libecap, and Schneider 1996). According to this statement, one might assume that *unstable* land tenure will most likely *hinder* agricultural productivity. On reservation lands in southern Belize, Mayan farmers are often afraid to invest in the diversification of their farms because they do not possess any legal rights to their lands. Thus, the future planting of cacao, citrus, and harvestable timber trees may become limited or perhaps non-existent if Mayan farmers do not want to make precarious long-term investments.

A lack of secure land tenure among farmers is one of the major problems in the initiation of agroforestry projects. Farmers do not want to risk planting permanent tree crops if they do not have a lease or title to their land. In addition, high poverty rates and limited access to credit make it difficult for farmers to make long-term investments for the purchase of tree seedlings and labor resources. Many species of fruit trees take five to 10 years before they can be harvested, whereas hardwoods require anywhere from 10-40 years to mature, depending on the species. Although the planting of tree crops may pay off financially in the long run, many low-income farmers prefer to plant short-cycle crops like vegetables and rice in order to make quick returns on their labor investments.

Other constraints that lower smallholder adoption rates of agroforestry projects include inaccessible markets and low prices for crops. When initiating these projects, government agencies and NGOs often assume that there will be an available market when crops are harvested. Even donors that fund NGOs have failed to examine current market potentials before introducing agroforestry projects (Smith 2000). Thus, during crucial harvests farmers often express bitter disappointment when their crops cannot be sold for a decent price. In southern Belize, the Hershey's Unlimited Company promised to purchase cacao from Mayan farmers at a price of US $ 1.55 per pound. A few years after farmers planted large cacao groves near their villages, Hershey's dropped the price to 55 cents per pound (Crucefix 1998). Mayan farmers became frustrated and abandoned their cacao trees that could have provided an important source of household income.

Research institutions have also had problems promoting agrodiversity to farming communities. Agrodiversity is a term that is used by scientists to describe farming systems that are "resilient to external pressures and are able to provide assured and sustainable production through the local management of biological diversity" (Brookfield 2002:35). Many smallholders in the tropics possess a wealth of traditional knowledge concerning forest ecology, climate, integrated pest management strategies, and seed varieties that are adapted to local conditions. However, most research is done in a top-down fashion, where scientists receive little input from local farmers. Responding to this issue, Smith has argued, "The prevailing research culture tends to view small farmers as people in need of modernization, rather than as individuals with useful local knowledge" (Smith 2000:157).

Agricultural systems that look good on paper do not always meet the demands of specific communities. Many poor farmers lack the financial resources needed for the purchasing of seeds, equipment, and labor resources that are necessary for the successful planting and harvesting of hybridized crops. It is also important to note that farming communities in the tropics are heterogeneous. Mixed ethnicities, dissimilar cultural practices, and unequal wealth distribution all play an important role in how these communities might view newly introduced agricultural systems. Thus, it is crucial for scientists, researchers, NGOs, and government agencies to understand the complexity of indigenous cultural and environmental systems if they are to be successful in promoting agrodiversity and the planting of tree crops such as cacao.

## Chocolate Trees (*Theobroma cacao*)

*Criollo, forastero,* and *trinitario* are the three distinct races of *Theobroma cacao* that exist in the Americas (Cheeseman 1944). *Criollo* varieties have red and yellow pointy pods when ripe and were probably domesticated by the Mayas throughout Mesoamerica (Young 1994). *Forastero* varieties come from Amazonia and contain dark and purple seeds that are enveloped in thick husks (Young 1994). Unlike the former two groups, *Trinitarios* did not originate in the wild. These types were formed by crossing *criollo* and *forastero*, and are derived from *T. cacao* subsp. *cacao* (Young 1994).

Cacao trees grow well under the shade of the forest canopy and on fertile and well-drained soils. Trees retain their leaves year-round and can reach heights up to 50 feet (West 1992:106). Two to three years after planting, the tree starts to flower on the main trunk and on large branches. The pinkish-white flowers are then pollinated by midges and other insects and soon develop into pods. As many as 20-50 football shaped pods may form on one tree, each containing as many as 50 beans (West 1992:107). The pods develop during the rainy season and are typically harvested in the drier months.

Cacao trees (*Theobroma cacao* L.) were thought to have originated along the upper Amazon and Orinoco river basins in South America (West 1992:107). Cacao seeds presumably arrived in Central America via trading networks. The Olmec people of southern Mexico began domesticating the trees around 1000 B.C. (Pacchioli 2001). As seeds were extensively traded throughout Central America and Mexico, the Zapotec, Aztec, and Mayan Indians began to cultivate cacao for medicinal and ritualistic purposes. In Mesoamerica, cacao seeds were crushed into a paste and mixed with maize, chile peppers, vanilla, and other spices to create an acclaimed beverage (Young 1994:11).

By the time Cortez arrived in Central America, cacao was a highly prized commodity throughout Aztec and Mayan empires. During the sixteenth and seventeenth centuries, cacao became an important cash crop to Spain and other European countries (West 1993:108). The popularity of cacao among wealthy Europeans eventually led to its mass cultivation throughout many tropical areas of the world.

In Mayan societies, cacao beans were an important means of currency well into the nineteenth century (Steinberg 2002). Cacao was also a central part of religious life among indigenous peoples, as the tree and bean are often portrayed on Mayan steles (Gomez-Pompa et al. 1990; Young 1994). The cacao tree represented a pathway between heaven and Earth, and the beverage was offered as food to the gods to ensure adequate rainfall and good harvests (Young 1994).

Figures 3.1 and 3.2. A one-year old cacao seedling (left) and the maturing pods of a hybrid cacao tree about three months from harvest (right).

The Environmental Benefits of Cacao Agroforestry Systems

The planting of cacao in a shaded agroforestry system has been shown to increase forest biodiversity, protect watersheds, produce energy, promote carbon sequestration, and create important buffer zones between agricultural areas and undisturbed forests. Because cacao trees are environmentally beneficial to the surrounding ecosystem, researchers, NGOs, and government agencies have promoted this crop as a conservation tool. Cacao trees can be planted in degraded landscapes like secondary forests and abandoned *milpas* to increase biodiversity and provide an important source of income for farmers in small agricultural communities.

Most varieties of *Theobroma cacao* produce decent yields when they are grown under tall shade trees. Mature cacao trees that grow in their natural environments require approximately 50% shade and 50% sunlight. A thick and nutrient-laden mulch layer resulting from fallen leaves, husks, and branches, helps to keep the trees healthy and properly fertilized (Young 1994:80). Proper shade management helps to reduce the presence of disease and fungi. Shaded cacao agroecosystems create a forest-like environment that harbors high levels of biodiversity equivalent or greater than that of a secondary forest (Parrish et al.). Lianas, epiphytes, mosses, lichens, insects, herpetofauna, and birds are all attracted to these systems (Parrish et al.).

The high levels of biodiversity that are found in cacao agroecosystems can also be used to promote ecotourism. The mid-level canopies of cacao trees give bird-watchers an excellent view for observing rare species of tropical birds. Tourists may also be interested in learning about the techniques involved in harvesting and processing cocoa beans. Thus, farmers should be encouraged to manage their cacao and shade trees in ways that will provide good habitat for birds and other animals. Current efforts are being made among community leaders in the tropics, mainly in Costa Rica, to develop ecotourism packages that include bird-watching, cacao harvesting processes, local food and culture, raptor migration, and hikes through forest reserves (Parrish et al.).

Another environmental benefit of a cacao agroforestry system is carbon sequestration, which helps offset carbon dioxide emissions that cause global warming.

If businesses in developed countries were to purchase carbon credits in cacao growing areas, then farmers would be rewarded financially for maintaining adequate shade trees above their cacao (Parrish et al). The money could also be used to purchase additional lands for planting more cacao trees. This would benefit local economies and also help to conserve valuable rainforests that are threatened by deforestation.

Cacao agroforestry systems can also be used as buffer zones around forest reserves and other agricultural areas. Buffer zones protect watersheds by absorbing rainfall and reducing erosion along steep hillsides. Buffer zones can also be established near *milpa*s or plantations to create windbreaks that prevent crops from blowing over during tropical storms. Furthermore, the high diversity of flora, fauna, and beneficial insects found within a cacao buffer zone may help to reduce pest problems and diseases in surrounding agricultural areas. Important forest resources can also be harvested in this species-rich zone. For example, shade tolerant plants such as ginger, jippy jopa, bananas, and plantain provide an important source of food and income to Mayan households.

Cacao byproducts can be used to improve the sustainability of farm sites by limiting the amount of resources that must be brought in to the farm. New research into the byproducts of the cacao industry in Para State, Brazil, has led to the discovery of energy generation. On average, 10 hectares of cacao trees will produce approximately 60 tons of fresh rind per year (Rocha BRP et al. 1999). The rind of the fruit can be used to produce biogas, nutrient-rich composts, soil-cement base constructions, microbial or unicellular protein, endocarp candies, and alcohol (Rocha BRP et al. 1999). The money spent to convert cacao residues into electricity is less than the costs to purchase fuel for diesel generators, which makes this system ideal for isolated farmers (Rocha BRP et al. 1999).

## Cacao Diseases and International Markets

Cacao trees are highly vulnerable to pest infestations and diseases, the latter of which are caused by the presence of fungi. Panama disease (*Fusarium cabense*), witches-broom (*Crintipellis perniciosus)*, coffee rust (*Hemileia vastatrix*), monilia (*Moniliopthora rorer*), and black pod (*Phytophthora* spp.) contribute to the destruction of approximately 40 percent of the global crop in a given year (Young 1994, Pacchioli 2001). These plant diseases usually attack *T. cacao* when it is grown outside its native habitat. Large cacao plantations often lack adequate shade systems and biodiversity, so farm laborers must use synthetic pesticides and fungicides to keep the cacao trees healthy and disease free.

International cacao markets are severely affected by social and environmental factors such as drought, flooding, crop disease, and political turmoil that exist in the world's largest cacao growing regions (Young 1994). During years of surplus, the price of cacao can be as low as US $2,000 per metric ton (Young 1994). However, worldwide shortages of cacao beans may cause high fluctuations in the market price, which can reach to more than $4,500 per metric ton (Young 1994). The arrival of Witches-broom to the Bahia region of Brazil during the early 1990's caused a 60 percent decline in cacao yields. A new strain of black pod disease discovered in Africa in 1999 was also responsible for destroying up to 80 percent of the country's crop (Pacchioli 2001). The arrival of these diseases has greatly affected the market prices of cacao during the last decade, which has resulted in an overall increase of cacao production in many of the tropical areas of the world (Young 1994).

# 4. Methods

From June 23rd to August 18th, 2002, I participated in an internship at the Chaa Creek Resort in the Cayo District, Belize, where I worked on a new ecotourism project known as the Mayan Farm with a young farmer from San Jose Village (see appendix A). Although the internship was instrumental in my research of traditional Mayan agricultural systems, it is not the primary focus of this paper. The Mayan Farm at Chaa Creek does, however, set an example of how indigenous agricultural systems can be used for education, research, and improved sustainability within a tourist resort.

I obtained valuable ethnographic information from the "expert farmer" whom I had worked with during my internship at Chaa Creek. I also recorded data concerning traditional Mopan planting techniques and harvesting schedules, the uses of medicinal plants, and contemporary issues that Mayan communities face in southern Belize. After my internship was completed, I gathered additional information in the Toledo District of Belize from August 20th to November 22nd, 2002. Throughout these three months, I collected data using snowball sampling techniques, participant observation, informal observation, archival data, informal interviews, and voluntary work on 17 Mayan farms in the Toledo District.

I utilized a snowball sampling procedure to obtain new participants for this study. "Expert" farmers were targeted for the farm-site data because they planted highly diversified *milpas* and agroforestry systems. In all, I conducted over 100 interviews with men, women, and young boys throughout the research project. Sixty of these interviews were with farmers in all ranges of the socio-economic spectrum. I also conducted interviews with staff members of several NGO's in Punta Gorda such as the Toledo Cacao Grower's Association, SAGE, Plenty Belize, the Toledo Ecotourism Association, and Sustainable Harvest International.

On November 12, 2002, I conducted a survey (with permission from the school principal, Mr. Medonio) with 38 male and female students in the San Jose primary school. A self-administered questionnaire (Bernard 2000) was given to two separate classes of students (see appendix G for the questionnaire and responses). Of the 21 students in grade five (ages12-13), there were 11 girls and 10 boys. Of the 17 students in grade six (ages 14-15), there were nine girls and eight boys. The purpose of this survey was to learn more about the goals and aspirations of the younger generation of Mopan boys and girls. I also wanted to obtain data concerning household labor and agricultural systems. I explained each question to the students in both English and Mopan Maya and had them circle an answer or fill in the blank on the questionnaire.

Before engaging in any type of interview, I described to each participant my research objectives and asked for their verbal agreement to participate in the study. Following Internal Review Board (IRB) guidelines, I presented a piece of paper to my informants with a brief description of the interview process along with my name, school affiliation, phone number, and e-mail. My research design and questionnaire were approved by the IRB at Oregon State University in May of 2002.

When I arrived in San Jose Village, I met with a knowledgeable farmer who came to work for a few weeks at the Chaa Creek Resort. I stayed in this farmer's guesthouse and immediately began to work with him in his botanical garden. Throughout the remainder of my stay in the village, I met many farmers who agreed to let me document their agricultural systems.

As I met farmers on the road or in their homes, I asked them how far their plantation was from the village, what types of crops they had planted, and what types of activities they would be doing that day. I sought farmers who maintained diversified farms and I never missed a chance to work with farmers in their cacao fields. I worked a full or half-day in each farmer's field, where I assisted in planting many different kinds of crops, weeding around plants, pruning cacao trees, harvesting corn, and gathering edible and medicinal plants and herbs. While working with these men, I was able to gather detailed information concerning their planting strategies, average yields, farm size, market opportunities, as well as any concerns they had with pests, income, or labor resources.

I felt that it was necessary to try to fit into the Mayan culture as much as possible. To do this, I constantly reviewed Mopan words, phrases, and plant and tree names that I recorded in my notebook at Chaa Creek. Although I was by no means fluent in the language, my attempt to communicate with the Mayas in their own language was very beneficial. People in the village seemed to respect my efforts and often corrected me when I made a mistake. It was very amusing for them to hear an American student trying to speak their complex language, and this helped to break some of the cultural tensions that existed. After five months of working with Mopan farmers, I became quite proficient in the language, which enabled me to interview some of the non-English speaking elders about the traditional uses of cacao.

I also tried to dress similarly to Mopan farmers. When I went to work each morning, I wore pants that had been stained by the resins of plantain and mucuna stems. I always wore my black rubber boots, which every farmer has a pair of, and also carried with me a machete, file, and seed bag. I learned how to sharpen my machete properly during my internship at Chaa Creek, which proved helpful when I sat down with farmers to talk about their agricultural systems. They observed my sharpening methods and would often ask to see my machete when I was finished. Occasionally I received a nod of approval, and then we would get on with our work.

Working side by side with Mayan farmers helped me to understand the great amounts of labor that are required for clearing, planting, weeding, pruning, and harvesting crops. This enabled me to obtain an emic perspective of their traditional agrarian lifestyles. I was able to immerse myself into a world that was quite unlike my own, thereby limiting my biases from my own culture.

Lunchtime was an excellent opportunity to ask questions about the Mopan's traditional methods of planting and harvesting crops. I also recorded information in my notebook during the frequent machete-sharpening breaks that we took. I asked farmers questions pertaining to land tenure issues, new markets, village politics, social issues, the younger generation, and other topics that were relevant to this study. I obtained valuable insights into the contemporary Mayan culture through these informal interviews and developed strong friendships that would help me through the rest of my fieldwork. When word got around that I was helping farmers free of charge, I became accepted rather quickly into the community.

Providing a valuable labor source for these farmers earned me a great deal of respect in the village. After the men and I worked for a full day, they would take me back to their house for some dinner and tea. It was during these visits that I was able to talk with the women about how they prepare cacao and other traditional foods and beverages. To conduct these interviews, I would often go into the kitchen and help the women make corn tortillas. They appreciated my efforts, as it is highly uncommon for Mopan men to help their wives prepare food.

On October 23, 2003, I worked with some members of the Green Creek group as they were hauling out salvage lumber from the hurricane-leveled forest. I helped them set up a base camp for the loggers and clear a trail to the next big cedar tree that was going to be cut. After our work was done, I interviewed the chairman, co-chairman, and other members of the group and asked them questions about the history and future goals of the Green Creek cooperative.

I also conducted interviews with the leaders of six different cooperative farming groups that exist in San Jose. I asked these men questions pertaining to the following: how their group was started; how many members they have; how much land they farm and if it is leased or not; hurricane damage to the cacao; cacao statistics (age, spacing, varieties of shade trees, planting strategies, etc.); logging practices (if any); group relationships; support from agricultural extension services; inheritance of cacao plots; and present and future goals.

After visiting many different cacao fields in San Jose, San Pedro Columbia, Crique Jute, and San Antonio, I became interested in learning how the preparation and usage of the cacao beverage has changed since cacao has become an important cash crop. I interviewed many of the older men and women of these communities to ask them how their parents grew, harvested, and prepared cacao, as well as when and how it was served. I measured this data against interviews that I gave with members of the younger generation to see if there was any difference in the frequency in which the cacao drink is consumed or in how it is prepared.

Another component of my research was to examine how the young boys in San Jose felt about farming as an occupation. I informally interviewed approximately 40 boys whom I met on the road or at school. I asked them if they were interested in planting cacao or taking over mature trees that belonged to their father or another relative. I also inquired as to what other types of crops they wanted to plant and which crops sold best at the market. Through talking with these boys, I was able to make accurate generalizations about the future of the San Jose farming community and the preservation of traditional agrarian knowledge.

## Limitations and Delimitations

The data that were recorded concerning Mayan farming systems are not representative of all agricultural systems in the Toledo District. Only 17 farms were surveyed out of over 100 farms located in the San Jose area. Wealthier farmers were able to invest more heavily into their farms, whereas poorer farmers did not have the financial means to partake in such investments. Although "expert" farmers who planted a variety of crops for the market were targeted for this study, I did not refuse to interview *milpa* farmers who grew a few staple crops for subsistence purposes. There were many instances where I agreed to spend a full or half-day at a farm without any previous knowledge of what types of crops the farmer planted. Even if some of these farmers planted only one corn crop in their field, I remained true to my word and fulfilled my volunteer obligations. This technique helped to reduce my bias in selecting farmers, as I was able to interview men with varying degrees of wealth and experience.

Another limitation to this study was the short three-month time period that was spent in the Toledo District collecting data. Costs and personal commitments kept me from extending my stay in Belize. Ideally, I would have liked to conduct research in the Toledo District for an entire year. The extra months of interviewing would have enabled me to document more farms in San Jose and in other villages, thereby making my sample size and data results more robust. My stay in the Toledo District did correspond to a busy schedule of planting and harvesting rainy season crops; however, I missed activities that occurred in the dry season such as the clearing of new *milpas*, harvesting beans and dry-season corn, and drying and fermenting cacao. In addition, average yields, labor expenditures, and plot sizes for individual crops were only recorded for some farms. Many farmers could not accurately remember harvest totals and their time spent maintaining specific crops.

# 5. Agriculture in the Study Region

Mopan farmers utilize several different agricultural techniques for producing subsistence and market-oriented crops. Diversified *milpas*, kitchen gardens, and agroforestry systems reflect the Mopan's knowledge of plant relationships and local environments. Maize has remained an important ceremonial and subsistence crop and efforts have been made to improve sustainability in *milpa* plots where corn is cultivated. Traditional labor systems and resource management strategies are also still employed; however, these systems have been slightly altered in response to religious conversions and the presence of collaborative farming groups in San Jose Village.

## The Symbolism of Maize in Mayan Societies

The production of maize among Mopan farmers is a sacred, meaningful, and often ritualized activity that permeates village life. Maize not only gives sustenance and nourishment to the Mayas, but it also represents a spiritual and symbolic link to the old ways of living. Wilk mentioned the importance of corn to Kekchi households in the following passages:

> The complementariness of male corn production and female corn processing and cooking are both symbol and substance of marriage. Festive exchanges of green corn among related households celebrate, renew, and elevate important ties of cooperation and sharing. Cornfields are cleared, planted, and harvested according to lunar cycles, vestiges of a calendar that has been in the heart of Maya communities for at least 2,500 years.
> (Wilk 1991:89)

Thompson (1970) also noted the significance of maize in Mayan societies. The Pokoman Maya practiced a ritual in which a child's umbilical cord was cut over a multicolored ear of corn. The ear was smoke cured and the grain was removed and carefully planted in a *milpa* in the name of the child. The seed of that crop would be sown again over and over until the boy was old enough to plant his own *milpa* (Thompson 1970). The same type of ritual is also performed among contemporary

Tzotzil Mayas. The *milpa* in which the blood-spattered grains of corn are planted is referred to as "the child's blood" (Thompson 1970:283). The eating of the "blood crop" by the family represents a type of communion that bonds the baby to the rest of the family (Thompson 1970).

Thompson also mentioned a Mopan Maya ritual that represents a spiritual connection between a farmer and his corn. He noted that Mopan farmers "believe that the maize spirit takes refuge in the last ears of corn to be gathered. These the owner of the *milpa* himself gathers; they are sprinkled with the blood of a chicken, set aside, and at the next sowing mixed with the rest of the seed. Thereby the maize spirit's presence in the new crop is insured" (Thompson 1970:287).

I also observed instances in which corn is symbolic to Mopan society. When a farmer plants his corn, he watches over the young plants as if they are his own children. He cares for his corn by constantly weeding, checking for pests, chasing away animals, and harvesting even the smallest of ears. Mopan farmers show much pride in their harvested corn by stacking the ears neatly inside their homes. This "food bank" is an important asset to households because it provides a year-round source of food for both humans and domesticated animals. Once the corn has dried, it is primarily used for making corn tortillas, which is the mainstay of the Mopan diet. Tortillas are prepared by the women and are consumed with practically every meal that is served in a Mopan kitchen. They are also incorporated into ritual activities such as the blessing of a new house.

## Traditional Mopan Agricultural Techniques

Mopan farmers engage in agricultural activities year-round, although there are some slack periods in the dry season when men can relax or pursue off-farm employment. In late December, farmers mark new sections by cutting lines in the bush around their plots (TMCC 1997). The Mopan typically clear and burn tall forests or secondary vegetation during the dry season (December through April) and plant staple crops such as corn and rice at the start of the rainy season (May or June). Annual vegetable crops like tomatoes, cabbage, and peppers are also sown primarily in the rainy season. Farmers who have access to a water source will typically cultivate vegetable crops in the dry season because there are fewer insects that will attack the plants. Red and black beans are also planted in the dry season, usually in last-years cornfield. The beans help to fix nitrogen back into the soil, which allows for a more successful corn crop in the following years.

Sweet potatoes, yams, and cassava are traditionally grown root crops that are cultivated during the rainy season. These plants are popular because they do not deplete nutrients in the soils (as compared to corn) and require low levels of maintenance. Planting cassava is a simple procedure in which 10-inch sections of stem are cut from recently harvested plants and then buried approximately six inches beneath the ground. Yams and sweet potatoes are cultivated by cutting off sections of the bulbs and burying them underground. Once the roots become established, they are transplanted to the field and spaced accordingly. Banana and plantain suckers (root balls with an attached stem) are uprooted with a digging stick and transplanted throughout *milpas* or in kitchen gardens during a first or last quarter moon phase. Pineapple suckers are planted in the same fashion. Squash, pumpkin, and peanuts are sowed from seed, preferably during a full moon.

Mopan farmers often grow two or more types of crops together in the same area. This intercropping technique helps to improve biodiversity, thereby reducing crop damage from insects and disease. Yams, pumpkins, ginger, and corn are sometimes planted together in the same area. The ginger and pumpkins grow close to the ground while the yams climb up the cornstalks. The plants are harvested at different times, which can be economically beneficial to farmers in times of hardship. Sweet potatoes are also cultivated among a variety of plants. Their ability to grow horizontally along the ground makes them an ideal cover crop because they help prevent weed growth and do not compete with other vertically grown plants for sunlight.

The Mayas cultivate most of their staple crops from local seeds that have been saved from the previous season. Seedbeds are prepared using strong sticks, the *tie-tie* vine (*Philodendron sagittifolium)*, and cohune palm leaves. They are usually kept a few feet off the ground to prevent attacks from leaf cutter ants and other insects. The palm leaf roof protects delicate seedlings from the intense tropical sun and heavy rains. Ashes from the *comal* (earthen fire pit used for cooking) are often mixed in with the soil for additional fertilization. Seeds from vegetable crops, such as tomatoes, cabbage, and sweet pepper, are placed in the beds approximately two inches apart. Once the plants grow to about six inches, they are transplanted to the field. Vegetable crops are vulnerable to insects, so many Mopan farmers use pesticides to prevent against attacks.

Mopan farmers also employ integrated pest-management (IPM) techniques to protect their crops from animals and insects. By allowing many different species of plants and trees to grow together in a small area, farmers rely on the surrounding biodiversity to reduce plant disease and pest damage. Weeds and insect-attracting plants and trees are always chopped with a machete to help maintain sterility in a *milpa*. The burning of a field before planting also helps to kill insects that live in the soil.

There are many plants, trees, and other biological agents that Mopan farmers use to help eradicate crop-damaging pests. Ramon trees (breadnut, *Brosimum alicastrum)* are planted near *milpas* to provide birds with a food source other than a farmer's crops. A mixture of lemongrass, ginger, and soap tree leaves can be soaked in water and used as an organic insecticide spray. Leaves of the castor bean (*Acete coche*) can also be crushed and added to water to make a potent insecticide. A plant known in Mopan Maya as *tat-ti*, is often intercropped with tomato plants to repel insects. Another technique for growing tomatoes without using pesticides is to plant a number of small patches within a cornfield.

Sweet potatoes, plantain, canavalia beans (*Canavalia ensiformis*), and cassava are planted in the nests of leaf-cutter ants to keep them from destroying crops. Pig manure can also be used as an ant repellant when it is placed in and around large nests because it contains high levels of ammonium. Farmers will sometimes place a pig's tail or entrails in a yellow bucket and hang it above an infested area. The insects are attracted to the blood and cling to the bucket rather than to the plants.

Figures 5.1 and 5.2. A Mopan farmer poses in front of his seedbed (left). Once transplanted, these two-month old seedlings will grow quickly (right) and provide this farmer with an important source of income. Many farmers have begun growing vegetable crops because they can be sold for a decent price in Punta Gorda markets.

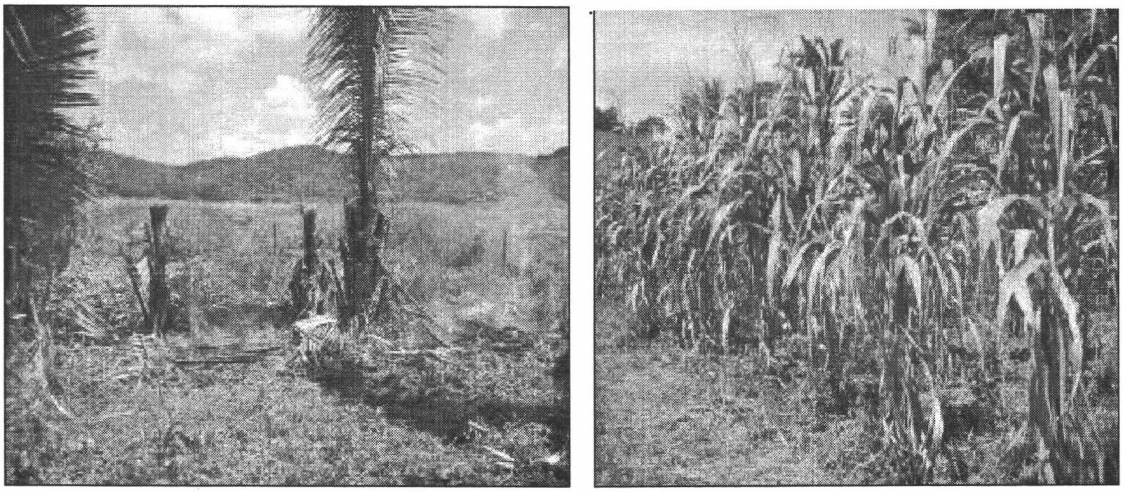
Mopan farmers also use certain techniques to protect themselves from pests and the elements. Working in groups allows men to assist one another in the event of a snakebite or accident. Before a group of farmers clears a weeded area, they sometimes blow tobacco smoke over the weeds to warn poisonous snakes of their presence. If a farmer happens to be stung by a scorpion, he can smash the scorpion and rub its feces on the wound to numb the pain. Termite nests are burned in trees to keep mosquitoes away when men are clearing forests. When there is a large downpour of rain, men use large cohune palm trees as a giant umbrella.

## Shifting Cultivation and the Use of Cover Crops

Mopan farmers follow a traditional shifting cultivation system in which crops are grown on a section of land for 2-3 years and then left fallow for 5-15 years (Field Notes 10-15-02). Insecure land tenure, however, has led the Mopan to shorten their fallow lengths, leaving vegetation that consists mainly of grasses (*Cecropias* spp. and *Helconias* spp.) and cohune palms (*Orbignya cohune*) (Steinberg 1998). As fallow lengths decrease, Mopan farmers struggle to obtain decent crop yields and must either venture into the high forests in search of more fertile farmland or develop more sustainable agricultural practices.

Most agricultural areas within a four-mile radius of San Jose Village consist of short, secondary vegetation. Older forests are located farther from the village, mostly near the Columbia Forest Reserve and on hillsides that are too steep for cultivation. In an effort to increase crop yields in fallowing secondary vegetation, Mopan farmers have relied on agroforestry practices for the production of tree crops and the use of the cover crops.

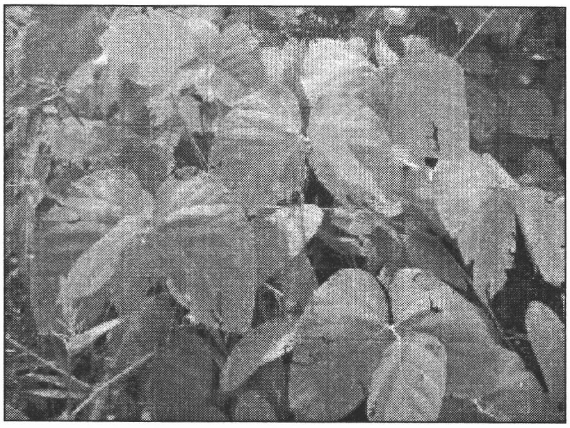
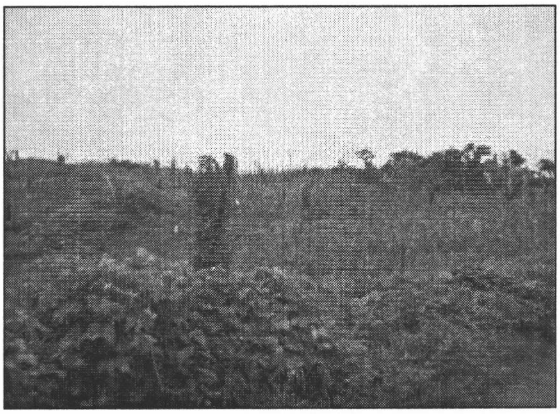
Many farmers in San Jose Village rely upon low-input sustainable techniques for agricultural production. One particular innovation is the use of the mucuna bean (*Mucuna* pruriens) and two other traditionally grown legumes known as kudzu (*Stitzolobium* spp.) and *vega* (*Melathera nivea*) as cover crops. Mucuna is used primarily when planting a dry-season corn crop. Mucuna seeds are planted at the start of the rainy season, which is usually around late May or early June. Mucuna flourishes with adequate amounts of rain and starts to produce seeds in October and November.



Figures 5.3 and 5.4. Left: a burning *milpa* in the Cayo District. Note the cohune palms in the background that are highly resistant to fires. Right: this white corn variety is three months old and was sown in the ashes of burnt trees and grasses. Once harvested, this corn will provide a vital food source for families and their animals.

Farmers have two options when growing mucuna in rotation with dry-season corn. If a farmer wants to continue planting dry-season corn in the same spot for multiple years, he will chop the mucuna down *after* it goes to seed. This strategy allows the farmer to save time by not having to replant the field because the seeds will sprout again during the next rainy season. An early variety of corn that can be harvested in two to four months is planted in the decaying mucuna leaves and stems. This layer of mulch provides the soil with nitrogen, helps to reduce erosion, and keeps the soil moist in the hot sun. The mucuna seeds will eventually sprout in tandem with the corn, but the bean grows slowly without much rain. A farmer will chop back the mucuna with a machete once the corn is waist high. After the corn is harvested, the mucuna will take over the field and grow vigorously throughout the rainy season. The same process is repeated year after year. Many Mopan farmers informed me that they get above average corn yields consistently each year when using a mucuna-corn rotation in the dry season.

If a farmer wants to use a field of mucuna for vegetable or fruit tree production during the subsequent rainy season, then he must chop down the mucuna *before* it goes to seed. The mucuna will continue to grow sporadically; however, plant growth is controlled by the use of a machete or herbicides. Other legumes like kudzu and *vega* have similar nitrogen-fixing characteristics as mucuna, but they are much harder to kill. These plants will grow year after year regardless of how often they are chopped down.

Figures 5.5 and 5.6. A close up view of a mucuna plant (left) that was growing voraciously along side a farmer's road (right). The mucuna bean has allowed farmers to continually plant dry-season corn in the same field without experiencing diminishing yields.

Mucuna works extremely well in rotation with dry-season corn; however, it is much more difficult to incorporate into a cornfield during the rainy season. The mucuna will quickly overtake the corn seedlings and prevent their proper growth. Farmers must clear the mucuna at least once a month to limit the competition between plants. This can be a daunting task if a farmer is growing a six-month strain of corn on two or more acres of land. Also, ears of corn that are left on the stalks to mature have a tendency to rot before harvesting because the sun cannot penetrate through the dense and rain-soaked layer of mucuna leaves. Farmers therefore prefer to use fallowed, non-mucuna fields for planting rainy-season corn, although they are difficult to clear because of the presence of 5-10 year old trees. Some farmers actually stopped growing rainy-season corn because of the amount of labor that was required to clear high forests and tall secondary bush. Another drawback to rainy-season corn is the inaccessibility of adequately fallowed lands throughout the reservation. Farmers must venture three to five miles away from the village to find an abandoned field or a new section of forest.

## Traditional Ecological Knowledge

Traditional ecological knowledge (TEK) is a holistic and constantly evolving means in which people have adapted to their environments through experimentation and innovation (Posey 2000). Many indigenous groups rely on TEK for utilizing forest resources and for the development of traditional agricultural systems. Netting discussed TEK as:

> Cultural knowledge transmitted by language and shared by members of a social group is focused on and elaborated around those elements of the local environment that are critical to the continuity and sustainability of an intensive agro-ecosystem...Members of a household may share a long attachment to a farm, and the fund of ecological information so vital to the agricultural endeavor is transmitted through observation, imitation, and instruction that accompanies more general processes of socialization and enculturation in the family.
> (Netting 1993:51,63)

From Netting's viewpoint, the family unit is responsible for disseminating relevant ecological data from generation to generation. Cohesive indigenous communities must utilize their wealth of cultural and environmental information to maintain and improve upon their traditional practices. Thus, utilizing TEK may help households to prevail amidst changing socio-economic and environmental conditions.

Many indigenous societies in the tropics have successfully sustained their populations by utilizing forest resources and medicinal and domesticated plants. For example, the Shuar people of Ecuador's Amazonian lowlands use over 800 species of plants for food, medicine, fodder, fuel, building materials, and fishing and hunting supplies (Posey 2000). The Hanunoo people of the Philippines use over 1500 different types of plants, 430 of which are cultigens (Netting 1977).

The Mayas of southern Belize utilize their traditional ecological knowledge in different ways. Many different species of edible and medicinal plants are cultivated and collected in tall forests, gardens, and *milpas*. When a farmer clears his *milpa*, he spares plants and trees that can be used for food, utility, or medicine. For example, calabash trees (*Crescentia alata)* are left to grow for the making of pots and containers. Lufa trees (*Luffa cylindrical*) are also left standing because their sponge-like fruits can be used for bathing and washing. The fruits and leaves of soap trees (*Sapindus saponaria)* are often crushed and soaked in water to make a cleaning detergent. In addition, the young shoots of jippy jopa *(Sabal mexicana)* are gathered as a food source and to make traditional baskets. Mopan farmers also listen to whistling sounds of the casseka bird, which repeats its call every half hour, to tell time when they are working in the fields.

The Mayas are also adept at using forest resources for building materials and hunting paraphernalia. Strips of bark from macapal trees are used as webbing devices for carrying heavy loads and securing posts in houses. Cohune palm leaves are fitted together with the *tie-tie* vine to make thatched roofs, while another species of vine known as *Iclab (Salmea scandens)* is collected to make a fish poison. The *Chalom* plant can also be used to catch fish by rubbing the poisonous leaves on rocks that lie beneath the surface of the water.

Traditional ecological knowledge also pertains to traditional agricultural techniques. Shifting cultivation techniques require farmers to be aware of subtle environmental changes. Farmers have learned through experience how to conserve soil properties and gauge fertility on fallowed lands. For example, Mopan farmers are able to recognize when fallowed land is fertile enough to begin cultivation by the growth of certain trees, plants, and grasses (Personal communication, Luis Teck, 7-22-02).

There are specific techniques a farmer must use when chopping, burning, and planting his *milpa*. If the cut trees and brush are not dry enough or not dispersed evenly along the ground, then the field will not burn correctly. Mopan farmers look at the ash to wood ratio to decide when they will plant the field. If there is too much woody debris on the ground that hasn't been fully burned, then the farmer will come back and plant the next year when the wood has decomposed (Personal communication, Luis Teck, 7-14-02). When the planted corn matures, the stalks are often broken to prevent birds from eating the ears. Allowing the corn to dry inverted also keeps water from collecting in the husk, which helps to prevent rotting.

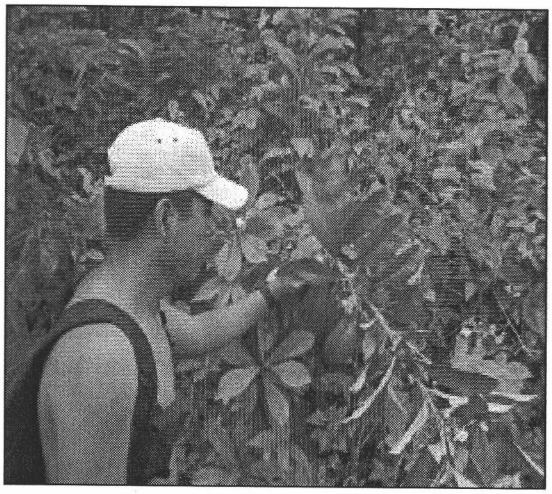
Mopan planting cycles revolve around a farmer's experience with plants and the environment. Some crops are planted on a full moon, whereas others are planted during a first or third quarter moon phase. Medicinal plants are typically collected in the late afternoon because that is the time of day when beneficial chemical compounds and anti-oxidants are stored in the leaves. This assures the collectors highly potent dried leaves that can be used in teas, tinctures, and swabs (see appendix B). When cohune palm fronds are cut during a full moon, the thatched roof on a house will last for over 10 years. However, if they are cut during any other moon cycle, they become susceptible to rot and insect infestations and only last for five years. The same theory holds true for harvesting trees that are used for building materials. If the trees are not cut during the proper moon phase, then the wood will not be resistant to termites and other insects.

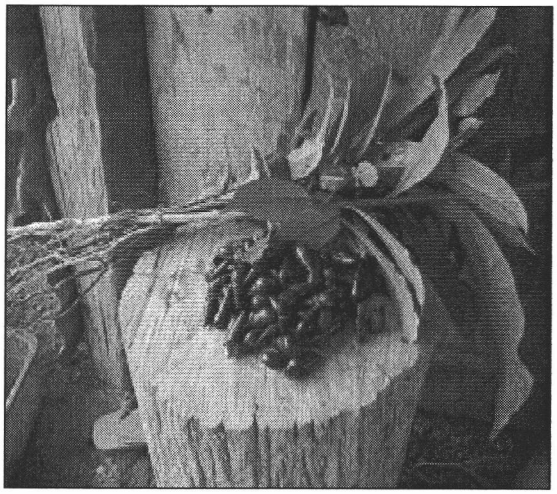
Mulching techniques are also a form of TEK among Mayan farmers. Some farmers prefer to use a slash-and-mulch system as opposed to a slash-and-burn method of cultivation. This adaptation has resulted from a combination of decreasing land availability, erosion problems, and the high costs of chemical fertilizers. The thick layer of decomposing leaf litter on top of the soil increases fertility, prevents erosion, retains ground moisture, and protects plant seedlings from birds and foraging animals.

Composts made of animal waste and decaying plant matter are also sometimes applied to the bases of trees as an organic fertilizer. Shells of river snails (*jute*) can be cooked in a pot with corncobs to create a potassium-rich ash fertilizer that is placed around plants when they are blooming. The same mixture of river snail shells is also used when boiling corn to remove the layer of skin on the kernel.

## Using Traditional Ecological Knowledge as a Research Tool

It has become important for researchers to recognize the importance of TEK when initiating agricultural projects among indigenous communities. Bellon has stated, "Traditional knowledge cannot make a contribution to sustainable development without having a functional link to management" (1995:264). Furthermore, Dove and Kammen have mentioned, "It is ironic that whereas green revolution agricultural scientists and planners have relentlessly dismissed swidden cultivation on the grounds that it is not sustainable if its fallow period shrinks, they have not questioned the sustainability of green revolution in light of its continuing growth in need for fertilizer inputs" (1997:96). Thus, it is imperative for researchers to understand indigenous cultivation practices and cultural institutions before engaging in development or intensification projects. It is common for scientists to view a traditional shifting cultivation system as environmentally destructive, or even "primitive." However, this type of agriculture is sustainable in places with small population densities and a low competition for land resources.





Figures 5.7 and 5.8. Left: A young Mopan farmer identifying a type of medicinal plant found growing in the bush. Right: river snails (jute) and seedlings of a san juan tree that were collected during a trip into the high forest.

## Traditional Resource Management of Reservation Lands

Mopan farmers in San Jose Village follow a traditional form of resource management in which agricultural lands are considered to be common property. This system is similar to what Wilk (1991) has described of Kekchi farmers, which is based primarily on kin relations and former land-use patterns. Older farmers who are unable to maintain their swidden plots will either pass them down to their sons or brothers or loan them to other farmers. The new generation of young men will then cultivate that same section of land until soil fertility is lost and the land must return to fallow. In this type of system the most suitable agricultural land in San Jose (close to the village, good drainage, and fertile soil) has been kept in the same family for over fifty years (Personal communication, Alfredo Sho, 09-22-02).

Spencer (1966) has noted that productive swidden areas may be individually owned, but "when commonly recognized harvest procedures are terminated, the tenure has ended, and the land is considered as returned to the regenerative cycle. Such land has then reverted to the common pool of land owned by the group. . .and becomes public domain open to all forms of appropriation" (Spencer 1966:90). The system of communal land tenure that Spencer describes is not practiced among Mopan and Kekchi farmers. Fallowed areas are reserved for the farmer who planted his crops there last. A section of land might lie fallow for up to 15 years; yet, most farmers are well aware of who will cultivate that land when fertility is restored. If a farmer decides not to plant crops on his section of reservation land, then he may allow someone else to do so through a verbal agreement (Personal communication, Alfredo Sho, 09-22-02). This often occurs when men temporarily or permanently leave the village in search of wage employment.

The village *Alcalda*, or community leader, is responsible for resolving land-use disputes in the village. The role of the *Alcalda* has become increasingly important, as competition for accessible and fertile farmland has increased due to cash cropping and the emergence of new agricultural markets. The resulting decrease in fallow lengths (Steinberg 1998) has placed stress on the local environment, as well as on the traditional swidden-pool management system. Game animals, firewood, building materials, and medicinal plants have been in short supply (Steinberg 1998) because fallowed land has not been allowed to fully regenerate before planting.

## Mopan Labor-Exchange Groups

Many indigenous agricultural societies rely on a communal labor source to efficiently plant and harvest crops. These labor systems evolved over thousands of years, especially in tropical areas where cropping schedules are dependent on seasonal variances such as rainfall, temperature, length of day, and plant growth (Netting 1993). The cutting and burning of fallowed land has to be completed by each farmer within a limited time period to ensure a productive plot. Fallowed bush is generally cut towards the end of the dry season. This strategy enables farmers to let the felled trees dry out before burning. Shortly after the trees are converted into ash, seeds are planted into the ground. When the bush is chopped too early, unwanted wild plants and weeds will take over the field. If farmers delay the cutting, then the field will be difficult to burn due to heavy rainfall (Netting 1993). Because this farming strategy depends on seasonal windows of opportunity, swidden farmers have organized their labor resources to maintain an adequate work force during crucial planting and harvesting periods (Netting 1993).

Many Mopan farmers still practice a traditional form of labor management; however, this system has been slightly changed due to increased out-migration and the influence of Protestant and Evangelical religious groups (see Chapter eight). Typically, fathers, sons, brothers, and uncles will share the responsibility of planting, weeding, and harvesting. Farmers will often stagger planting times to ensure that each field gets planted by the time the rainy season starts. This strategy also allows for a rotating work schedule during the harvest. A farmer who must plant a large field or harvest his crops will ask for assistance from close relatives and friends. Although no wages are paid for their services, there is the expectation of lunch and drinks at the farmer's home. The host farmer slaughters and cooks a pig or some chickens while his wife prepares rice, tortillas, and a beverage of cacao or *sa-a* (a mixture of corn meal and water). After the task of planting or harvesting is completed, the men walk back to their host's house and relax, eat, and joke with one another. The women stay in the kitchen during this activity and eat after the men have finished their meals. The host farmer will make note of all the people who helped him, as he is obligated to return the labor service within one year.

Wilk (1991) noted that Kekchi farmers work in groups to allow for maximum efficiency, safety, and a more enjoyable working atmosphere. The same is true among Mopan farmers; however, working groups are also important for maintaining important social and kin relationships in the village. Men who are invited to work parties feel as if they have earned the respect of the host and his family. There also seems to be a heightened sense of security in a tight-knit group because each farmer can depend on one another when faced with a shortage of labor or crop failure. While the men are working, they often talk about village gossip, families, women, farming strategies, politics, and new market opportunities. Older farmers also demonstrate to young boys the correct methods for clearing and burning the bush and planting traditional crops. This helps to spread an invaluable source of ecological knowledge to the younger generations.

Figure 5.9. This is a group of Mopan farmers who are planting dry-season corn during a labor party. These farmers use large, pointed dibble sticks to dig holes two feet apart. They then toss 5 or 6 seeds of corn into each hole to ensure that a few will sprout.

Communal labor is also beneficial economically because few farmers can afford to hire 10 to 20 people to help plant or harvest their crops. The cost of the food that is served for lunch is relatively low because most of the ingredients are grown or raised by the host family. Through utilizing these traditional labor systems, the Mopan have been able to produce a surplus of agricultural products to sell in Punta Gorda and Guatemalan markets. The additional income they receive helps families purchase medicine, school supplies, kerosene, and other necessities they may need.

The Kofyar people of Africa use a traditional system of labor that is very similar to that of the Mopan's. They form work parties known as *mar muos* (farming for beer), in which over 30 friends and family members partake in agricultural labor (Netting et al. 1989). Kofyar laborers are also invited back to the host's home for food and drinks. The high rates of participation that are involved in Kofyar work parties have enabled them to compete in a market economy with cash crops such as yams and millet (Netting et al. 1989).

The similarity between Mopan and Koyfar work parties raises important insights into the significance of traditional labor systems to indigenous farming communities. Neither of these two groups must depend on paid laborers and the help of government agencies to intensify their agricultural holdings and compete in markets. In addition, the work was not rewarded with money, but with the promise of food, drinks, and socialization. The examples of Mopan and Kofyar communal labor practices show how a self-developed indigenous labor system can remain successful amidst a changing socio-economic paradigm.

## Agricultural markets in the Toledo District

In the Toledo District, there are a few markets where farmers can sell their crops. Most men and women from rural Mayan villages sell their harvested fruits, vegetables, and grains in Punta Gorda on Wednesdays and Saturdays. Crop prices often fluctuate depending on the surplus and demand for certain products. According to some informants, shelled corn sells between US $4-15 per 100 lb. bag. If the bags are taken to Mango Creek (a four hour bus ride away), then prices range between $15-20 per bag. Red and black beans are sold at a price of US 40-50 cents per pound. Tomatoes, cabbage, and peppers sell for around 50 cents per pound. One bunch of plantains or bananas will fetch US $2.50. The same price is paid for 10 oranges or grapefruits.

Markets in the Toledo District are highly unstable. When a rumor goes around that a good market is available for a certain crop, many farmers purchase those seeds and begin planting. After the men harvest, the price usually drops because there is a surplus of goods. In some cases, farmers discover that a market never existed in the first place. This has happened in the past with a few cash crops such as annatto (*Bixa orellana)* and coco yams (*Xanthosoma violaceum*).

The red fruits from an annatto tree (also called achiote) are used to produce a yellow coloring paste that is added to foods (Sams 1998). The Belize Marketing Board and a private company began to purchase the seeds for export in 1985; however, the market collapsed in 1989 due to low prices and high transportation costs (Wilk 1991). During the 1990's, Toledo farmers were told that there was another market for annatto in northern Belize and in southern Mexico (Personal communication, Auxibio Sho, 11-07-02). When the farmers harvested the crop, they learned that the buyer backed out of the deal because he found another product elsewhere at a cheaper price.

A similar situation surfaced in the 1980's when the Ministry of Agriculture informed Toledo farmers about an available market for coco yams in Florida. The Ministry of Agriculture encouraged farmers to grow the yams with the help of government extension workers. However, when the yams were harvested the market suddenly disappeared. Farmers were then forced to sell their crop for very low prices in Punta Gorda and in neighboring villages.

When I arrived in San Jose Village, the Ministry of Agriculture initiated a project that promoted the planting of habanera peppers for a new market in the United States. A hurricane swept through Mexico in the fall of 2001 and destroyed part of Mexico's pepper crop that was destined for a Florida market. Toledo farmers were also told of a potential market for dried habanera peppers in Orange Walk, Belize. The Ministry of Agriculture selected five pepper groups in the Toledo District to plant habaneras, cabbages, and carrots for new markets. They provided farmers with seeds, fertilizer, and extension services. A solar powered drip irrigation system was also promised to each group but it was never delivered.

The San Jose Village pepper group planted 3,000 cabbages, 1,000 carrots, and 2,000 habanera plants. Raised seed beds were used for germination until the seedlings were ready to be transplanted into the field. Another pepper group from Golden Stream had already harvested their first crop, yet there was no help from the Ministry of Agriculture in locating the market that had been promised. As a result, the Golden Stream farming group was forced to sell their product locally at low prices. This worried the pepper growers in San Jose, so a Peace Corps volunteer decided to follow up on the Ministries unfinished business and contact the buyers himself.

While working with farmers in San Jose, I discovered that the Ministry of Agriculture failed to deliver on many of their promises. The projects they started usually ended in complete disappointment, as farmers were left to do the legwork of finding a market that was supposed to have already existed. Many farmers complained that they wasted their time planting crops that were suggested by the Ministry of Agriculture. Although this government organization does aid farmers by supplying many of their starting materials, they generally do not follow up to meet the project's underlying goal of establishing secure markets for Toledo farmers. The Ministry of Agriculture's failure to fully commit to agricultural projects has therefore caused bitter relationships between farmers and Belizean government agencies.

## Cooperative Farming Groups

Extension agents throughout the tropics favor working with cooperative organizations rather than with individual farmers (Hall 2000). Government agencies do not have adequate financial resources to allow extension workers to travel from farm to farm to disseminate technological information and advice. Throughout parts of the Amazon, extension agents have been able to work with only a limited number of individual farmers (Smith 2000:162). Therefore, rubber tappers and small farmers formed cooperative groups that gave them better access to services and a more direct control over pricing (Rodgers and Starr 1995). In parts of Africa, government and NGOs encouraged cacao producers to organize themselves into 'common initiative groups' so that farmers could lower their production costs and increase members' wages (Duguma et al. 2001). The formation of collaborative groups among indigenous farmers has also created a network for expert farmers to exchange their knowledge (Pinedo-Vasquex et al. 2002:105). Participation among kin members, friends, and outside agencies has become an important strategy that has helped indigenous farmers enter into a global economy.

In San Jose Village, Mopan farmers formed six farming groups in which members grow cacao and *milpa* crops on shared sections of land. Most of these groups formed as a result of the TAMPVITA project that was initiated by the Ministry of Agriculture in 1986 to intensify the Mayas' agricultural practices. Farming collectively on large parcels of reserved land helped to protect cacao trees and other crops from fires and theft. This strategy also made it easier for extension workers to examine the trees and hold workshops for proper pruning, fermenting, and drying techniques. Extension workers provided Mopan farming groups with instructions for growing the trees properly. They also gave farmers free seedlings and fertilizers, helped to establish tree nurseries in nearby villages, and offered assistance if the trees became sick or damaged.

San Jose farming groups have helped the Mopan to overcome many socio-economic constraints. These collaborative organizations inspired farmers to work together towards a common goal of maximizing the production of cash crops. The social bonds that were created during this process mimic traditional farming practices, which were based largely on kinship ties and established social networks throughout the village. Farming groups therefore reinforced traditional social behaviors because they allowed for a means of communal agricultural production that was not dependent upon kin relationships. For example, two farmers who do not share a common family or network of friends might end up working together in the same farming group. This would be highly uncommon in the traditional labor system.

The existence of farming groups has also affected the role of women in San Jose Village. Although Wilk mentions that in Kekchi society, "Labor-exchange groups keep women completely out of the arena of agricultural production and exclude them from the economy of labor," this is not true within Mopan farming groups (Wilk 1991:201). While there is certainly a distinct division of labor between the sexes, I observed a few occasions where women accompanied the men to help prune and harvest cacao trees. I learned through informal interviews that most women enjoy their trips with the men to the shady cacao groves. It gave them a chance to break away from their ordinary routine of preparing food and washing clothes. This activity seemed to improve family relationships because it broke down the strict division of labor that existed between men and women.

Many of the older Mopan women whom I interviewed remembered helping their fathers take care of the cacao trees. They were responsible for cutting off the pods and splitting them open to remove the beans. Women also played an important role in the fermenting, drying, and preparation of the cacao. During my research, I discovered that many Mopan women and children still participate in these traditional activities. Group members often take their families to work in the cacao fields on weekends or during holidays when the children are not in school. Young boys receive proper instructions for pruning the trees and the girls are taught how to harvest and process the beans. Thus, the presence of farming groups in the village has helped to pass traditional knowledge down to the younger generation.

Farmers' cooperatives have also led to new economic opportunities for Mayan families. Members often help one another with the pruning and harvesting of cacao trees. If a member decides to temporarily leave the village to seek wage employment, he will usually ask another group member to take maintain and harvest his trees until he returns. Farmers therefore use cacao trees as a permanent "bank account." Some farming groups have also taken advantage of the large storehouses of valuable timber trees in their leased parcels of land by applying for logging concessions. Harvesting timber resources has enabled group members to substantially increase their incomes.

## Six Successful Farming Groups in San Jose Village

### The Mopan Group

The Mopan group formed in 1981 and planted 4,500 cacao trees on a non-leased parcel of reservation land approximately 1.5 miles due north of San Jose Village. Each of the five members planted 900 cacao trees at 10'x10' apart on two acres of land. Shade trees such as cedar *(Cedrela odorata)*, cabbage bark *(Andira inermis)*, hog plum *(Spondias mombin)*, and cotton trees *(Ceiba petandra)* were incorporated into the cacao agroforestry system. Members of the Mopan group prune and weed in their cacao individually; however, they sometimes work together as a cohesive unit. When I visited the Mopan group's cacao in October of 2002, only a few sections of trees had been pruned after Hurricane Iris struck the area in October of 2001. The group had also applied for a lease in May of 2002.

The Western Group

The Western Group was formed in 1985 with 32 farmers. The group planted cacao trees on 1500 acres of non-leased reservation land approximately two miles southwest of the village. Each farmer received a parcel of 25 acres for *milpa* and cacao production. Members planted 450 cacao trees per acre at a spacing of 15'x15'. The identifiable shade trees were cabbage bark, salmwood (*Cordia alliodora)*, macapal, and gumbilimbo (*Busera simaruba palomulato*). As of September 2002, there were only 15 members remaining in the group. The Western group never logged the valuable trees on their land before they cleared the forest to plant crops. Like most Mayan farmers, they used a swidden technique for clearing and cultivating their *milpa*s and cleared rows in the *guamil* (fallowed *milpa*) for the planting of cacao trees. Although many farmers work individually in their cacao, there are times when the group meets and members help each other weed, prune, and harvest.

Western group members are allowed to sell their individual sections of land to whomever they want. The new buyer is not required to join the group. Western group members applied for a lease to their land in 2001, but they had not yet received the papers as of November 2002. No members sold any of their land after the hurricane and only a few cleared the underbrush in their sections of cacao. The group also had problems with woodpeckers boring through the pods; thus, harvest totals were very low in 2001 and 2002. They also had some pest infestations when they first planted their cacao. Insects bored through the stems, causing them to die. TAMPVITA supplied the group with new trees; however, this set their harvest schedule back a full year.

The South East Group

The South East Group was established in 1983 when six family members planted 800 cacao trees each on a total of 12 acres of land. All of the parcels were leased but they did not lie adjacent to one another. They were located about one mile due south of San Jose Village. The spacing of trees was 10' x 10' and the identifiable shade trees were cabbage bark, laurel, salmwood, bribri (*Inga edulis*), and leucaena (*Leucaena glauca*). There were also some old cedar trees that had fallen down during the hurricane. New cedar and mahogany trees were planted as windbreaks during the 2002 rainy season. The group's land was mostly used for cultivating cacao; however, bananas, cassava, beans, jippy jopa, corn, mucuna, and ginger were planted in *milpas*.

## The Green Creek Group

The Green Creek Group was the most active and influential of all the farming cooperatives in San Jose. This group formed in 1983 in the San Jose Catholic Church. 2000 acres of land were leased approximately two miles due west of the village near Green Creek. Cacao trees were planted on 35 acres of this land in 1986. Government officials helped the Green Creek group to construct a dirt road that led from the west end of the village out to the leased land. This road was used to bring in small cacao trees with a tractor, as well as to transport harvested rice, beans, and corn back to the village.

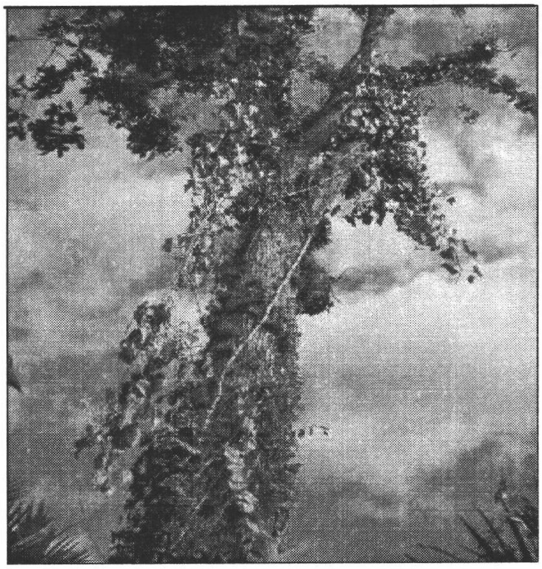
For the first five years, group members worked together in their *milpas* and sections of cacao. However, problems arose when some men stopped showing up to work. After that incident, individual members were responsible for maintaining their own plots. I learned from informal interviews that some Green Creek group members want all of the cacao fields to be surveyed so that they can have their sections of land individually parceled. This proved to be difficult because the government no longer provides this service at a minimal charge. A private surveyor must be hired, which is very costly for low-income farmers.

Boundary lines between members' sections of cacao are large trees, rocks, and creeks. This system of demarcation has been inadequate because individual farmers were never quite sure which trees belong to whom. This created tensions between group members, especially during the harvest season when cacao pods were picked off trees that belonged to other members.

If a Green Creek member no longer wants to keep his section of cacao, he is encouraged to sell it to another member of the group or pass it down to one of his sons or nephews. If the trees are sold to someone outside the group, that person must become a Green Creek member. The exchange of cacao fields between father and son was the most common method of transferring land ownership.

The Green Creek group initially cleared and burnt approximately one-fourth of the forest in their leased parcel for *milpa* agriculture. They eventually realized that the abundant timber resources on their land could bring them a significant source of revenue. The group therefore decided to set aside the last three-fourths of forest for future logging operations. This area contained a high concentration of cedar, mahogany, and other valuable hardwoods. When members spotted one of these seedlings, they would clear the weeds from around tree with a machete. This technique allowed more sunlight to reach the seedling and ensured that other members wouldn't chop it down when clearing new trails. The group's early policy on timber extraction was that members could remove trees from the forest only if they needed to build a house. Trees could not be harvested and sold in the market.

The Green Creek members planned to eventually cut and process the large hardwoods in the dry season of 2002, but Hurricane Iris blew many of them down in October of 2001. The trees that remained standing lost their crowns, which made them vulnerable to pest and termite infestations. After the hurricane, the group applied for a salvage-harvesting permit with the Forest Service of Belize. In October of 2002, the Green Creek Group logged approximately 50,000 feet of board lumber, most of which consisted of cedar and mahogany trees.

Figures 5.10 and 5.11. The Green Creek group hired these men (left) to use chainsaws and guides to mill damaged trees like this mahogany (right), as well as cedars and other hardwoods on Green Creek's leased land.

The logging operations of the Green Creek group were limited to members only, except for two men who processed the trees (see figure 5.10) and the investors who funded the project. Investors from Punta Gorda supplied the group with chainsaws, guides, gasoline, and trucks to process and haul the timber. Fifty percent of the total profits were given to the investors to cover the start up costs. Members took turns working two weeks at a time scouting their land and chopping trails that led to large trees. Once the trees were felled and sawed, the boards were loaded onto horses and sent back to San Jose Village. Green Creek members were paid US $12.50 per day for their labor and received an additional 20 cents for each board foot that was hauled. The quality of the lumber was second-grade because the trees were milled using a chainsaw.

The Green Creek group has planned to build a small sawmill near their concession to produce higher quality lumber. The Government of Belize was supportive of this enterprise because they wanted the group to produce boards that could fetch a higher price on the market. The salvage permit that was given to the group specified that when the permit expired in May of 2003, trees could no longer be milled using a chainsaw and guide. The trees would have to be processed in a local sawmill for the Green Creek group to continue with their logging operation. Some Green Creek members also contemplated setting up a woodshop to produce traditional Mayan chairs and tables that could be sold to tourists. This venture may help to boost the village economy and preserve the traditional methods in which these products are made.

During my interviews with the chairman and co-chairman of the group, I asked if there was a group policy for replanting trees. Although it is recommended by the Forest Service of Belize to plant three new trees for every tree taken, this practice was not done. I was informed that it is sufficient to chop down the weeds that surround valuable trees, thereby ensuring their continued growth. However, with the loss of many large parent trees from the hurricane, seed dispersal may be on the decline. This may prevent the Green Creek group from harvesting more trees in the future.

### The Morning Star Group

The Morning Star group started with 10 members in 1986. The group applied for a lease to their land, but they had not yet received the title in October of 2002. The Morning Star group functions differently than the other farming cooperatives. The entire group has only two acres of cacao (1,000 trees) that are all maintained collectively. The profits from the harvest are divided up evenly among members. The group purchased a rice-huller machine in 1999 from a loan they received from The Belize Enterprise for Sustainable Technologies (BEST) out of Belmopan. The business was doing well before the hurricane because many farmers were planting rice. Members charged customers 10 cents per pound and the loan was almost paid off. After the hurricane, however, farmers did not plant rice because they were advised not to burn their *milpa*s. As a result, the rice huller did not provide the group with much income in the year 2002.

Another interesting fact about the Morning Star group is that members who are too old to work still receive equal pay from the cacao harvests and rice huller business. The group also donates 10% of their income to the church for offering. Group members expect their sons to take over the group's projects when they grow older. When the group goes to work in the cacao, they encourage their sons to help. This helps to pass down valuable agricultural knowledge to the younger generations.

The Cedar Group

The Cedar group was formed in 1981 with 40 members. The group leased 3,000 acres of land near the present day village of Na Luum Ca in 1981. Many of the Cedar group members were originally from San Antonio Village. As fertile lands became scarce in San Antonio, farmers (who would eventually form the Cedar Group) began searching for areas of high forest to the north of San Jose that could be cleared for *milpa* agriculture. Members traveled by foot between San Antonio and San Jose to tend to their crops. This was an arduous journey, as there were no main roads or bridges in place at that time. The men left San Antonio around three in the morning and arrived at their leased parcel by early afternoon. They would then work for two or three days and return to San Antonio. After a few years of enduring the hardships of this commute, the men decided to relocate closer to their *milpas* and established the village of Na Luum Ca.

During the early 1980's, Cedar group members started growing vegetables for the market from the training they received from TAMPVITA extension workers. They also became interested in harvesting timber resources and initiating a sustainable agriculture, agroforestry, and ecotourism project. Their overall plan was to harvest valuable trees, plant *milpa* crops, and then replant the forest with mahogany, cedar, cacao, and coffee trees. They also planned to build a guesthouse and campground and develop trails that led to caves and waterfalls. By accomplishing these tasks, the Cedar group hoped to attract tourists and researchers to their village.

In 1986, the Cedar group received a grant to purchase the machines that would be used to mill the large trees. Although this plan for a sustainable logging operation was well conceived, the Cedar group did not receive enough training for the project's ultimate success. Many problems arose, particularly with the sawmill. The machine that was purchased was not large enough to handle the large diameter (over six feet) mahogany and cedar logs that were cut from the high forests. As a result, the machines broke and there was not enough money left from the grant to have them fixed.

There were also political issues that contributed to the demise of the project. Disparities between Na Luum Ca villagers arose as the result of a division between the two political parties in Belize (Peoples United Party (PUP) and United Democratic Party (UDP)). Although PUP supporters owned the sawmill, UDP supporters would not allow a road to be built to access the prime timber areas. These conflicts, as well as others, eventually led to a cessation of the project.

The Cedar Group had once been very strong. They were politically active and well affiliated with the Toledo Maya Cultural Council. However, during my time of research, there were only 14 members left in the group. Many families moved to Maya Mopan, San Ignacio, or Punta Gorda. Members who remained in the villages of Na Luum Ca and San Jose make a living by cultivating *milpa* crops, cacao, and coffee trees on their sections of leased land. Some members have also applied for small logging concessions with the Forestry Department and sell harvested cedar and mahogany trees to buyers in Punta Gorda.

# 6. Cacao Cultivation in Southern Belize

Mopan and Kekchi farmers in the Toldeo District have developed highly diversified cacao agroforestry systems that are well adapted to local conditions. Farmers who cultivate cacao trees organically must follow specific certification guidelines. Synthetic inputs are prohibited, so farmers must select specific shade trees that supply a source of nitrogen to the roots of their cacao trees. In addition, valuable hardwoods, fruit trees, and shade tolerant cultigens are often intercropped with the cacao to supplement farmers' incomes and provide an important food source.

The harvesting and processing of cacao beans often involves all available members of a household. Children assist in harvesting ripe cacao pods and women are responsible for preparing the chocolate beverage. Although cacao is still considered a ceremonial crop, the presence of a lucrative organic market and the availability of inexpensive cocoa powder have led to a decline in home usage of the beans.

The damage incurred to cacao trees from Hurricane Iris in 2001 resulted in extremely low harvests. This disrupted Mayan economies and limited the availability of cacao to households. Though many farmers adapted to this calamity by pruning, weeding, and planting new trees, some farmers became discouraged and abandoned their cacao fields. The high investment costs, long-term commitments, and the risk of natural disasters associated with cacao cultivation has led many Toledo Mayan farmers to rely more heavily on the production of short-cycle crops.

## Cacao Varieties and Traditional Planting Techniques

Mopan farmers who settled in Belize after leaving Guatemala in the 1850's resumed planting their local varieties of cacao (*Forastero* and *Criollo)* in small kitchen gardens and fallowed *milpas*. *Forastero* seeds were apparently brought to Belize from the Peten region in Guatemala. *Criollo* seeds were collected from trees that grew wild in the high forests of Belize. These trees were most likely the descendents of those that were planted by the ancient Mayas.

Mopan farmers planted local varieties of cacao by tossing two seeds directly into each hole, which often resulted in two trees growing together. The local trees were spaced approximately 20' x 20' apart and grew tall and bushy because they were seldom pruned. Harvested beans were mostly used for consumption of the chocolate beverage; however, a small market emerged when farmers decided to plant large groves of cacao trees on reservation lands. In the 1960's and 70's, cacao beans were sold to local villagers for up to one U.S. dollar per pound, which was a fairly expensive price during that time period (Personal communication, Alfredo Sho, 11-07-02).

Local cacao trees are very hardy and can consistently produce beans for over 100 years. They do well in an organic system without any additional inputs and they are also known to be highly resistant to pests and diseases. Their yields, however, are not as impressive as those of the hybrid variety. The mature pods are smaller, as are the beans inside. Many of the older generation of farmers prefer the local cacao because they believe that it yields more consistently than hybrid varieties and is less likely to succumb to disease (Steinberg 1998).

The hybrid variety of *Theobroma cacao* that is cultivated by many Mayan farmers in southern Belize was introduced from Costa Rica during the 1980's. This strain was engineered for commercial production in which a combination of low shade and chemical inputs are utilized to achieve maximum yields. In an organic system that relies on decomposing leaf litter and nitrogen fixing trees for nutrients, the hybrid trees do not bear pods consistently. A single tree may grow many pods one year and hardly any the next. This phenomenon occurs because there is a lack of nutrients that helps to push the tree into a consistent flowering stage year after year (Personal communication, Auxibio Sho, 10-31-02). Another disadvantage to this strain is that it is more susceptible to disease and fungus than the local variety. Without proper shade management, trees can become infected with black pod disease (*phytophthora*) and monilia (*Moniliopthora rorer*). Hybrid varieties also have a short life span, which causes diminishing yields after 30-40 years.

Mayan farmers in southern Belize plant cacao trees by chopping rows 10 – 20 feet apart in secondary vegetation. The spacing of the trees varies anywhere from 8' x 8' to 15' x 15' apart. Cacao seedlings need to be shaded most of the day, particularly during the dry season. As the young trees grow taller, a farmer will select certain species of trees for shade and cut down the rest. He may also plant desired nitrogen-fixing shade trees such as madre de cacao (*Gliricidia sepium)*, bri bri (*Inga edulis*), cabbage bark (*Andira inermis)* or leucaena (*Leucaena glauca)* at approximately 60 feet apart. It takes roughly five years for a young cacao seedling to mature and produce pods. It is therefore a common practice for farmers to plant cash crops such as bananas, plantains, jippy jopa (*Sabal mexicana*), cassava, or ginger in the rows next to the cacao. These plants provide some additional shade to the sunlight-sensitive cacao trees. Decaying banana stems also provide a habitat for breeding midges, which is necessary for the successful pollination of cacao flowers. Wild *helconias,* such as *chi-ki* and *ma-buy*, are usually left to grow under cacao trees, as their fruits and flowers can either be consumed or sold in local markets.

## Traditional Uses and Preparation of the Cacao Beverage

Cacao use among Toledo Mayan populations still has religious and cultural significance, although the tree has become more of a cash crop in recent years (Steinberg 2002). The Mopan still prepare the cacao beverage for home use and for ceremonial events such as dances, large work parties, the building of a new house, and entertaining guests. A family needs approximately five to 10 lbs. of dried cacao beans to host any of these activities (Personal communication, Justino Peck, 9-24-02).

According to some of my older informants, the cacao beverage was consumed more often in the past. Although village elders had a difficult time remembering exactly how much cacao was kept for home use in the old days, many of them told me that they drank the beverage at least a few times per month. The average yearly amount of cacao that was kept for home use by five different households in 2001 was approximately 15 lbs. (Field Notes, 11-13-02). Household consumption of the beverage occurs about once every two to three months. The decline in home usage of the beans is probably due to a combination of a high organic market price (extra beans are often sold for cash) and the availability of inexpensive, processed cocoa powder in village stores.

The cacao beverage, or *cucu,* was prepared differently in the past. Before the Mopan grew cacao commercially, the beans were never fermented. This resulted in a drink that was bitter and oily. It was usually a woman's task to split open the pods, remove the beans, wash them in the river, and allow them to dry for five to seven days. The beans would then be roasted on a *comal,* peeled and skinned, ground into a fine powder that was mixed with water and black pepper (and sometimes vanilla), and served in a calabash cup. Women would then remove the layer of butterfat that formed on the surface of the beverage. This often was spooned on top of corn tortillas or applied to men and women's hair as a conditioning agent.

During my time of research, the preparation of cacao was still the women's responsibility. They also helped their husbands ferment and dry the beans. Cacao beans and pulp were removed from the pods and placed in wooden boxes where they were allowed to ferment for six to eight days. This fermentation process kills the beans and alters their carbohydrates, proteins, and pigments (West 1993:112). The beans were then left in the sun to dry for about ten days before they were ready to be sold or processed into a beverage.

To make the cacao drink, women roast the dried beans on a *comal,* let them cool, and then place them in a corn-grinder. The powdery cocoa product is then rolled into balls and placed in a sealed container. Older villagers remembered adding chili peppers and vanilla to their cacao for flavoring; however, processed sugar is now the main ingredient that is added to the beverage. The younger generations of Mopan prefer the taste of a sweetened and fermented cacao drink, while some of the elders like their cacao prepared in the more traditional way.

## International Organic Markets and Cacao Affiliated NGOs in the Toledo District

The production and export of organic agricultural products is not a new concept. The Finca Irlanda plantation in Chiapas, Mexico was exporting organically grown coffee beans back in 1967 (Nigh 1997). In 1996, Mexico earned approximately US $20 million from organic coffee (Nigh 1997). As the organic market grows worldwide (about 23% annually)(Nigh 1997), smallholder producers have found a niche that brings them higher prices, better working conditions, and a more environmentally sustainable method of production that often incorporates traditional techniques such as composting, mulching, IPM practices, and the use of nitrogen-fixing trees. Farmers throughout many underdeveloped countries have organized themselves into cooperative groups to capitalize on this growing market. For example, the Mam Indians in Chiapas formed a 1,328 member organic coffee cooperative known as Indigenas de la Sierra Madre de Motozintla (ISMAM)(Nigh 1997). ISMAM has been successful in improving the lives of many impoverished Indian farmers because of higher wages, a decrease in out-migration, and the elimination of hazardous agrochemicals (Nigh 1997).

Mayan farmers in southern Belize practice techniques and cooperative strategies that are similar to those found among organic coffee producers in Mexico. Mayan farmers cultivate both hybrid and local varieties of cacao organically and sell the beans to the Green and Black's Company, which is based in the United Kingdom. Farmers sell their cacao for around US $1.45 cents per pound and fair trade policies ensure that the price never drops below 80 cents per pound (Personal communication, Chris Nesbitt, 10-17-02). In 1998, the Toledo Cacao Grower's Association (TCGA) produced 28.6 tons of organic cocoa beans. In 1999, the number was down to 22.2 tons (Fair Trade Cocoa Farmers in Belize: TCGA). Cacao yields in 2001 were extremely low because many trees were destroyed from Hurricane Iris.

Table 6.1

Annual sales of cacao by TCGA to Green and Blacks

| Year | TCGA sales of cacao – kg |
|---|---|
| 1993 | 8200 |
| 1994 | 13200 |
| 1995 | 21818 |
| 1996 | 16363 |
| 1997 | 23636 |
| 1998 | 29545 (estimate) |
| 1999 | 22933 (estimate) |
| 2000 | 23000 (estimate) |
| 2001 | 7272 (estimate) |

Sources: Chris Nesbitt 2002 and David Crucefix 1998

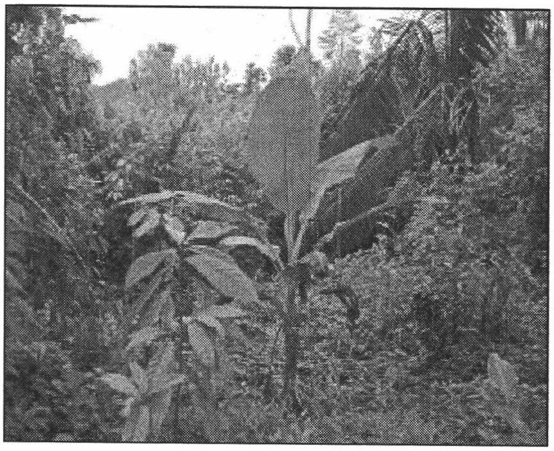
In 1994, the Green and Black's chocolate company initiated a five-year rolling contract with the TCGA for the purchase of certified organic cacao beans. In an organic system, farmers do not need to rely upon chemical inputs to produce a successful harvest. Although organically grown trees yield fewer beans compared to those found in a conventional system, there are added social and environmental benefits. The methods that are used to grow cacao organically depend greatly on the traditional knowledge that has been learned by Mayan farmers over the course of many years. In addition, the organic certification process ensures that farmers are not using chemical fertilizers and insecticides that may contaminate the groundwater or poison workers.

The Toledo Cacao Grower's Association (TCGA) has been involved in researching highly sustainable organic cacao agroforestry systems, as well as new techniques for propagating and maintaining the trees. During a trip to Costa Rica in September of 2002, a group of TCGA extension workers and staff met with members of the Centro Agronomico Tropical de investigaciones y Enzenanza (CATIE) organization and visited some of their experimental cacao farms (see appendix C). CATIE has become a large international resource center for the study of agriculture in tropical regions throughout the world (Young 1994). Some of their programs are aimed at producing new disease-resistant varieties of cacao trees that produce above-average yields (Personal communication, Chris Nesbitt, 10-14-02).

Cacao growing operations in the Toledo District have been successful due to the presence of an organic market. This has inspired some NGOs to initiate new cacao projects throughout rural areas in southern Belize. The Belize Enterprise for Sustainable Technologies (BEST) received a grant from the Caribbean Agricultural Research and Development (CARD) organization in 2002 to expand cacao production in the Toledo District by 150 acres within the next year. BEST believes that this initiative will help rural farmers increase their incomes (BEST newsletter 2003). SHI and TCGA have provided extension services, seeds, and equipment with the money they received from the CARD grant. SHI primarily targets wealthier farmers who have the resources to initiate a diversified cropping system, whereas the TCGA will offer their assistance to anyone (including non-Mayan farmers) who wants to grow cacao trees.

The TCGA also gives farmers an extra five cents per pound of harvested cacao beans if they plant cedars, mahoganies, mamey apples, or cohune palms as shade trees in their cacao fields (Crucefix 1998; Personal communication, Chris Nesbitt, 10-15-02). These trees can be planted along the edges of fields to help protect the shallow rooted cacao trees from toppling over during high winds. Large shade trees draw nutrients that lie deep in the soil up to the roots of the cacao and their fallen leaves provide a nutrient-rich mulch layer.

Farmers are also encouraged to plant nitrogen-fixing trees such as madre de cacao, bri bri, cabbage bark, and leucaena in their cacao systems. The roots of these trees fix nitrogen into the soil, which is extremely beneficial in an organic system that does not allow for the use of chemical fertilizers. Fruit trees are also recommended for planting because they can be used as a food source or a form of economic security if the cacao trees yield poorly or become diseased.



Figures 6.1 and 6.2. Left: A banana tree (in the background) was planted next to this two year-old cacao tree (front, left) for extra shade, a food item, and an additional source of income. Right: This young cacao seedling (bottom) was planted next to a chaya plant. This strategy helps to shade the young tree and provides a rich dietary supplement to households.

## Proper Shade Management in Cacao Agroforestry Systems

Cacao that is grown in an agroforestry system requires 50% shade and 50% sunlight. If the trees receive too much shade, they are vulnerable to black pod disease. If trees receive too much sun, they may become susceptible to thrips and monalonia (Johns 1999). In the late 1990's, a rumor went around among Mopan and Kekchi cacao farmers that their yields would increase if they chopped down many of their shade trees. Although this method is employed on conventional cacao farms that are dependant on chemical fertilizers and pesticides, it is not recommended for an organic system. The farmers who cut down their shade trees did quite well for their next harvest; however, during the next dry season they noticed that the leaves of the trees had been badly burnt, which was actually caused by monalonia (Personal communication, Chris Nesbitt, 07-20-02). Cacao yields plummeted during the following year, and only then did farmers realize the value of shade trees.

The traditional cacao agroforestry system used by the Mayas in southern Belize is similar to indigenous-managed cacao farms in Bahia, Brazil. During the 1970's, the Brazilian government introduced a modernization program that encouraged farmers to remove their shade trees. Because of high cocoa prices, the government wanted farmers to adopt a more "modern" approach to growing cacao, which was to use heavy applications of synthetic fertilizers, insecticides, and fungicides combined in a low shade system. The Executive Commission for Planning Cocoa Agriculture (Comissao Executive do Plano da Lavoura Cacaueira, CEPLAC) recommended that farmers eliminate 50% to 70% of their shade by poisoning large trees (Johns 1999). CEPLAC figured that this new technological package would increase cacao profits on each farm by US $260 (Johns 1999).

Johns's research results on the after effects of this modernization program are quite staggering. He learned that many of Bahia's cocoa farmers had not complied with CEPLAC's requirements. Much of the tree poison that was purchased by extension personnel was never used (Johns 1999). Farmers reasoned that by reducing their shade they would become dependent on the use of fertilizers and insecticides they could not afford. In addition, their cacao trees would become more susceptible to drought and disease (Johns 1999). Johns therefore concluded that the Bahian cocoa farmers have "an interlinked agroecological and risk-based decision logic" (Johns 1999:42). The ability for Bahian farmers to draw upon their traditional knowledge of agroforestry systems helped them to save their cacao, as well as a large section of Atlantic rainforest trees.

There are lessons to learn from the example of the Bahian cacao farmers. Unlike Mopan and Kekchi farmers, they decided not to remove their shade trees, even with the advice of researchers and extension agents. They trusted an agroforestry system that had been in place for many years. Bahian farmers did not want to engage in a risky maneuver that would jeopardize their cacao investments. Some Mopan and Kekchi farmers, however, did not see things in the same way. Following bad advice, they drastically altered their traditional systems. As organic cacao growers, they do not even have the option of using synthetic fertilizers and pesticides. It took several years for some Mayan farmers to replace their shade trees, during which they lost a considerable amount of income from their low-yielding cacao trees.

## Diversified Cacao Agroecosystems

Diversification within cacao systems is important for maintaining proper shade management and nutrient intakes, as well as for bringing in additional income through intercropping marketable crops. Hybrid varieties of *Theobroma cacao* yield well using conventional methods of production; however, because cacao trees in San Jose are grown organically without the use of fertilizers, yields tend to fluctuate from year to year. Therefore, it is extremely important for farmers to incorporate a variety of nitrogen-fixing trees into the canopy.

The Toldeo Cacao Grower's Association, Sustainable Harvest International, and Plenty Belize have been involved in promoting diversification through the planting of beneficial shade trees within cacao fields. Each of these organizations has helped to establish nurseries at various farms in the Toledo District. SHI also provided seeds, plastic bags, and extension services for Toledo cacao farmers. Plenty Belize helped some farmers obtain solar panels and pumps for irrigating tree nurseries. Cacao, cedar, teke, and mamey apple seedlings were sold for US 50 cents each. Madre de cacao, leucaena, and mylana seedlings were given away for free.

During my last week of research, I visited two cacao fields that were planted in the 1950's by my informant's grandfather. The 200 local trees were still bearing quite well, even after extensive hurricane damage. What surprised me the most were the many different types of shade trees that had been planted. Within the two systems I discovered the following species of plants and trees: mango, sugar cane, orange, grapefruit, cohune palm, coconut, tangerine, calabash, mahogany, banana, cedar, mamey apple, and salmwood. The farmer who planted this cacao used his traditional knowledge to create a diversified agroforestry system. He was able to harvest cacao and many other varieties of crops to sell to the market or keep for home use. The grandson who had inherited the trees was in the process of applying for a salvage permit to harvest two of the hurricane-damaged cedar and mahogany trees.

## Cacao Damage from Hurricane Iris

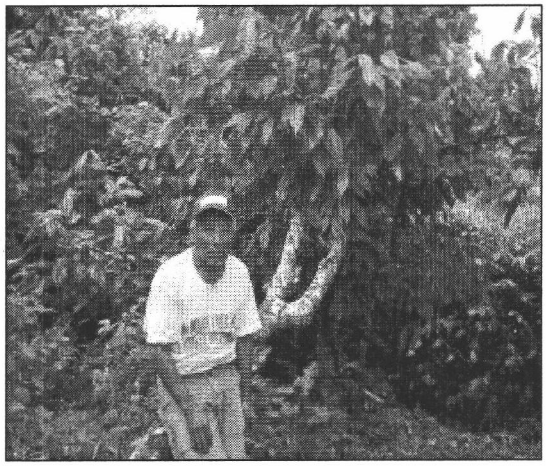
The damage to cacao fields from hurricane Iris in October of 2001 was immense. Many of the shallow rooted trees blew over in the high winds. In addition, tall shade trees fell on top of the cacao trees, causing them to break into pieces. When I arrived in San Jose in August of 2002, many farmers were reluctant to go in their cacao fields to clear away new growth and prune their trees. They only examined the damage and left the cacao to be overgrown by weeds and small trees. One informant told me that when he saw his cacao field after the hurricane it made him cry. He related the cacao to a loved one who had gotten sick or hurt. He spent many years taking care of his cacao trees and he simply could not leave them to be taken over by the forest. Although it was hard work, he decided that he needed to respect the trees that provided him with a steady income and restore them to the best of his ability. A few months after the hurricane, he and his sons went back to their cacao field and spent many weeks pruning and weeding around the damaged trees.

Figure 6.3. Cacao trees (bottom of photo) that are exposed to the intense tropical sun. Note the shade trees in the background that have been broken or have lost most of their leaves as a result of Hurricane Iris.

Mopan farmers' attitudes towards growing cacao have changed since Hurricane Iris leveled the Toledo forests in October of 2001. In 1998, Steinberg noted that many Mopan farmers were "increasingly interested in activities other than swidden agriculture such as cacao farming" (Steinberg 1998). During the fall of 2002, I observed that many farmers were skeptical of growing cacao because of the risk of future hurricanes. Instead of going out to their cacao fields to prune and weed, they concentrated on planting an abundance of *milpa* and cash crops such as corn, beans, and vegetables. It became apparent that these farmers needed to earn money quickly, as no one knew if or when the cacao trees would ever recover from such a disaster.

The damage to cacao trees differed on each plantation. Farmers who properly pruned their cacao had noticeably less damage than those who did not. Many farmers let their trees grow to heights of up to 15 feet, whereas only eight to 10 feet is recommended. They also let their trees grow very wide and bushy. The added weight from the tall and uncut branches caused the trees to topple in the heavy winds. Farmers who pruned their trees to be short and narrow had fewer trees that were lying on the ground. The well-pruned trees that remained standing also started to bear large pods in less than one year after the hurricane. On other cacao farms where pruning was done hastily, there were very few trees that started bearing pods. This may have been the result of too much stress being placed on the sensitive trees.

Hurricane Iris also destroyed many of the wild fruit trees and edible plants in the forests. This allowed birds and animals to rely on farmers' cacao and other crops as a food source. Woodpeckers bore holes in the pods, causing them to rot. Squirrels and nightwalkers (a cat-like rodent) were also seen eating ripe cacao pods. Parrots and other birds ate much of the corn and vegetable crops that were planted after the hurricane. Many farmers did not even attempt to harvest their cacao after the hurricane; therefore, the TCGA received only 16,000 pounds of cacao beans in 2001 (Personal communication, Chris Nesbitt, 10-16-02).

Figures 6.4 and 6.5. Left: A shade tree (lying flat) that had uprooted and fallen on some cacao trees. Right: A disgruntled Mopan farmer is assessing the damage to his cacao before he begins pruning.

## Cacao Pruning Techniques

Mayan farmers used a few different methods for pruning their damaged cacao trees. Most farmers simply hacked off overhanging and split branches with a machete. Although this is the most efficient means of pruning, it is not the best for the overall health of the tree. Branches can be cut by accident, which may cause a tree to dry out. Also, chopping with a machete can cause an uneven cut, which causes branches to split and peel off.

The preferred method recommended by the TCGA is to use a small handsaw to cut unwanted branches. A handsaw creates a cut that is flush with the trunk or branch of the cacao tree. This helps the tree to "seal the wound" better so that water does not collect inside a protruding notch and cause a branch to rot. Another method that is employed comes from Costa Rica and involves using a hammer and a small machete. The machete is placed underneath the desired cutting branch and a hammer is used to knock the machete upwards into the branch. This creates a precise cut that does not risk damage to the tree.

Figure 6.6. A TCGA extension worker explains to farmers the proper methods for pruning cacao trees.

I attended a pruning workshop for Toledo cacao farmers on November 5, 2002. Approximately 20 farmers from San Antonio, Crique Hoote, San Jose, Na Luum Ca, and San Pedro Columbia showed up at the meeting. Ignacio Ash (lead extension officer for the TCGA) and Auxibio Sho (Ministry of Agriculture extension worker) led demonstrations for farmers regarding post-hurricane cacao recovery strategies. The group of farmers met at an elder TCGA member's farm that contained over 1,000 thirty year-old local trees that suffered significant damage from Hurricane Iris.

The group's first task was to clear the weeds from around the trees that were going to be pruned. This helps the farmer to get under the tree and see what branches need to be taken out. Any branches that touched the ground were removed so that ants and insects would be less likely to crawl up and infest the trees. Trees that had completely blown over were not cut if pods were still forming on the trunk. Instead, one shoot that came up closest to the ground was left standing, while the others were cut away. This shoot would eventually form a new chupon (main stem) and become the new tree when the main trunk is cut away within a year or two. It was advised that the trunk should not be cut immediately because it can still produce cacao pods for one to two more years before dying. The new shoot may also dry out if the main trunk is severed, which would require a new tree to be planted. The TCGA's pruning and shade management guidelines (see appendix D) were written to help farmers improve their cacao production after the hurricane.

On October 22, 2002, I attended a meeting for cacao growers in San Jose Village. The TCGA was concerned that farmers were not cleaning and pruning their cacao trees after the hurricane. The TCGA also wanted to hear about any problems farmers may have encountered while restoring their damaged cacao trees. During the meeting, Auxibio Sho gave details to farmers about the group's recent trip to Costa Rica (see appendix C). He explained how the CATIER project farms were much better organized than those found in southern Belize. He also noted that farmers were properly trained to maintain organic cacao systems. Mr. Sho encouraged TCGA members to become more educated about diversified cacao systems and organic markets so that they could disseminate their knowledge to less experienced farmers. In addition, he mentioned that farmers in Costa Rica were producing organic bananas, coffee, and honey. Mr. Sho convinced San Jose farmers to follow the examples of these Costa Rican projects to expand into new organic markets.

# 7. Socio-economic Conditions in Southern Belize

Acculturation into a modernized Belizean society has influenced the culture and economies of Toledo Mayan villages. The growing pressures of development and the need for cash have inspired many of the younger generation of Mayas to seek wage employment in the construction industry or on shrimp and banana farms. Thus, out-migration presents a serious problem for households in rural villages. Educational opportunities have also become limited due to the low prices Mayan families receive from selling their crops.

One way in which the Toledo Mayas can integrate into a foreign economic system and still maintain their traditions is through engaging in ecotourism. The Belizean government has been promoting economic development via tourism throughout the past twenty years; yet, rural Toledo communities have not fully benefited from this industry. The paving of the Southern Highway and increased development in the Toledo District may allow the Mayas to engage in new ecotourism ventures, thereby improving economic and environmental conditions and preserving traditional practices.

## The Changing of Mopan Agrarian Traditions

San Jose Village lays an arduous one and a half hour bus ride away from Punta Gorda. The remoteness of this village is what makes it so special, but also so vulnerable. The modern world has been creeping upon this place for decades; yet, the majority of Mopan who live there are farmers who cultivate traditional crops. Men tend to their fields each day and use machetes and long, sharpened sticks for cutting down forests and planting seeds, respectively. Horses provide the means for transporting harvested crops from the field to the home. Mopan women are responsible for domestic chores, which include cooking, cleaning, and caring for the young children. They also maintain kitchen gardens and help the men to harvest and process cacao beans and other crops. Although the Mopan have retained an agrarian way of life in Belize for over 100 years, it remains uncertain as to whether they can fully maintain their culture and traditions amidst a modernized Belizean society.

The Mopan culture revolves heavily around agriculture and the processing and consumption of locally grown crops and farm animals. Houses are almost always filled with ears of corn that are constantly shelled and used for tortillas and animal food. The Mopan diet consists mostly of fruits, vegetables, rice, eggs, chicken, fish, pork, and wild game. A cast iron circular plate is laid over the fire on one side of the *comal* and is used for making tortillas and roasting peppers, cacao, and coffee beans. The other side is used to prepare meats, stews, and teas. Mopan women start a fire in the *comal* each morning to prepare breakfast, which usually consists of fresh eggs, tomatoes, cilantro, peppers, and corn or flour tortillas. The extra tortillas are then wrapped up and given to the men to carry with them to the fields. If a large group of men are out planting, the women and their daughters sometimes carry the men's lunches and beverages to the field. *Caldo* (a chicken or pork stew) is a traditional dish that is served with a drink of cacao or *sa-a* when the men are planting or harvesting crops.

Holmes (1985: 239) has noted that increased exposure to markets and acculturation often leads to the deterioration in health among indigenous societies. Likewise, the arrival of new technologies and processed food items into Mayan villages has affected the Mopans' diets. Canned goods and processed foods have begun to replace highly nutritional plants that are cultivated in kitchen gardens or gathered in the forests. The processing of raw sugar from cane plants has also declined because of the availability of cheap and imported white sugar. Many Mopan children and young adults have rotten teeth as a result of consuming this product and poor dental care. The cacao beverage is also consumed less frequently in Mopan villages because of the high market price for cocoa beans and the availability of processed cocoa and chocolate candies in village stores. In addition, soft drinks and beer have slowly begun to replace traditional beverages such as limejuice and *sa-a.*

Figure 7.1. This Mopan farmer's wife and daughter brought chicken *caldo*, corn tortillas, and a beverage of *sa-a* to workers planting corn. These women are wearing traditional Mopan dresses; however, some young girls in San Jose Village choose to wear more modern clothes that are purchased in Punta Gorda.

The increased use of synthetic pesticides and herbicides for the production of vegetable crops also poses serious health threats to families. Farmers are often unaware about the health risks involved with using these chemicals. Masks and rubber gloves are rarely worn when men spray their crops because they are expensive and deemed unnecessary. In addition, buckets of harmful chemicals without proper labels often lie exposed in the house where children play and eat.

## Education in San Jose Village

In San Jose Village, children attend primary school until the ages of 15- 16 years old. After completing grade six, they have the opportunity to attend High School in Punta Gorda. Parents who can afford to send their children to school generally do so. Others, however, rely on their sons and daughters to help in the fields and with domestic chores. Young men who do not attend high school often become farmers, find temporary work in Punta Gorda or along the Southern Highway, or join the Belize Defense Force.

If young men choose to remain in the village and become farmers, they play an important role in the community because they are helping to continue an agrarian lifestyle that is the cornerstone of the Mayan culture. Between the ages of 18 and 20 years, young farmers will marry, have children, and eventually cultivate their own sections of land. As their children grow, they will learn the age-old traditions of planting and harvesting crops, utilizing forest resources, and preparing important foods and beverages such as corn tortillas and cacao.

Table 7.1

Total Population by Level of Education Reached for Major Ethnic Groups and Sex

| | 1991 | 1991 | 2000 | 2000 |
|---|---|---|---|---|
| **Level of Education** | **Maya Kekchi** | **Maya Mopan** | **Maya Kekchi** | **Maya Mopan** |
| **Both Sexes** | | | | |
| Total | 7954.0 | 6770.0 | 11290.0 | 8272.0 |
| % | 100.0 | 100.0 | 100.0 | 100.0 |
| None | 41.0 | 35.2 | 49.5 | 44.6 |
| Nursey/Kinder | 1.1 | 1.1 | 0.1 | 0.2 |
| Primary | 55.2 | 59.2 | 46.1 | 47.9 |
| Secondary | 2.2 | 3.8 | 3.3 | 5.4 |
| Pre-Univ/Post-Secondary | 0.1 | 0.5 | 0.5 | 1.5 |
| University | 0.1 | 0.2 | 0.1 | 0.2 |
| Other | 0.1 | 0.0 | - | - |
| DK/NS | 0.2 | 0.1 | 0.3 | 0.1 |
| **Female** | | | | |
| Total | 3913.0 | 3368.0 | 5599.0 | 4207.0 |
| % | 100.0 | 100.0 | 100.0 | 100.0 |
| None | 41.4 | 36.8 | 52.1 | 48.0 |
| Nursey/Kindergarden | 1.0 | 1.0 | - | 0.1 |
| Primary | 56.0 | 58.9 | 45.0 | 46.4 |
| Secondary | 1.2 | 2.9 | 2.3 | 3.9 |
| Pre-Univ/Post-Secondary | 0.1 | 0.2 | 0.4 | 1.2 |
| University | 0.0 | 0.1 | - | 0.1 |
| Other | 0.1 | 0.1 | - | - |
| DK/NS | 0.2 | 0.1 | 0.2 | 0.1 |
| **Male** | | | | |
| Total | 4041.0 | 3402.0 | 5691.0 | 4065.0 |
| % | 100.0 | 100.0 | 100.0 | 100.0 |
| None | 40.7 | 33.6 | 47.1 | 41.2 |
| Nursey/Kindergarden | 1.1 | 1.1 | 0.1 | 0.2 |
| Primary | 54.4 | 59.5 | 47.2 | 49.5 |
| Secondary | 3.1 | 4.8 | 4.4 | 7.0 |
| Pre-Univ/Post-Secondary | 0.2 | 0.7 | 0.7 | 1.7 |
| University | 0.2 | 0.3 | 0.1 | 0.3 |
| Other | 0.0 | 0.0 | 0.1 | - |
| DK/NS | 0.2 | 0.1 | 0.3 | 0.1 |

Source: Belize Population Census 2000, Central Statistical Office

Table 7.1 shows the levels of education reached by male and female Kekchi and Mopan students in the Toledo District over a nine-year period. Although there is roughly a two percent increase of students who attended secondary school (high school) from 1991 to 2000, the overall average percentage is still relatively low (4.4%). One factor that may contribute to this statistic is the high poverty rates that are found in Mopan and Kekchi villages. Families who rely on selling agricultural products for the bulk of their income often find it difficult to afford to send their children to high school. In addition, families may also be reluctant to send their children to because they offer a valuable source of farm and household labor.

When comparing male and female students, there are a higher percentage of males who attended secondary school. This trend may be the result of a Mayan society that is typically male dominated. Young men have a greater opportunity to further their education because of their role as providers, whereas young women play a more submissive role and are expected to stay at home and help with domestic responsibilities. However, the one percent increase in females who attended secondary schools in 2000 indicates that these male-female roles may slowly be changing as the Mayas become more integrated into a contemporary Belizean society.

The statistics also show that there are an extremely low percentage (between 0.1% and 0.2%) of Kekchi and Mopan men and women who have achieved a university-level education. These results are rather discouraging because young men and women play an important role in the future preservation of the Mayan culture. If more students could enter a university and study subjects such as environmental or indigenous law, agricultural science, market economics, or tourism, then the Toledo Mayas may eventually become more successful in securing their land tenure, alleviating poverty, and promoting sustainable development throughout rural villages.

## The Effects of Out-migration in San Jose Village

Out-migration presents serious problems throughout many underdeveloped countries. Capital markets, wage labor, deforestation, land pressure, modernization, and new educational opportunities have all contributed to the migration of both young and old people to larger towns and cities. Although farming communities can limit out-migration through farm-site diversification and the planting of cash crops, it is likely that at some point a market will collapse or certain crops might fail. To eliminate this risk, it is common for some members of a household to find wage employment either full-time or seasonally (Boserup 1981).

Boserup mentioned that out-migration is not a result of population growth, "but a response to increasing rural-urban differentials in incomes, opportunities, and facilities" (Boserup 1981:205). When examining out-migration in Toledo Mayan villages, Boserup's statement holds true. Although there has been a general increase in population (see table 2.1) over the past decade, it is not significant enough to warrant high rates of rural-urban migrations. It seems more likely that social and cultural changes are responsible for the increase in out-migration. Higher standards of education, improved transportation, modernization and acculturation, and new economic opportunities have inspired many Mayas (particularly the youths) to leave their villages and travel to other Districts. In addition, development along the Southern Highway has allowed Mayan men to find seasonal and full time work on banana, citrus, and shrimp farms.

The migration of young men from Mayan villages will most likely impact the social structure of Mayan communities and the transfer of indigenous knowledge to the younger generation. Young men are responsible for helping their fathers in the *milpas*. When these men leave the village seeking wage employment, older men in the family must provide food and money for their families. The older farmers whom I interviewed were disappointed to see their sons leave the village in search of jobs. Many felt overwhelmed by the amount of work they had to accomplish without the help of their sons. It is also difficult for these farmers to afford a laborer at a price of US $7.50 per day. With already low market prices, the profit margin shrinks even further without the help from family labor resources.

In addition to losing a valuable economic resource, out-migration has a negative effect on the preservation of Mayan traditions. Netting mentioned, "Increased schooling and lack of opportunity to find farmland may result in 'deskilling' and a rapid decline in agricultural information" (Netting 1993:63). The inherited knowledge of planting crops and using herbal medicines has become unfamiliar to a younger generation that is no longer interested in pursuing farming as an occupation. Some young men whom I interviewed turned down an opportunity to take over their fathers' cacao fields and *milpas* because they did not want to stay in the village or because they were uninterested in farming. Thus, it appears that the transfer of established farmlands from father to son has become less valued in contemporary Mopan society.

Out-migration of young males in Toledo Mayan villages will most likely increase in the near future. The paving of the Southern Highway, the building of new roads, and international and domestic development projects will create new jobs that may attract young Mayan men who are looking for work. Although these men can earn an income that is more lucrative than farming, it is uncertain as to whether or not the money will make it back to their families who live in the village. I was told that some men who work away from home spend much of their earned dollars on transportation costs, liquor, and prostitution. Without the watchful eyes of family and church members, Mayan men might feel free to indulge in activities that would be considered inappropriate in their villages.

## Ecotourism Opportunities for the Toledo Mayas

Ecotourism may provide the Toledo Mayas with an opportunity to improve their economic conditions and preserve a traditional way of life. The Toledo Ecotourism Association (TEA), which was founded in 1993, has helped the Mayas establish ecotourism projects that provide a supplementary means of income for villages throughout the Toledo District. In 1995, the TEA received US $26,193 from US AID and the Belize Ministry of Tourism and Environment to help bring in materials for the building of village guesthouses (Personal communication, TEA, 11-08-02). Visitors could stay overnight in these guesthouses, eat traditional foods prepared by host families, and engage in activities such as bird watching, listening to traditional music, hiking to caves and waterfalls, and visiting ancient Mayan ruins. Mayan women were encouraged to make baskets, embroideries, pottery, and jewelry to sell to the visitors (TMCC 1997).

Although this program has helped to preserve some of the Mayas' traditional practices, the economic success has been non-substantial. With each visitor spending an average of two nights in the guesthouse, the amount of money spent per person is around US $75 (Personal communication, TEA, 11-08-02). Eighty percent of this money is distributed to families for meals and services, while the remainder is put in a village fund for health care and training. In the year 2000, there were a total of only 150 tourists who stayed in village guesthouses (Personal communication, TEA, 11-08-02). There is money coming in with this project, but it is not enough to significantly improve village economies.

Another ecotourism project was conceived in 1992 when a group of Mopan men formed the Maya Trekkers. The Trekkers provided a guiding service for tourists that included bird watching, caving, and hiking in the rainforest (Steinberg 1998). An offshoot of the Maya Trekkers, known as the Mayas Inland Expedition Group, was formed some years later in a joint partnership with the Department of Forestry, and government officials in Belmopan (Trekforce Expeditions International Scientific Support Trust Report 2001). The ultimate goal of this group was to find a feasible route that led northward to the Cayo District and document the varied terrain, ruins, caves, water sources, and diverse species of flora and fauna that would be of interest to scientists and tourists. After the trip was completed on April 4, 2001, the Mayas Inland Expedition Group recommended to the Government of Belize that the route had the potential for specialized tourism and further research by scientists. The following are excerpts from the Expedition Group's report:

> If the route is developed for tourism, it is suggested that the route be established on paper only, led by a pool of local guides, so as to not overly affect the current ecological status of the reserves...It is recommended that all stakeholders be part of the development and implementation process. As has been shown by participatory conservation practice in protected areas around the world, mutual trust is built when all parties are involved in the process. When the local community can sense the tangible benefit of conservation, they are more likely to work for conservation than against it....For the indigenous

> Maya, the mountains have provided an escape from the forced Catholic conversions of the 1600's, and have over time provided medicinal plants, materials for housing, animals, and areas of cultivation for subsistence production. The forest and the mountains house symbols of important spiritual value to the Maya, and have come to represent who they are and where they come from…The present challenge is to identify new workable options for effective conservation management and use of the lesser-known and less productive forest reserves comprising the Maya mountain region. It is thought that the potential for tourism receipts from these remote areas could be much greater and could contribute overall to the effective monitoring of these areas. Such potential could be unlocked if partnerships comprising of all major stakeholders could work together to develop and manage a series of small-scale, sustainable programs to support more visitors, whether scientists or tourists, to the area. (Trekforce Expeditions International Scientific Support Trust Report on the Expedition to Explore and Document a route across the Maya Divide, 20 March- 4 April, 2001)

The details of this report are significant because they address the concept of local participation, which is a form of self-development among Mayan communities. The initiation of this ecotourism project may help the Mayas reconnect with their homeland and find new ways to collectively manage their forest resources. It would also provide a source of income for Mayan guides who are knowledgeable of local terrain, flora, and fauna. Unfortunately, the Maya Mountain forests had been leveled by Hurricane Iris shortly after this report was sent to government officials in Belmopan. This was a tragic blow to the Mayas, as it would take many months to clear new trails. In addition, tourists and scientists might be discouraged in participating on such a venture because of the overall decline in biodiversity and species habitats due to the hurricane.

There was yet another plan for an ecotourism project that was partly construed by an American ex-patriot who resides in Punta Gorda. His idea was for the creation of an Eco-Park that would set aside 65,000 acres of land for both Mayan and Garifuna interests. The original Toledo Village Guesthouse and Ecotrail Program (TVGEP) was instigated in 1991 and included six indigenous settlements. Three of these settlements were Kekchi, one was Mopan, and the other was a Garifuna village. The TVGEP would later incorporate a total of 10 villages in the plan. For funding purposes, the TEA received a grant of US $4,750 from the Partners of Development of the United Nations in September of 1993 (Personal communication, TEA, 11-08-02).

The TVGEP included many different types of community participation programs that would eventually bring a source of income to impoverished villages. These programs included the following: tours of cash crops (cacao, citrus, cashews); home-site farms; ruins and waterfalls; a sustainable forestry program and wildlife breeding project; tourist camps; health clinics; wood- working shops; craft shops and museums; village guesthouses; farmers' centers; plant and tree nurseries; communication systems; and forest products processing plants (Personal communication, Nature's Way Guesthouse, 11-15-02). Although this program had the support of the village *Alcaldes* in the Toledo District, it was never initiated because of a lack of support from the Government of Belize and inadequate funding.

Mayan farmers can also become involved in ecotourism projects by planting botanical gardens. A farmer from San Jose chose a 25 acre leased parcel of land close to the village to plant many different varieties of tropical trees, plants, and herbs (See farm #2 in Chapter 9). The farmer planned to build a guesthouse near the garden that would attract birdwatchers, hikers, and researchers who were interested in exploring the unique flora and fauna of southern Belize.

Although ecotourism has the potential to improve Mayan economies and cultural institutions, there are some negative implications worth mentioning. An increase in tourism may result in environmental deterioration if a project is not planned and run properly. New roads that are created or improved to access old-growth rainforests may open up formerly protected areas to increased logging, hunting, and farming activities. Trails may also have to be cleared through undisturbed forests, which may alter the habitats of sensitive animals such as jaguars.

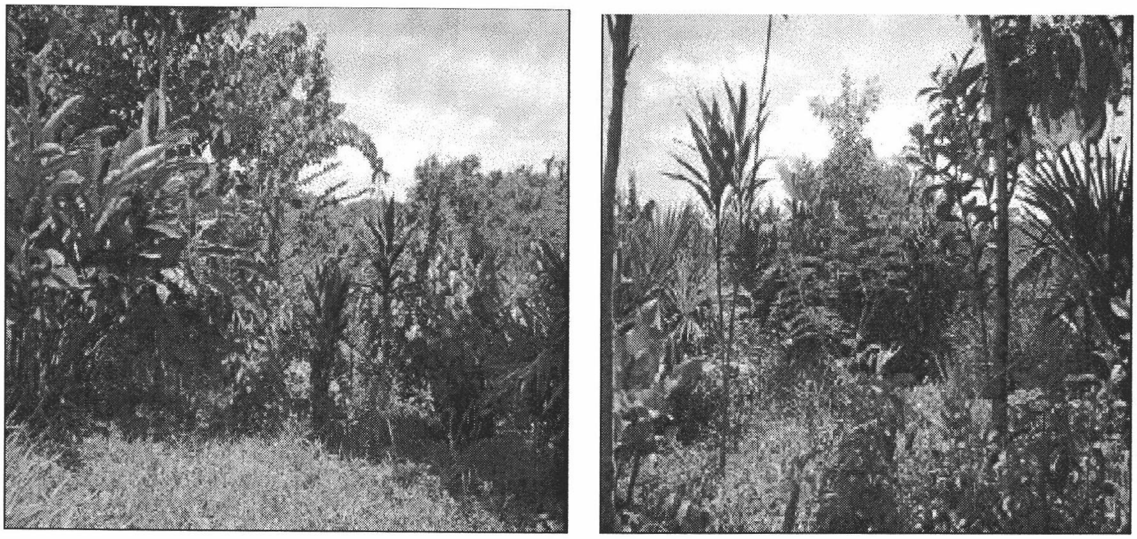


Figure 7.2 and 7.3. This Mopan farmer's botanical garden contains over 50 different species of plants and trees. The farmer hopes to attract tourists, student groups, and researchers who are interested in learning about traditional Mopan agricultural techniques and the cultivation of rare and medicinal plants.

Tourism can also have a tremendous impact on the scope of development within the Toledo District, as an increase in commodity consumption has often resulted in cultural and political change among indigenous groups (Juarez 2002). The newly paved Southern Highway may contribute to this change because of the increased traffic of visitors into rural Mayan villages. A prolonged contact with an affluent tourist population may interfere with traditional values such as dress, occupation, music, and religion. In order for tourism to be successful it must remain sensitive to cultural variations, thus preventing the unnecessary exploitation of indigenous peoples.

# 8. Ecological Theories

Cultural and political ecology theories explored in this chapter help describe how the Mopan have adapted to socio-economic, political, and environmental changes. The pressures of modernization have influenced the Mopan's culture in many ways. Religious conversions have affected traditional labor and agricultural systems in San Jose Village. In addition, population pressure and intensified agricultural practices led to deforestation and declining fallow lengths in secondary forests. Hurricane Iris also limited agricultural production and restricted access to forest resources. Thus, Mopan farmers had to reassess and diversify their farming systems to improve their economic and environmental conditions. Agricultural diversification strategies enabled the Mopan to form collaborative farming groups, which have led to Mayan controlled logging operations and newly forged relationships with NGOs and the Government of Belize. These political alliances may help to strengthen Mayan land claims, prevent unsustainable development, and conserve valuable forest resources bordering reservation areas.

## Cultural Ecology Theory

Cultural ecology theory examines the dynamic relationships that exist between people and their environment. Julian Steward defined cultural ecology as the study of "the adaptive processes by which the nature of society and an unpredictable number of features of culture are affected by the basic adjustment through which man utilizes a given environment" (Tax 1953:243). Many facets of Mopan life can be described using this theory, most notably, their religious beliefs and their dependence upon forest resources for agriculture, hunting, building materials, and medicines. Over many years, the Mayas developed a spiritual and symbolic relationship to flora and fauna found in tropical forests (see appendix E – Mopan bush doctors, rituals, and folklore). This relationship has helped Mopan farmers adapt to environmental stresses.

Mopan Adaptation Strategies

Cultural ecology theory can be used to elucidate the ways in which cultural adaptations are influenced by changing environmental conditions. As population pressure and competition for land intensifies, forest resources become limited. What typically follows this trend is a migration to less populated areas, the adoption of more sustainable cultivation techniques, the intensification of agriculture (Arnould 1990), or farm-site diversification. With regard to Mopan communities in southern Belize, all four of these adaptation strategies have occurred within the last 50 years.

Degraded environmental conditions in San Antonio Village inspired Mopan villagers to migrate to new areas. During the 1950's, population pressure in San Antonio led to shortened fallow lengths, declining soil fertility, the overexploitation of forest resources, and a large pig population that destroyed farmers' crops. These dire circumstances tempted farmers to search for new areas to plant their crops. A group of Mopan farmers scouted out a large section of land that was covered in high forest approximately six miles northwest of San Antonio. Game animals and forest resources were plentiful in this area and soils were well suited for growing crops. The farmers felled new areas of high forest and established the village of San Jose. Mopan households in San Jose Village were primarily self-sufficient; however, they did engage in some local markets in nearby villages.

Another Mopan migration occurred from San Antonio during the 1980's. Although lands were fertile enough to sustain yields under a seven-to ten-year fallow, a continuously rising population resulted in fallow lengths of less than five years (Wilk 1991). Again, the persisting problems of low soil fertility, increased erosion, and an abundance of crop-eating pigs disrupted the Mopan's agricultural strategies, thereby affecting household economies. Farmers adapted to this ecological calamity by either planting less demanding crops, pursuing other economic ventures, such as shop keeping, honey production, and petty trade, or by migrating to other towns and villages in search of employment or new farmland (Wilk 1991). Many Mopan residents moved northward and established five new villages in the Stann Creek District (Wilk 1991).

Steward mentioned, "Environmental adaptations depend on the technology, needs, and structure of the society and on the nature of the environment" (Steward 1977:44). Mopan farmers who lived in San Jose Village during the 1970's and 80's converted high forest areas into highly productive *milpas* in response to new market opportunities and a need for cash. This intensification of agriculture contributed to deforestation around San Jose. An increase in competition among farmers for fertile agricultural lands also contributed to the decline in forest resources such as game animals and building materials. San Jose villagers were faced with the same environmental problems that occurred in San Antonio Village a few decades earlier. Farmers who did not want to migrate to other areas had no choice but to alter their agricultural practices.

One of the ways in which Mopan farmers in San Jose Village adapted to these new environmental conditions was through utilizing sustainable and indigenous farming practices (Rodgers and Starr 1995) such as the use of cover crops, dense intercropping strategies, nitrogen-fixing trees, agroforestry systems, and natural pest-management practices. The mucuna bean enabled Mopan farmers to plant dry-season corn year after year in the same field without losing yields. This helped to alleviate natural resource depletion by allowing fallow lengths to increase in other agricultural areas near the village. The planting of shade grown cacao and coffee trees can also be seen as a response for alleviating ecological constraints. By planting "forest gardens," Mopan farmers were able to engage in a market economy without relying wholly on expensive chemical inputs and swidden agricultural practices.

Another way in which Mopan farmers adapted to environmental problems was through their adoption of modern agricultural technologies. During the 1980's, the Mopan were encouraged by the Government of Belize to intensify their agricultural practices. The Ministry of Agriculture provided extension agents, who were working under the TAMPVITA project, to train Mayan farmers to grow hybrid varieties of vegetables (tomatoes, peppers, and cabbages) and cacao for new markets. TAMPVITA recommended the use of chemical fertilizers, herbicides, and pesticides to increase yields, limit pest damage, and reduce labor costs (Field Notes 9-26-02).

As fertilizers and chemicals became available to Mopan farmers, the traditional swidden-fallow rotation may have become less significant. Dove and Kammen (1997) indicated that one of the major intentions of modern agricultural development was to eliminate the fallow period and maintain a continuous cropping schedule with the use of chemical fertilizers. Mopan farmers could therefore cultivate crops on the same piece of land year after year without losing soil fertility. Farmers have also learned to use herbicides in the place of a machete to clear weedy, secondary growth and mucuna. This technology has helped to reduce the amount of labor that is needed on each farm.

The conversion from subsistence to market-orientated agriculture had a significant impact on Mopan culture. For example, the transformation of cacao from a ceremonial crop to a major cash crop disrupted land-use patterns among *milpa* farmers in the reservation system. Steinberg (1998) noted that the planting of large numbers of cacao trees on indigenous reserves led to disputes within Mopan communities because such actions take land permanently out of the common-pool swidden system. Wilk also mentioned instances where Kekchi villagers were opposed to planting cacao because it "calls into question the basis of the land tenure system" (Wilk 1991:120). Wealthier farmers could afford survey costs and the purchase of leases on reservation lands (Steinberg 1998). This eventually led to economic stratification (Steinberg 1998), where wealth, jealousy, and animosity led to the creation of separate classes of farmers. Entire cacao fields were purposely burned down as a result of these social tensions between villagers (Wilk 1991; Personal communication, Chris Nesbitt, 07-20-02).

The emergence of collaborative farming groups in San Jose Village may have further increased social tensions and economic stratification within the village. During the 1980's, six different farming groups planted large numbers of cacao trees, as well as *milpa* crops, on thousands of acres of reservation land. The removal of these lands from the common-pool swidden system contributed to an increasing animosity between group members and other *milpa* farmers in the village who were not associated with a farming group. In addition, a well-known farming group called Green Creek has engaged in logging operations on their large parcel of leased land. This economic venture has enabled the Green Creek group to increase their wealth and status and become a politically strong organization in San Jose.

Conflicts appeared between farming groups because of competing interests for leasing high-forest lands that were closest to the village. Farmers within groups have also pitted against one another, mostly over the issues of land surveying. As mentioned previously in Chapter five, some Green Creek members want their large parcel of leased land surveyed and split up into individual sections. This would help to delineate boundaries that are presently not marked, thus guaranteeing each member harvest rights to specific trees. The land survey would also allow members to sell their parcel more easily because they would know exactly how much acreage and how many trees they owned. Other group members, however, disagreed with this strategy because the division of the Green Creek land-base takes away from the group's cooperative ideologies (Personal communication, Thomas Coh, 11-18-02).

Although the Mopans' intensified agricultural practices were most likely an adaptive response to degraded environmental conditions and the availability of new markets, there were also social and cultural influences that spurred this intensification process. Mopan farmers became more interested in learning about new agricultural techniques and market opportunities because of their desire to gain material wealth and social status. The hybrid variety of cacao that was introduced by extension agents was quickly adopted because it yielded more beans, though the Mopan had relied upon the local and disease resistant variety for many years. Vegetable crops such as sweet peppers, tomatoes, and cabbage that had been traditionally grown in kitchen gardens were beginning to be cultivated in large numbers using chemical inputs that were unfamiliar to many farmers. These risky behaviors were most likely a response for the need of cash, as Goldin (1996) has noted that poor families often rely on the market production of non-traditional products such as vegetables to improve their economic conditions. Although the Mopan still cultivated their traditional staples of corn, beans, and rice, many farmers expanded their production of these crops for markets in Guatemala and northern Belize.

The interplay between Mopan farmers and extension officers, government agencies, businessmen, researchers, and conventional farmers such as the Mennonites, has played a significant role in the Mopan's modernization process. The desire to earn cash through intensified agricultural production most likely contributed to a greater dependence upon imported goods and technologies. As the Mopan became more integrated into the Belizean economy, they began to adopt new cultural traits as well. English soon replaced Mopan Maya as the primary language that was spoken in the San Jose school. Students were even discouraged to speak in their native tongues with some non-Mayan teachers. Reggae, rap, and punta music that were borrowed from the Garifuna culture (a mixture of African and indigenous Caribbean ethnicities) have become the most popular forms of music among Mayan youths. Newly forged political relationships with the Government of Belize have also brought new types of development into some Mayan villages such as new and improved roads, electricity, and tourism.

Although modernization and the intensification of agriculture may have sparked a cultural change among the Mopan, it did not contribute much to the economies of local villages. Even with the increased production of cash crops, the Mopan still remain a relatively poor ethnic group. Most farmers lacked the monetary resources to purchase the hybrid seeds and chemicals that were being offered by the Ministry of Agriculture. Mechanized agricultural equipment could not be purchased from credit because farmers could rarely obtain any financial assets. In addition, traditional forms of labor were still utilized for cash cropping. Although farm laborers sometimes arrive from Guatemala looking for work, there have been no significant seasonal migrations of migrant farm workers to rural Mayan villages.

Modernized farming practices have not completely taken hold in San Jose Village; however, they have had a tremendous influence on Mopan society. Processes of cultural diffusion have enabled farmers to learn about new markets and crop varieties, most notably cacao, mucuna, peppers, and annatto, as a result of their meetings with extension agents. The Mopan have also become increasingly interested in organic agriculture, logging operations, and ecotourism as a result of new contacts with NGOs and private businesses.

As farmers learn to merge new and old techniques, they must still utilize their knowledge of traditional agricultural systems. These systems revolve around a farmer's intrinsic experience with plants, soils, and trees, and microclimates, as well as other farmers. Amanor noted that a farmer's knowledge is "a dynamic system of interaction between people and the environment in which responses are continually made to changing conditions, and knowledge is continuously updated as adaptations are made and remade" (Amanor 1994:126). The organic cacao market provided an excellent opportunity for the Mopan farmers to draw upon this source traditional knowledge. Without the use of synthetic fertilizers and pesticides, they must rely on the traditional method of planting different varieties of shade trees to keep the cacao healthy. This results in high levels of biodiversity that helps to protect cacao trees against pests and diseases.

Farm-site diversification has allowed the Mopan to successfully adapt to a changing environment and economic system. Farmers have substantially increased their incomes by cultivating organic cacao trees in a highly sustainable agroforestry system. Fruit trees and some species of hardwoods have also been planted for investment purposes. In addition, the commercial production of vegetable crops such as tomatoes, cabbages, and peppers has allowed farmers to tap into fairly lucrative Punta Gorda markets. Intercropping strategies also allow farmers to maintain more productive *milpas.*

Farmers have diversified their farms through activities such as bee keeping, pressing sugar cane, and raising livestock. Wild plants that were traditionally collected for subsistence and medicinal uses are sold in markets and to tourists. Farmers have also begun cultivating rare and useful plants such as palms and jippy jopa for seed production. Even wild species of *helconias*, such as *chi-ki* and *ma-buy,* have become economically important to Mopan families. These plants grow in abundance in the now "open" forests that were created from Hurricane Iris. Price (1997) indicated that it has become increasingly common for indigenous people to sell wild foods in the market because of the need for extra cash. Thus, the ability for the Mopan to recognize specialized resources as valuable commodities has enabled them to become more competitive in a growing market economy.

The Mopan's emergence into a modern society and economy has led to a loss of traditional knowledge, particularly among young men and women. Most village boys whom I interviewed had little interest in learning about traditional agriculture, medicinal plants, or Mopan music. New houses were constructed out of cement or with tin siding, as opposed to traditional thatched structures. In addition, there was a dependence upon imported and processed foods, as well as gas-powered engines for grinding corn and milling rice. As the Mopan embrace new technologies that are both available and affordable, the old ways of living may become forgotten.

Religious Influences in Mopan Society

The decline of traditional knowledge among contemporary Mopan societies may also be associated with the introduction of Protestant and Evangelical religions during the late 1970's (Steinberg 1998). Before the arrival of these missionary groups, Mopan religion was a fusion between Catholicism and pre-conquest ideologies. The Catholic Church allowed to Mayas to practice their traditional rituals and ceremonies such as the deer dance, the sacrifice of animals, the burning of incense, and the recognition of mountain spirits and deities.

Goldin (1996) mentioned that Protestant conversions among the K'iche' Mayas in Guatemala brought about social and cultural changes because of the influence of American missionaries and their capitalist ideologies. The same holds true for Mopan communities. Protestant missionaries were sent to San Jose Village to dissuade the Mayas from their traditional and Catholic-based forms of worship (Field Notes 10-14-02). Leaders of Baptist, Mennonite, Nazarene, and Pentecostal religious groups started building churches in San Jose with the prospect of converting the Mopan. An examination of dissimilar religious beliefs among members of the San Jose community provides valuable insights as to how the Mopan culture has changed as a result of modernization and foreign influences. The arrival of new religions in Mopan society may also help to explain processes of secularization, market integration, and the decline of social ties and communal labor pools among farmers.

Protestant and Evangelical religious groups arrived in San Jose at a time when the Mopan were in the process of acculturating into a modern Belizean society. The Mopan's infatuation with a modern lifestyle may have led to their eventual acceptance and adoption of these new religious beliefs. This often resulted in secularization, where the old ways of living and worshipping became replaced with those that are similar to late twentieth century European and American cultural institutions.

Secularization changed the way in which the Mayas viewed their natural environment. Converts who associated natural phenomenon with the spirit world were considered to be practicing witchcraft (Steinberg 1998). The old practice of burning incense to appease mountain spirits and protect one's crops was not only seen as taboo, but it was also considered a waste of time because the results of such actions could not be proven scientifically. When farmers stopped practicing these rituals and noticed that their crops grew the same as before, they abandoned many of these traditional behaviors. Furthermore, newly introduced technologies such as fertilizers and pesticides lessened the Mopan's dependence on the environment for successful harvests. When using these synthetic chemicals, farmers could rely less upon nitrogen-fixing trees and plants, mulching techniques, fallow lengths, or an integrated pest-management system to maintain soil fertility and prevent crop damage from insects and diseases.

The presence of Protestant and Evangelical religious groups in San Jose Village also led to changing socio-economic conditions within the community. As the Mopan joined different churches, relationships in the village began to change (Field Notes 10-27-02). Each new religion had its own set of rules that members had to follow. Kinship networks eventually dissipated as a result of new social pressures and cultural disparities between the younger and older generations (Field Notes 10-27-02). Steinberg (1998) noted that younger generations were attracted to the new religions because of their emphasis on individual prosperity that is found in developed countries. Young men and women may have therefore wanted to break away from the older ideologies of their parents because of the influences of modernization (Steinberg 1998). This has resulted in a loss of communication and shared knowledge between generations.

The traditional labor system that is practiced among farmers has been an integral part of the Mopan's cultural heritage. It has also provided the Mopan the means to produce agricultural goods without relying on an expensive source of hired labor. This system, however, has been affected by the Mopan's conversion to Protestant and Evangelical religious groups. The size of the communal labor pool among farmers slowly dissolved as animosity, distrust, and jealousy grew between villagers with different religious beliefs (Field Notes 10-16-02). The new religious groups did not tolerate the practice of the old Catholic-based rituals because they were associated with the worshipping of idols. Mopan farmers who remained Catholic performed these rituals in secrecy, as to not draw attention from neighbors and relatives who belonged to a non-Catholic church. During my research, I noticed that Catholic farmers generally farmed with other Catholics. The same was true with farmers who belonged to other religious groups. Traditional communal labor pools apparently shifted from a primarily kinship-based system to one that placed more emphasis on similar religious beliefs.

Table 8.1 shows the diversity of religious groups in the Toledo District. Although no data could be found concerning Mopan and Kekchi religious affiliations, these statistics describe trends associated with the rise in new religious groups and the decline of Catholicism in the Toledo District within the past decade. The 9.7 percent increase in Baptist denominations and the 7.6 percent increase in the 'other' category are significant because they indicate the presence of Protestant and other missionary groups throughout the Toledo District. The 14.5 percent decrease in Roman Catholic affiliations appears to be the result of a high conversion rate among Catholics to Protestant and other religious denominations.

Table 8.1

Toledo District Populations by Religion for Major Divisions
Source: Belize Population Census 2000, Central Statistical Office

| Major Religions | 2000 Total | 2000 % | 1991 Total | 1991 % |
|---|---|---|---|---|
| Total | 23117 | 100.0 | 17486 | 100.0 |
| Anglican | 98 | 0.4 | 162 | 0.9 |
| Bahai Faith | 28 | 0.1 | 35 | 0.2 |
| Baptist | 2234 | 9.7 | 3 | 0.0 |
| Hindu | 11 | - | 708 | 4.0 |
| Jehovah Witness | 199 | 0.9 | 160 | 0.9 |
| Mennonite | 645 | 2.8 | 451 | 2.6 |
| Methodist | 627 | 2.7 | 597 | 3.4 |
| Mormon | 7 | - | 0 | 0.0 |
| Muslim | 10 | - | 9 | 0.1 |
| Nazarene | 1015 | 4.4 | 836 | 4.8 |
| Pentecostal | 2001 | 8.7 | 1780 | 10.2 |
| Roman Catholic | 12137 | 52.5 | 11722 | 67.0 |
| Seventh Day Adv. | 351 | 1.5 | 144 | 0.8 |
| Salvation Army | 3 | - | 1 | 0.0 |
| Other | 2089 | 9.0 | 239 | 1.4 |
| None | 1574 | 6.8 | - | - |
| DK/NS | 88 | 0.4 | 639 | 3.7 |

## Hurricane Iris and the Adaptive Cycle

When hurricane Iris swept through the Toledo District in October of 2001, Mayan communities were severely affected by the damage. The strong winds leveled a large section of forest that was over 100 miles wide and destroyed the Mayas' homes and crops. Much of the forest became inaccessible due to the fallen trees and excess weed growth from the newly opened forest canopy. This prevented the Mayas from obtaining medicinal plants and other important forest resources. In addition, animals that were hunted for a protein source had either been killed by the hurricane or left the area in search of standing forests.

After this environmental catastrophe, the Mayas had to adapt to their new surroundings. The Mopan's corn plants had blown over, so farmers went out to their fields and collected the ears off of the fallen stalks. Although the corn was premature, it was used for tortillas and chicken feed. The Mopan also had difficulty rebuilding their homes because of a lack of cohune palm fronds for roofing materials. In response to this situation, men were hired to cut palm leaves from sections of undamaged forests and deliver them to San Jose Village.

As a result of the hurricane, Mopan farmers who were engaged in cash-cropping activities had to change their strategies in order to provide food for their families. The tasks of repairing and rebuilding homes left farmers with little time for planting new crops for the market. In addition, farmers' fields were covered with debris that had to be removed. In response to these conditions, farmers planted enough crops to cover their subsistence needs (Field Notes 9-28-02). Rice, however, could not be planted due to the presence of woody debris and its potential for starting large forest fires. Mopan families therefore had to purchase the grain from stores in Punta Gorda.

Hurricane Iris also disrupted the ecotourism business in which Mayan communities depended upon for an additional source of income. Tourists have been reluctant to visit the Toledo District because the pristine forests that had once contained many types of birds and animals had been destroyed (Personal communication, TEA, 11-08-02). Many of the guesthouses also had to be repaired in order to accommodate visitors. The effects of the hurricane on the tourism business are long-term. It will probably take another 10 to 15 years for the forests and wildlife to return to their former conditions. During that time, the Mayas likely will have to focus on agriculture and wage employment as their primary means of income.

Hurricane Iris was also responsible for changing the attitudes of the Mayan people. Those who found it difficult to make a living from farming before the hurricane were completely discouraged by the events that took place. Some Mopan families in San Jose chose to leave the village and move to other districts after their homes and crops were destroyed. Many of the families who remained in San Jose were distraught and feared future hurricanes, although they are not as common in Toledo than in northern Belize. The last major hurricane to hit the Toledo District was in 1945. It leveled entire forests and farmlands, causing widespread famine (Romney 1959).

Farmers were also reluctant to continue planting and maintaining cacao trees because all of their hard work could be lost in a single moment. Instead, they focused primarily on short-term crops such as corn, beans, and vegetables. It is uncertain as to whether or not Mopan farmers will continue to engage in agroforestry systems, as Hurricane Iris meddled with the Mopan's confidence in the economic security of those systems.

The environmental and social changes that were incurred as a result of Hurricane Iris can be analyzed using Holling and Gunderson's (2002) model of the adaptive cycle. There are four phases in this cycle, which include exploitation, conservation, release, and reorganization (Holling and Gunderson 2002). During the exploitation phase, Mopan farmers clear fields and plant an array of crops. As land use intensifies and environmental conditions worsen, the conservation phase evolves because "the slow accumulation and storage of energy and material are emphasized" (Holling and Gunderson 2002:33). The release phase would typically describe events that cause the system to collapse, such as pest outbreaks, natural disasters, fires, or droughts. In this case, it was the destruction of Hurricane Iris that caused the point of release. Following next is a reorganization phase, where farmers must rebuild homes and replant crops that had been destroyed. It is also during this phase when farmers evaluate whether or not they will keep planting permanent crops in the future. The learned experience of losing entire fields of cacao trees is an important part of this process.

To elaborate more upon cultural ecology theory, it is necessary to examine how cultural and environmental dichotomies are representative of Mopan social institutions and agricultural systems. As discussed previously, cultural transformations affect environmental conditions, just as changes in the environment influence cultural behaviors. Thus, nature and culture are embedded within a web of connectedness (Holling and Gunderson 2002). The Mopan's emergence into a market economy has led to an increase in land use and shortened fallow lengths (Steinberg 1998). This over-exploitation of resources therefore contributed to modernization and the subsequent decline of traditional and kinship-based farming strategies.

Cultural adaptations have also changed the ways in which the Mopan utilize their environment. The influence of a modernized Belizean culture and Protestant religious groups has led to a decline in traditional knowledge and agricultural practices. The

Mopan's reliance on synthetic fertilizers and pesticides for cultivating vegetable crops has led to a less significant swidden-fallow rotation. Pesticide use may also contribute to the polluting of local rivers and streams that are used for drinking water, washing, and bathing, as well as a reduction in beneficial insect populations. The formation of farming groups in San Jose Village was also a cultural adaptation that has led to an increase in the planting of cacao trees and the extraction of timber resources. Farming groups have contributed to the removal of lands from the common-pool swidden system (Steinberg 1998), which leaves other farmers less land for cultivating subsistence and cash crops.

## Political Ecology Theory

Political ecology theory has become an important tool among social scientists for understanding how development schemes and discriminatory government policies affect socio-economic and environmental conditions in peasant and indigenous communities. Modernization theorists have stated that less developed countries do not actively pursue economic development because they possess low levels of available capital (Billet 1993:4). Therefore, poorer countries must depend upon external capital flows (official development assistance, external debt, and foreign direct investments) to initiate economic development programs (Billet 1993:5). Large multinational corporations often seize upon this opportunity by investing their capital into countries with favorable political climates, cheap labor sources, and relaxed environmental policies.

Global production and trade have become necessary means for maximizing the profits of corporations throughout developed countries. In 1992, there existed over 10,000 multinational corporations with over 90,000 subsidies located in many countries from around the world (Billet 1993:5). Foreign investments are deemed necessary for economic development in less developed countries; however, many of these development schemes disrupt the economic and political systems of rural communities, especially those that are dependent upon communally owned resources for agriculture and gathering forest products.

Large-scale agricultural development poses many threats to indigenous farming communities in underdeveloped countries. Although many smallholders have intensified their agriculture to better cope with a changing economic system and unstable markets, it remains difficult for them to improve their economic conditions amidst a rapidly growing industrial agricultural movement. Development economists have stated, "In poor countries, agriculture absorbs most of a country's land, capital, and labor. As agriculture modernizes, it becomes an engine of general economic growth – pushing rural people out of the countryside and luring rural people into higher-paying urban jobs by encouraging growth in activities unrelated to agriculture" (Godoy 2001:16). The prevalence of modernized agriculture in underdeveloped countries not only affects migration patterns, but it also disrupts the traditional management of resources and basic food procurement strategies in rural farming communities.

Agro-industrial production intensifies the amounts of land and labor used to cultivate crops for international markets, thereby limiting land use for subsistence agriculture (Rodgers and Starr 1995). For example, in northern Thailand, the introduction of corn and litchi fruit monocultures has resulted in the abandonment of subsistence practices (Jian 2001). The development of oil palm plantations in Indonesia in the 1990's has turned forest lands into monocultures, thereby encroaching upon traditional swidden fallows, groves of rubber trees, and mixed gardens that had once been used for subsistence food production and an economic venture (Potter 2001).

Policies initiated by governments in underdeveloped countries have generally favored large-scale infrastructure development projects that tend to neglect resource-poor farmers (National Research Council 51). Green revolution agriculture tends to "favor larger, capital-rich, mechanized farms and thus exacerbates local socio-economic inequity" (Dove and Kammen 1997). Thus, the establishment of industrialized farms throughout the tropics has led to environmental degradation, shifting economies, and unstable land tenure.

The rise of multinational agribusinesses has enabled government agencies and wealthy landowners to profit from agriculture, livestock, and timber production, all of which have long-term impacts on local populations. As indigenous communities become further marginalized, they are at risk of losing their land-base and traditional agricultural practices (see appendix F for more examples). Without adequate land on which to sow their crops, families must relocate to urban areas or the agrarian frontier in search of employment.

## Development Initiatives in the Toledo District

The Mayas who live in remote areas of the Toledo District have not yet been fully exposed to rigorous development activities that have been described in the previous section. The Toledo District has often been referred to as the "forgotten district," and for a good reason. The Maya Mountains form a geographical barrier that secludes Toledo from the Cayo District to the north. High annual rainfall totals and a lack of paved roads leading into the interior, have also contributed to its relative isolation and rural atmosphere. Pichon (1996) noted that accessibility to markets and the quality of infrastructure are both major factors that contribute to changing land-use patterns. Thus, agricultural production in remote areas of the Toledo District is primarily small-scale and subsistence oriented, although a few main crops are grown specifically for the market. Most of the large agro-industrial farms are located in the Orange Walk, Cayo, Corozal, and Stann Creek Districts of Belize.

The Government of Belize has recently designated the Toledo District as a target for economic development via agriculture, oil and gas exploration, marine resources, and tourism. In 1997, the Ministry of Energy, Science, Technology and Transportation granted a permit to a foreign gas and oil exploration corporation, known as AB Energy, Inc., to search for oil reserves on approximately 750,000 acres of land in the Toledo District (Indian Law Resource Center 1998). The paving of the Southern Highway will near completion in 2004, therefore bringing more development into the heart of the Toledo District. The government has also proposed to pave a road that links Punta Gorda to Guatemala. This road would serve to expand agricultural markets into Guatemala, which may result in more intensive farming practices throughout southern

Belize. It may also attract large businesses that would establish large banana and citrus farms near reservation lands.

The Indian Law Resource Center is representing the Mayas in their case against the Government of Belize. Although the government issued a temporary ban on development along the Belize-Guatemala highway in the spring of 2003, there still remains a sense of urgency to protect Mayan homelands from government sponsored development schemes. The Indian Law Resource Center's report mentions the following:

> A second major focus of our work with the Maya regards a road-paving project that will run through the heart of the Maya communities to Guatemala and link Belize with the Pan-American highway network....The paving of the road raises major environmental, social and safety concerns, as the existing dirt road cuts directly through now-remote Maya villages where the rare vehicle passing by is a major event. Paving will dramatically increase traffic and inevitably lead to accidents as well as the development of gas stations and convenience stores along the road. Large-scale citrus and banana farming will become more attractive to commercial interests, and logging and oil development will become much more profitable. Without legal rights to their lands, the Maya communities will suffer devastating impacts. This road-paving project bears the hallmarks of unsound development: lack of transparency; failure of the national government to consult with or respect indigenous peoples; and preference for top-down, unsustainable development over protection of the environment and human rights.
> (Report from the Indian Law Resource Center 1998)

Political ecology theory can also be used to describe how growing political and economic interests have influenced the Maya's access to forest resources. The Mayas who live in Belize are considered by many to be a minority with weak political connections to the government (Field Notes, 07-19-02). These connections, however, have grown stronger as the Maya have become more knowledgeable of how politically based decisions may ultimately affect their communities. In the past 20 years, NGOs such as the Toledo Maya Cultural Council, the Toledo Cacao Grower's Association, Plenty Belize, the Toledo Ecotourism Association, Sustainable Harvest International, and SAGE have helped Mayan communities to become more politically active in their struggle against unfair land tenure policies, government development schemes, low market prices for agricultural products, and non-Mayan logging operations on reservation lands.

The two main political parties in Belize are the People's United Party (PUP) and the United Democratic Party (UDP). The term of office for the party in power is five years. After that term is over, a new democratic election is held. PUP and UDP parties have recently been successful in reaching out to Mayan communities in southern Belize in search for votes. Promises of new roads, improved agricultural services and markets, and stronger economic conditions have inspired the Toledo Mayas to become more involved in local politics. Although many of these promises are seldom fulfilled, they create a means for drumming up support and capturing votes.

According to one of my informants, the PUP has been successful in supporting small farmers and farming groups by providing extension services and initiating inexpensive government sponsored land surveys. Their former leader came from a poor family and was apparently a good representative to Mayan farming villages. On the contrary, the UDP political agendas were more concerned with increased development activities like improving roads and infrastructure in Mayan communities. Many of these projects were initiated but seldom completed.

The Maya's entrance into the political arena has both positive and negative influences on small agricultural communities in the Toledo District. One benefit is that a minority voice is now present in the larger political arena. This is important because land tenure is highly unstable in most Mayan occupied areas of Toledo. The Mayas may eventually become successful in obtaining their land rights if they can elect a politician who is sympathetic to their causes.

There are also many negative consequences that have surfaced in Mayan villages due to political associations. Communities have become divided because of political issues. After attending political rallies that were held by both UDP and PUP parties, I noticed that the population of the San Jose Village was equally divided between the two parties. The Mayas take these elections seriously because many people are affected by a change of political power. For example, the man who drove the bus from San Jose to

Punta Gorda twice a day refused to carry PUP supporters to the rally in San Pedro Columbia because he wanted the UDP to win. If the PUP won the upcoming election, the new administration would fire him and replace his bus service with one that is supportive of PUP interests.

The Mayas' access to farmlands and forest resources is also affected by political decisions. Individual farmers and farming groups have been steadfast in their attempts to persuade government officials to build new roads that lead to common-use areas. These roads would help to increase the efficiency of transporting crops. Problems arise, however, when there is a shift in power between the two main political parties. Many of the road construction projects that were promised by politicians were only completed halfway because the party that was in power lost the following election. Such an event happened to the Green Creek farming group during the 1980's. The road leading out of the village to their leased land was never finished, therefore making it difficult for members to transport cacao seedlings to their fields and bring in harvested crops to the village.

Discriminatory political associations were also observed in the San Jose community when I noticed that building supplies from hurricane relief funds were delivered to selected households throughout the village. Although every family was supposed to receive lumber to repair or rebuild their homes, only those who belonged to the UDP (the party that was then in power) received the materials. The scenario that emerged was rather disheartening. On one side of the road lived a UDP supporter whose house had not been badly damaged, yet he had stacks of lumber that were lying unused in his yard. On the other side of the road lived a PUP supporter with a hurricane-ravaged house and no materials to rebuild or repair it.

Political ecology theory can also be used to elucidate the complex issue of land tenure. Securing Mayan land rights in the Toledo District has been a major priority for NGOs and Mayan cultural organizations. In the 1980's, the Toledo Mayan Cultural Council planned for the creation of a 500,000-acre land-base that would be shared by Mayan communities (Palacio 1989; Wilk and Chapin 1989). The outcome of this political battle between advocates for indigenous land rights and the Government of

Belize will most certainly influence the Maya's future socio-economic conditions. Without a designated land-base for the cultivation of cash crops, Mayan agricultural areas may become threatened. The government's interest in controlling Mayan occupied lands may lead to new development schemes that will displace Mayan communities and convert Indian reservation lands into privately owned monocultures.

Rodgers and Starr (1995) have commented on the types of development schemes that contribute to the marginalizing of indigenous peoples. In their views, modernization and economic development are based on profit motives that are held by central controlled agencies (Rogers and Starr 1995). This type of development impedes local peoples' abilities to make decisions that reflect their own goals and interests. Rodgers and Starr therefore argue for self-development, which places more emphasis on social and cultural improvements rather than economic strategies (Rodgers and Starr 1995). Self-development teaches communities to rely on traditional knowledge as a means to achieve sustainability. For example, the rediscovery of indigenous farming techniques has led to a new appreciation for intercropping, integrated pest-management, mulching, and the use of nitrogen fixing trees in agroforestry systems (Rogers and Starr 1995).

The Mopan in San Jose Village have initiated this type of self-development in an effort to compete in a market economy. Their reliance on a traditional shaded agroforestry system for the cultivation of cacao has enabled them to produce organic cocoa beans for an international market. Their use of cover crops has helped to conserve land and avoid the need to purchase expensive fertilizers. In addition, the Mopan's venture into the ecotourism business has provided a small but significant source of revenue for local villages. It has also helped to preserve the Maya's culture and environment.

The success of any community-based development plan is largely dependent on the availability of agricultural lands and forest resources to local user groups. Access to communal resources is vital for improving social and economic conditions among indigenous groups, as common property allows for an equal distribution of resources within a given boundary (Tucker 1999). Tucker's research (1999) in Honduras examined social, political, and ecological issues associated with the Lacamperos' uses of common property forests. In 1974, the Honduran national Forestry Development Corporation (COOHDEFOR) designated all trees as federal property, thus creating a situation where timber resources were no longer controlled by the local population (Tucker 1999). When COOHDEFOR withdrew from the program in 1987 as the result of public protest, the forests became common property again (Tucker 1999). Although traditional resource management systems had been reintroduced, Tucker observed that the size of common property forests had declined due to privatization (Tucker 1999). This often occurs when communally managed resources become exploited for commercial uses (Chapman 1989). As access to forest resources became limited because of new privately held land claims, social stratification eventually emerged within the Lacampero community (Tucker 1999).

Picchi (1995) has given another example of how privatization affects communal resource management among indigenous societies. His study of the Bakairi Indians of Central Brazil is grounded in political ecology theory and has shown how macro and micro-level forces influence demographic and economic variables that are related to local production systems (Picchi 1995). The Bakairi's communal uses of *Cerrado* lands for cattle-raising and gallery forests for cultivating food crops became altered when the Brazilian Indian Foundation (FUNAI) sponsored agricultural development programs. These new modernization initiatives were designed to allow the Bakairi to increase their food supply on *Cerrado* lands and engage in new markets (Picchi 1995). Although the Bakairi did succeed in improving their economic conditions as a result of using mechanized farming equipment and FUNAI-owned cattle, these changes eventually disrupted traditional patterns of resource uses. The Bakairi never recognized private ownership of any type of resource, including cattle. This changed, however, when some members of households began acquiring additional cattle from the communal herd and hiding them in remote sections of *Cerrado* lands (Picchi 1995).

The mechanized rice-farming project also affected traditional resource uses among the Bakairi. Fewer households planted swidden gardens in the gallery forests because they were receiving money from FUNAI and from selling rice that was grown on *Cerrado* lands (Picchi 1995). The Bakairi's dependence on rice production for their main source of income also led to new demands for vehicles and other types of Western technology (Picchi 1995). This, in turn, affected Bakairi cultural patterns and the ways in which they traditionally exploited their environment.

Tucker's study of Lacampero common property resources and Picchi's analysis of development projects among the Bakairi Indians become relevant when evaluating the Mopan's political relationships with the Government of Belize. The Mopan face similar pressures of modernization as the Bakairi; however, Mopan farmers have not fully adopted new agricultural technologies and cattle-raising projects. Could it be that Mopan farmers also have an "interlinked agroecological and risk-based decision logic," much like Johns (1999:42) described of Bahian cocoa farmers? It is possible that Mopan farmers did not want to adopt these new practices because their traditional agricultural and labor systems were still highly functional and adaptable. Farmers may have also reasoned against investing in expensive machinery, agrochemicals, and livestock because of the many difficulties they have faced in finding stable and profitable markets.

Similar to the Lacampero's situation, the Mopan's system of traditional resource management has become threatened because of a lack of secure land tenure and the government's interest in agricultural development and commercial logging operations. Although leased land titles are a form of privatization among Mopan farmers and farming groups, they do not guarantee land rights. This prevents the Mopan from having full access to common-use forest resources both inside and outside of reservation areas.

The privatization of communal land through leasing has had both positive and negative influences on Mopan communities. One benefit of the leasing option is that it encourages farmers to employ more sustainable agricultural practices, which helps to reduce fallow lengths on reservation lands. Farmers who choose to cultivate their crops year-round on a 25 or 50-acre section of leased land will most likely use a cover crop of mucuna or kudzu (*Stitzolobium* spp.) for conservation purposes. Farmers may also be more likely to invest in long-term crops like cacao, citrus, and timber trees because they feel that their land tenure is more secure with a lease.

One of the consequences of privatization through lease titles is that it removes land from the common-pool swidden system. As mentioned earlier, this has been known to increase tensions that exist within the village because only wealthier farmers can afford survey costs for leases (Steinberg 1998). Brown has stated, "The institution of private property pits one group struggling for survival against another struggling to accumulate greater wealth" (Brown 1997:108). Social stratification may therefore have a negative effect on the Mopan's traditional farming practices because of disparate political and economical interests that are held between households and groups of farmers. Furthermore, Wilk noted, "When private ownership is instituted suddenly by government action, contracts and agreements are more likely to be broken than negotiated" (Wilk 1991:237). This process may eventually lead to a decline in communal resource use and the dissolving of labor-exchange groups in San Jose, both of which would affect social relations and food distribution within the village.

## The Political Ecology of the Southern Highway

A major concern to Toledo Mayan communities is the paving of the Southern Highway. This highway project connects the more developed northern section of the country to the rural south and was initiated to bring economic potential to southern Belize via tourism and the export of agricultural products (Personal communication, Chris Nesbitt, 10-16-02). To create awareness about the project, the Government of Belize and the Inter-American Development Bank initiated a program known as the Environmental, Social, Technical Assistance Program (ESTAP) (TMCC 1997). Although ESTAP encouraged participation among community leaders in the Toledo District, their demands were largely ignored (The Maya Atlas 1998).

The paving of the Southern Highway is a mixed blessing for the Mayas who reside in southern Belize. There will most certainly be new economic opportunities for the Mayas in the agricultural and tourism sectors. The availability of new jobs may help to reduce poverty and improve health conditions in remote villages. The road may also benefit Mayan farmers who choose to send their crops to more profitable markets in central and northern Belize.

Although new economic development may contribute to a more productive and financially secure district, there are many social and environmental concerns that have been mentioned by NGOs and Mayan leaders. The most controversial issue at hand is the Maya's lack of secure land tenure, which was supposed to have been resolved before the completion of the highway. The inability for Mayan communities to secure access to their lands may lead to the increased exploitation of forest resources from logging, oil exploration, and the creation of large banana and citrus plantations. These activities will most likely contribute to enhanced patterns of out-migration, environmental deterioration, and a decrease in subsistence agriculture, all of which may further erode the Maya's social and cultural institutions.

Increased development in the Toledo District may also disrupt traditional practices throughout Mayan villages. San Jose and other less populated villages in the Toledo District do not have access to electricity, although the government is planning to provide electricity to rural villages by the year 2010 (Field Notes, 10-17-02). When I asked San Jose villagers if they wanted electricity to be brought to the village, most of them agreed that they would most likely benefit from such a service.

The availability of electricity in San Jose and other small villages will most likely change the ways in which the Mayas live and work. For example, the presence of television sets in the village may interrupt the daily activities of children and adults. Women may be more reluctant to partake in traditional household chores with the distraction of television. Children might opt to stay at home and watch television instead of helping their father in the fields or their mother in the home. Television could also affect migration patterns, as young men and women may wish to leave the village to pursue a more contemporary lifestyle. Furthermore, the images found on television may disrupt important cultural activities such as language, music, traditional dress, storytelling, and farming practices that are symbolic to the Mayas. Miller (1998) has described such instances in her research concerning the impacts of television on indigenous Yucatec Mayan communities. She noted the following:

> As media penetration within the Yucatan region becomes more intensified, rural communities of indigenous Maya are continually re-evaluating social life, with increasing awareness of external referents which are alien to local cultural practices. Through television viewing, the continuity and contrasts of daily life are re-contextualized within national ideologies and global commodities.
> (Miller 1998:307)

The Political Ecology of Two San Jose Farming Groups

The Cedar and Green Creek farming groups share a common history that can be examined using political ecology theory. Of the six farming groups in San Jose Village, only the Cedar and Green Creek groups have initiated logging operations on their large sections of leased land. This activity has had a tremendous influence on the ways in which these groups manage their resources. It has also led to new political alliances and power struggles with the Government of Belize.

The sustainable logging and agriculture project that was instigated by the Cedar group in 1986 can be used as an example of how political affiliations can disrupt plans for self-development within a community. Similar political and economic interests led to the planning and development of this project; however, when people in the community became divided along the two different party lines, tensions arose within the village. Members of the PUP party took over ownership of the logging equipment, but the most valuable trees were located on UDP lands. Because of divergent political interests, members of the UDP party refused to build a road that would allow access to their timber areas.

This example presents an opportunity to discuss how political discrepancies can affect environmental conditions and local economies. The Cedar group had everything in place for this project to succeed. Their 3,000 acres of leased land contained a plethora of cedar, mahogany, teke, and other valuable hardwood trees. Once these trees were felled, the fertile soil would have been highly suitable for planting *milpa* crops, followed by cacao and coffee trees. There were also many waterfalls and caves in the area that could have been exploited for tourist activities.

Had the Cedar group set aside their political differences, the sustainable logging and agriculture project might have been a success story. This self-developed project could have served as a model that illustrated how cooperation and careful planning among an indigenous group contributed to the sustainable extraction of forest resources and improved economic returns through engaging in new markets and ecotourism ventures. Instead, a shift in power among political leaders of the community led to the restricted access of a formerly common-use land area. The valuable hardwood trees that could have been processed and sold for a handsome profit were eventually felled and burnt solely for the production of *milpa* crops. Thus, an initial strategy of resource conservation and sustainable development failed because of politically motivated behaviors.

Many of the farming groups in San Jose are affiliated with political organizations; however, there is one group that stands above the rest in terms of how they use their political connections to protect and utilize their collective resources. In contrast to the Cedar group, the Green Creek group has been successful in gaining political power without experiencing a division among group members over major political issues. They have done so by creating a set of rules and regulations that members must abide by, regardless of their political status. The Green Creek group members democratically elect a chairman who is responsible for facilitating regular meetings, overseeing group projects, and making sure that all members are working towards a common goal.

The political focus of the Green Creek group has placed much emphasis on conservation strategies, as well as economic concerns shared by group members. The Green Creek group's conservation techniques have enabled them to become a powerful and influential political presence in San Jose Village. Instead of cutting and burning valuable trees for the planting of *milpa* crops, the Green Creek group decided to set aside one third of their 2,000-acre land-base for logging activities. Most of the large and valuable species of trees were surveyed, and a plan was conceived to harvest the trees once they reached maturity.

The Green Creek parcel of leased land became an important economic asset that contributed to the group's political leverage with the Government of Belize. Before the

Green Creek group became politically active, the GOB largely ignored the Mayas' interventions in logging activities. The government often viewed the Mayas as being incapable of obtaining the funding and resources needed for a large-scale logging operation. They were considered to be a group of poor farmers who burned valuable trees for the production of *milpa* crops. The GOB therefore took advantage of the Mayas by granting logging concessions on reservation lands to non-Mayan companies.

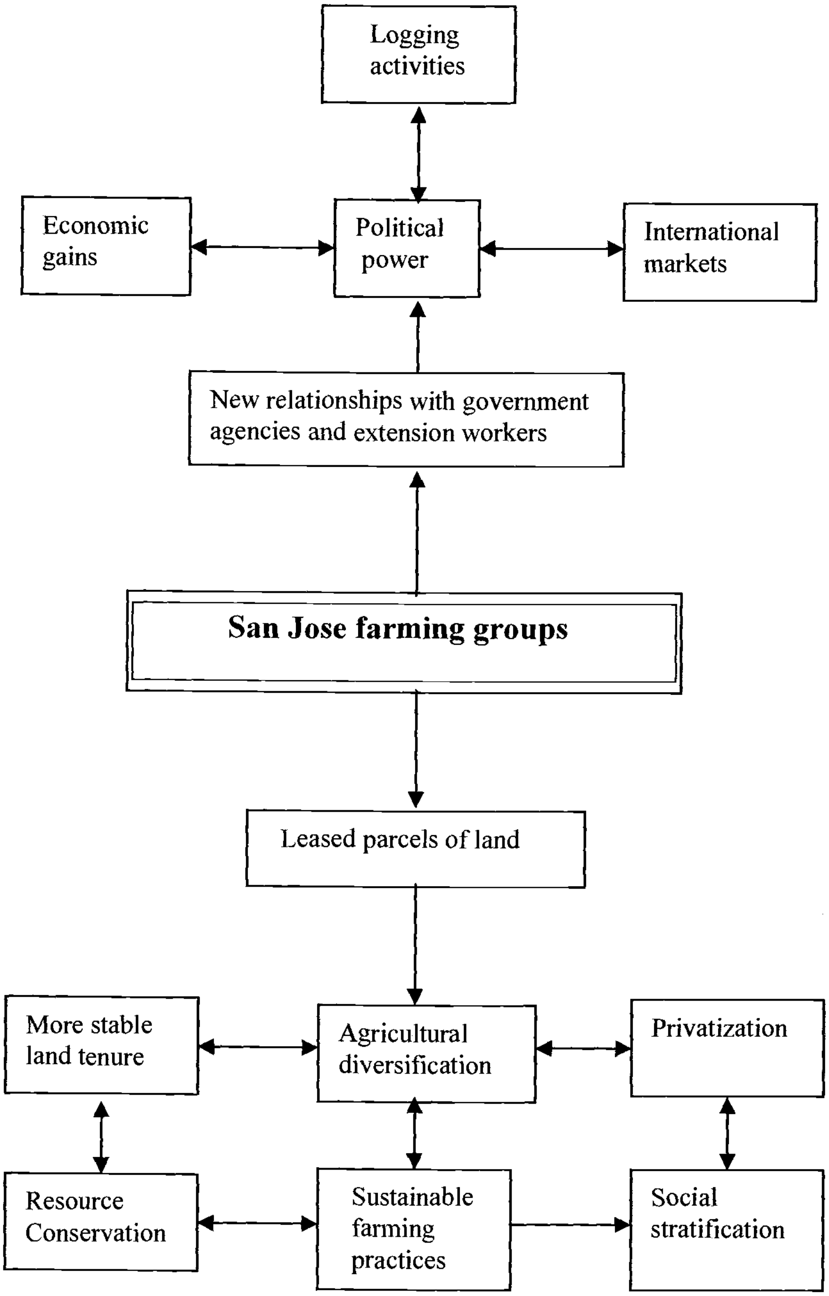
The political strength acquired by the Green Creek group eventually led to their protest against the GOB for granting of timber concessions to foreign companies. After the group became aware that a large section of their leased land had been approved for logging by a Malaysian company, they wrote to the Minister of Natural Resources and requested that all new timber concessions must be reviewed by Mayan leaders before they are granted (Personal communication, Thomas Coh, 11-18-02). This action resulted in the eventual cessation of Malaysian logging activities in the Toledo Forests.

The Green Creek group's political ties also attracted the interests of NGOs such as SAGE and Sustainable Harvest International, which operate out of Punta Gorda. SAGE has worked closely with the Green Creek group, and they have been successful in monitoring all the timber concessions that have been granted by the Government of Belize in Mayan occupied areas. SAGE has been apprehensive of Belize's existing forestry program, and the organization has placed pressure on the government to amend some of the old forestry laws. SAGE was also concerned that the government's outright ownership of trees on any section of leased or reservation land may ultimately lead to the Maya's inability to access important forest resources (Personal communication; SAGE, 11-20-02). If present laws continue to exist, it will remain difficult for the Mayas to engage in future logging activities on Crown or reservation lands. Such laws also impede upon the Mayas involvement in agroforestry projects that have been promoted by SHI and TCGA. This is one reason why these organizations offer economic incentives for farmers to plant timber trees throughout their *milpas* and cacao fields.

The Green Creek group's political connections have also enabled members to substantially increase their incomes after Hurricane Iris. After receiving a salvage logging permit from the Department of Forestry, the Green Creek chairman asked several businessmen in Punta Gorda to supply the logging equipment and find a market for the harvested trees. Once these contacts were made, Green Creek members worked hard to clear trails and haul out lumber. The new logging concession became an important economic venture because many of the group's cash crops were destroyed by the hurricane.

A venture into the logging business has inspired the Green Creek group to expand their operation by building a sawmill near their leased land. Members selected a spot along Green Creek that would allow the group to mill the timber to a finer quality than the previous method of using chainsaws and guides. However, in order for this project to succeed, the Green Creek group would have to petition the GOB to widen the road that leads to the sawmill to allow for the passing of heavy machinery and motorized vehicles. Although they had not yet succeeded in this task in November of 2002, the group's newfound political strength may be helpful for the completion of this project.

Figure 8.1 The political ecology of San Jose farming groups



## Event Ecology Theory

Event ecology theory has emerged among anthropologists as an alternative to political ecology. Event ecology looks first at environmental changes, and then works backwards to determine political causes and effects which led to those changes (Vayda and Walters 1999). Vayda and Walters (1999) used event ecology theory to understand the reasons why wealthy landowners destroyed vast sections of mangrove forests in the Philippines for the development of shrimp farms. The political agendas of landowners became clearer after first assessing the environmental problem and then analyzing how it came to be. In the case of the Mopan, there are a few examples of how environmental changes can be viewed using event ecology.

The most significant environmental change among the Mopan in San Jose was the loss of primary forests that lie within close proximity to the village. A reduction in fallow lengths resulted in the increased felling of high forests for new agricultural lands. Using political ecology theory, one might assume that the Mopans' emergence into a market economy was the major cause for these deteriorating environmental conditions.

Looking at these scenarios from an event ecology perspective allows one to work backwards in time to answer questions pertaining to political motives. Although the increased production of cash crops for new markets was most likely a major cause of environmental degradation, there may have been other factors at play that should be explored. According to ethnographic research, trees found in high forests were harvested for building materials, firewood, and medicinal purposes. Thus, deforestation may have simply been the result of a need for timber products, and not because of economic interests that were tied to cash-cropping.

Additional arguments can also be made that challenge the political ecology assumption that the emergence of new agricultural markets was a primary cause of deforestation. Subsistence agriculture has always been in the mind of the Mopan farmer. Mopan families do not feel secure until their home or storage area is filled with ears of corn and 5-gallon buckets of beans and rice. When the Mopan relocated from San Antonio to San Jose, they left a network of friends and family that would provide food in the event of a crop failure, tropical storm, or forest fires. The Mopan's isolation may have brought about the desire to intensify their agriculture to ensure each household had an adequate food supply that would last throughout the year. Thus, by exploring productive subsistence agriculture as a possible catalyst for deforestation, the formerly presumed political and economical assumptions become less valued.

When a Mopan farmer came across a high forest, his instinct probably told him to cut it down and plant his crops there. He may have hunted or collected some medicinal plants first, but eventually, the forest would succumb to axe, machete, and fire. That is the Mayan way of thinking and living. Like the many generations of swidden agriculturalists that came before him, he knew that tall forests meant fertile land. The Mopan's traditional shifting cultivation system places a high value on mature forests. These forests were precisely what farmers were looking for when they left San Antonio Village. Once cleared, the ashes of burnt trees provided enough nutrients to grow corn for two to three years. Many of my participants told me that one can obtain impressive corn yields (3-4 times greater than in a ten-year fallow) by cultivating a piece of land that was previously high forest.

Although it was likely that Mopan farmers were searching for high forest because they wanted to grow high yielding crops for the market, event ecology places more emphasis on the means rather than the end. When fully exploring the environmental problem, which is in this case deforestation, one may develop a greater understanding of why and how such an event occurred without any preconceived notions of political agendas. For example, the cutting down of high forests near San Jose Village may have been the result of an inherited cultural trait among Mopan farmers. This trait would have resulted in locating the best land that is available (high forest), cutting it down, burning it, and growing an abundance of food in the dark and fertile soil. Whether this food was intended for subsistence uses or the market, or both, does not matter. The point is that event ecology forces one to examine all possibilities for environmental problems without making assumptions of the political factors that may be the cause of such problems.

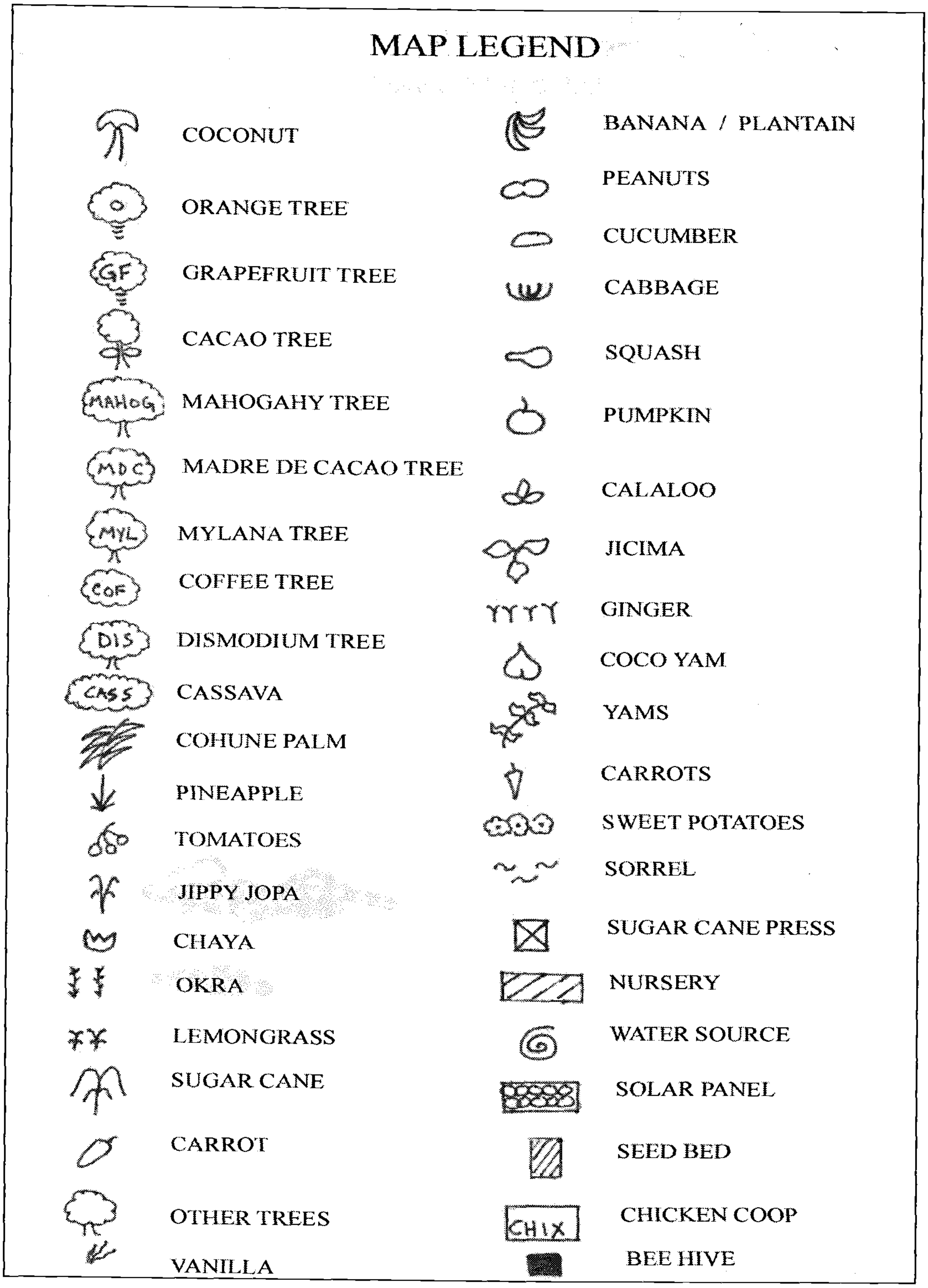
All of the possibilities for deforestation that I have mentioned (using forest materials for houses, firewood, and medicine; highly productive *milpas* for subsistence agriculture; and inherited cultural traits pertaining to swidden farming practices) helps one to better understand the original political motives of Mopan farmers. These motives may have been more influenced by the overall need to produce shelter and food for the village, rather than the desire to grow cash crops and enter into a market economy. Although the Mopan's eventual emergence into a cash economy led to the increased exploitation of forest resources, this did not happen until the 1970's. Now that event ecology has been explored, there appear to be two sets of political factors that were responsible for the decline of high forests in San Jose. Before the 1970's the political rationale may have included basic food procurement strategies and the need for building materials. After the 1970's, political agendas were probably more concerned with the production of cash crops for new markets.

# 9. Data from Documented Farms

The data represented in this chapter are from seventeen highly diversified Mayan farms in the northern section of the Toledo District. I obtained this information while working on each farm and through informal interviews with each "expert" farmer. Fifteen farmers were of Mopan descent and two farmers were Kekchi Mayas. Thirteen farms in this sample were located in or near San Jose Village. The other farms were located in Crique Jute, San Antonio, Maya Mopan, and Columbia San Pedro (see figure 2.1).

Rice is typically sowed in the rainy season; however, none had been planted in 2002. Farmers were advised by the Ministry of Agriculture not to plant rice because of the threat of forest fires in hurricane damaged areas. The fallen and dried timber could easily ignite from farmers' swidden plots. Therefore, rice is not listed as a main crop on any of the documented farms. In addition, the cacao fields I visited were not representative of pre-hurricane agroforestry systems. Many of the shade trees had been chopped into pieces or removed from the forest for use as firewood and building material, which made them difficult to identify. Although cohune palm trees (*Orbigyna cohune)* were found throughout most farming systems, they were not included in the data set because they are seldom planted by farmers. Also, some of the rare plant and tree names were told to me in the Maya Mopan language. Because there was no available written text of Mopan Maya flora, some of the names are spelled phonetically and the scientific binomials are unknown. Detailed maps of seven highly diversified farms are integrated within the data sets. A legend for the maps (Figure 9.1) is provided on the following page.

Figure 9.1 Map Legend



**Farm #1**

**Household labor:** two sons (father was sick)
**Farmland:** 25 acres with lease, 1 mile from village
**Cultivation techniques:** slash and burn
**Cacao:** * (500 trees = approximately one acre at 10x10 spacing)
1000 trees; hybrid; 10'x10'; 15 yrs old
Shade trees: (all cut down) bri bri (*Inga edulis*), leucaena (*Leucaena glauca)*, calabash (*Crescentia alata)*
**Main crops:** rainy-season corn (*Zea mays*), banana and plantain (*Musa spp.*), tomatoes *(Lycopersicon esculentum*), hot peppers (*Capsicum frutescens*), pineapple *(Ananas comosus)*, red beans *(Phaseolus vulgaris)*
**Trees:** orange, sapodilla (*Manilkara sapota)*, papaya *(Carica papaya)*
**Animals and livestock:** chickens
**Other plants:** cilantro
**Other Income:** 5 organic beehives (non-certified)

**Farm #2**

**Household labor:** father and two sons
**Cacao:**
1000 trees; 12'x12'; 15 yrs old; Western group
Hurricane damage: extensive- fallen shade trees, tall bush, fallen cacao trees, standing cacao was beginning to bear well
Shade trees: cabbage bark (*Andira inermis)*, salmwood (*Cordia alliodora)*, macapal, gumbilimbo (*Busera simaruba palomulato*), *trash-awa*
Average yield: 300 lbs. per year; no harvest in 2001
**Farmland:** botanical garden- 25 leased acres, 1.5 miles from village
**Cultivation techniques:** slash-and-mulch, intercropping
**Cacao:**
100 hybrid; 30 local; seven yrs. old; 15'x15'; four balente (similar to cacao)
Shade trees: mylana, leucaena, mahogany *(Swietenia macrophylla*), salmwood, madre de cacao (*Gliricidia sepium)*, lemon *(Citrus limonia)*
Average yield: 140 lbs in 2000; 60 lbs. in 2001
**Main Crops:**
dry and rainy-season corn, mucuna (*Mucuna pruriens)*, black and red beans *(Phaseolus vulgaris)*, yams *(Dioscorea alata)*, cassava *(Manihot utilissima)*, okra *(Hibiscus esculentus)*, jicima (*Pachyrrhizus erosus*), pineapple *(Ananas comosus)*, bananas and plantain, yellow, red, and local ginger (*Renealmia aromatica)*, sugar cane *(Saccaharum officinarum)*, sweet potatoes *(Ipomoea batatas)*, jippy jopa *(Sabal mexicana)*
**Trees:**
mahogany *(Swietenia macrophylla*), white mahogany *(V. hondurensis* Sprague), bastard mahogany (*Carpapa guianensis)*, coffee *(Coffea arabica)*, mamey apple (*Mammea americana)*, lemon *(Citrus limonia)*, flamboyant *(Delonix regia)*, salmwood, copal (*Protium copal)*, rubber tree *(Hevea brasiliensis)*, allspice *(Pimenta officinalis)*, annatto

*(Bixa orellana)*, bitterwood *(Quassia amara L.)*, almond (*Terminalia catappa)* , mayflower (*Tabebuia pentaphylla*), santa rosa, san juan macho, cedar (*Cedrela odorata)*, guanacaste (*Enterolobium cyclocarpum)*, fig *(Ficus carico)*, madre de cacao, mylana, mylady (*Aspidosperma cruetum),* marian (fruit), poisonwood (*Metopium browneii)*, fecenstile, balente, custard apple *(Annona reticulata)*, trumpet (*Cecropia obtusifolia)*, na-ba, bokut, tamarind (*Tamarindus indica)*, teak *(Tectona grandis)*, mango (*Mangifera indica)*, naragusta (*Terminalia amazonia*), warree cohune (*Astrocaryum mixicanum*), sapodilla (*Manilkara sapota)*, obeillo, leucaena, orange *(Citrus sinensis)*, provision tree *(Pachira aquatica)*, barba jolote (*cojoba arborea)*, castor (*Rincinus communis)*

**Seed production:**

warry cohune, pacaya (*Chamaedorea tepejilote)*, jippy jopa, *zamia procema*, ascendence palm, seprosy palm, window palm

**Medicinal plants:**

poinsetta, scoggineal, snake plant *(Sansevieria trifasciata)*, baby tearce, horseballs (*Stemmodenia donnell-smithii), sham-kroot, bul-te-maya*

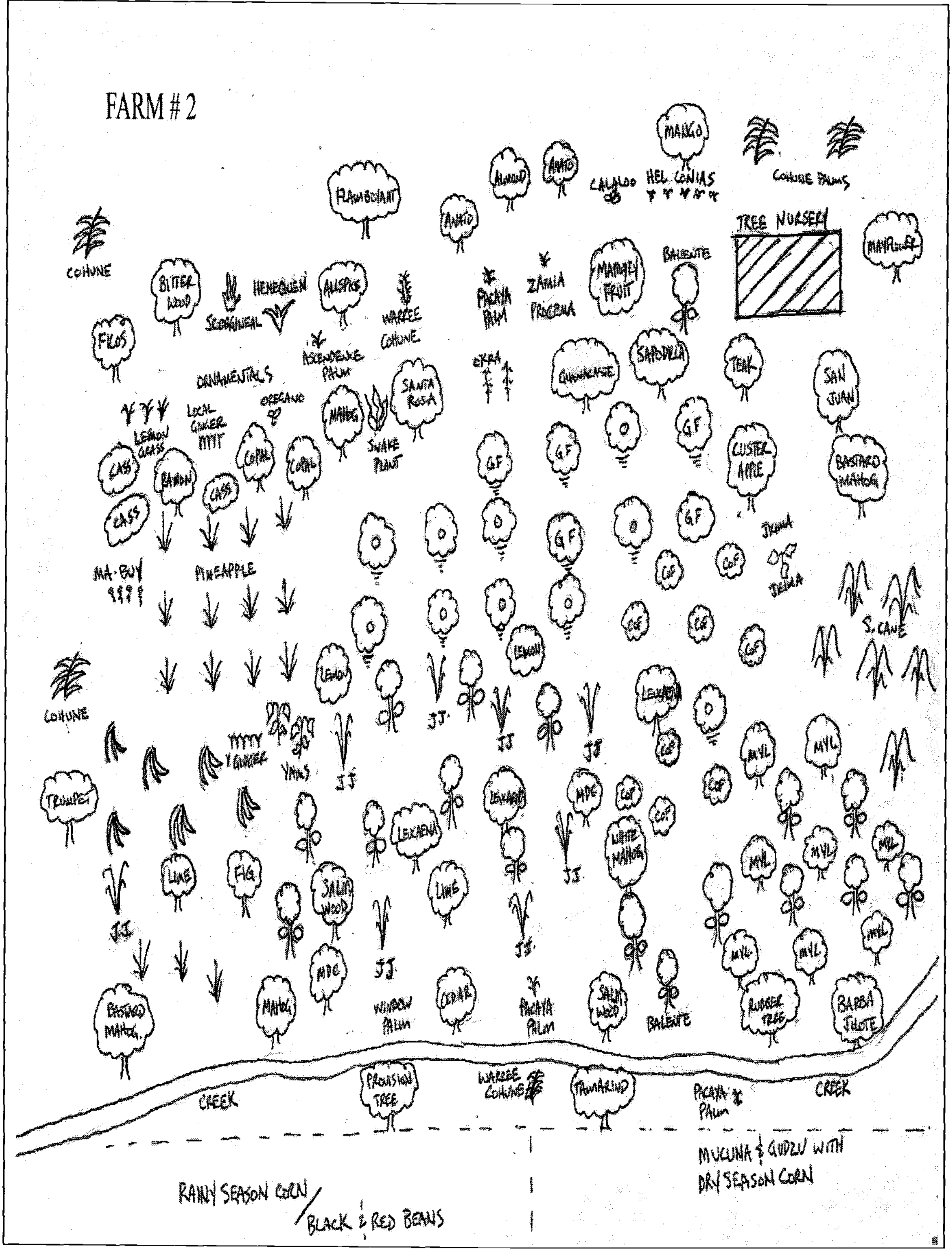
**Other plants:**

Henequen (*Agave froucryode*), we-tee (attractive flower), helconias, ploy red head (*Hamelia patens*), chi-ki, calaloo (*Phytolacca icosandra*), sunflower (*Artemisia spinescens*), ma-buy, lemongrass (*Cymbopogon citrates*), vanilla (*Vanilla planifolia*), oregano (*Hyptis* spp.), culantro (*Eryngium foetidum*)

**Animals and Livestock**: chickens

**Other income:** ecotourism (guest house, naturalist, botanical garden), sells plant seeds, wage employment (works a few months a year at the Chaa Creek Mayan farm in the Cayo District)

Figure 9.2 Farm #2



**Farm #3**

**Household labor:** father and son
**Farmland:** 25 acres, no lease, 0.5 miles from village (farm is adjacent to house)
**Cultivation techniques:** slash and burn, intercropping (plants leucaena in cornfield)
**Cacao:**
500 hybrid trees; eight yrs. old; 10'x10'
20 local trees; 25 yrs. old; 15'x15'
Average yield: 400 lbs. in year 2000
Weeding: every two months
Pruning: every four to six months
Hurricane damage: extensive- shade trees blown down, uprooted trees, pest problems (squirrel, woodpecker, agoute, leaf cutter ants)
Shade trees: *ki-meta*, soursop (*Annona muricata*), cohune palm *(Orbigyna cohune)*, hog plum
**Main crops:**
Cucumber *(Cucumis sativus)*, jippy jopa, banana, plantain, cabbage *(Brassica oleracea)*, carrot *(Daucus carota)*, mucuna, yam (*Dioscorea alata*), rainy season and dry-season corn (short and tall varieties), cassava, black and red beans, pineapple
**Other plants:** *ma-buy*
**Trees:** leucaena (planted in cornfield), mango (*Mangifera indica*), orange, grapefruit *(Citrus paradigi)*, sour sop *(Annona muricata)*, custer apple (*Annona reticulata)*
**Animals and livestock:** chickens
**Other income:** none

**Farm #4**

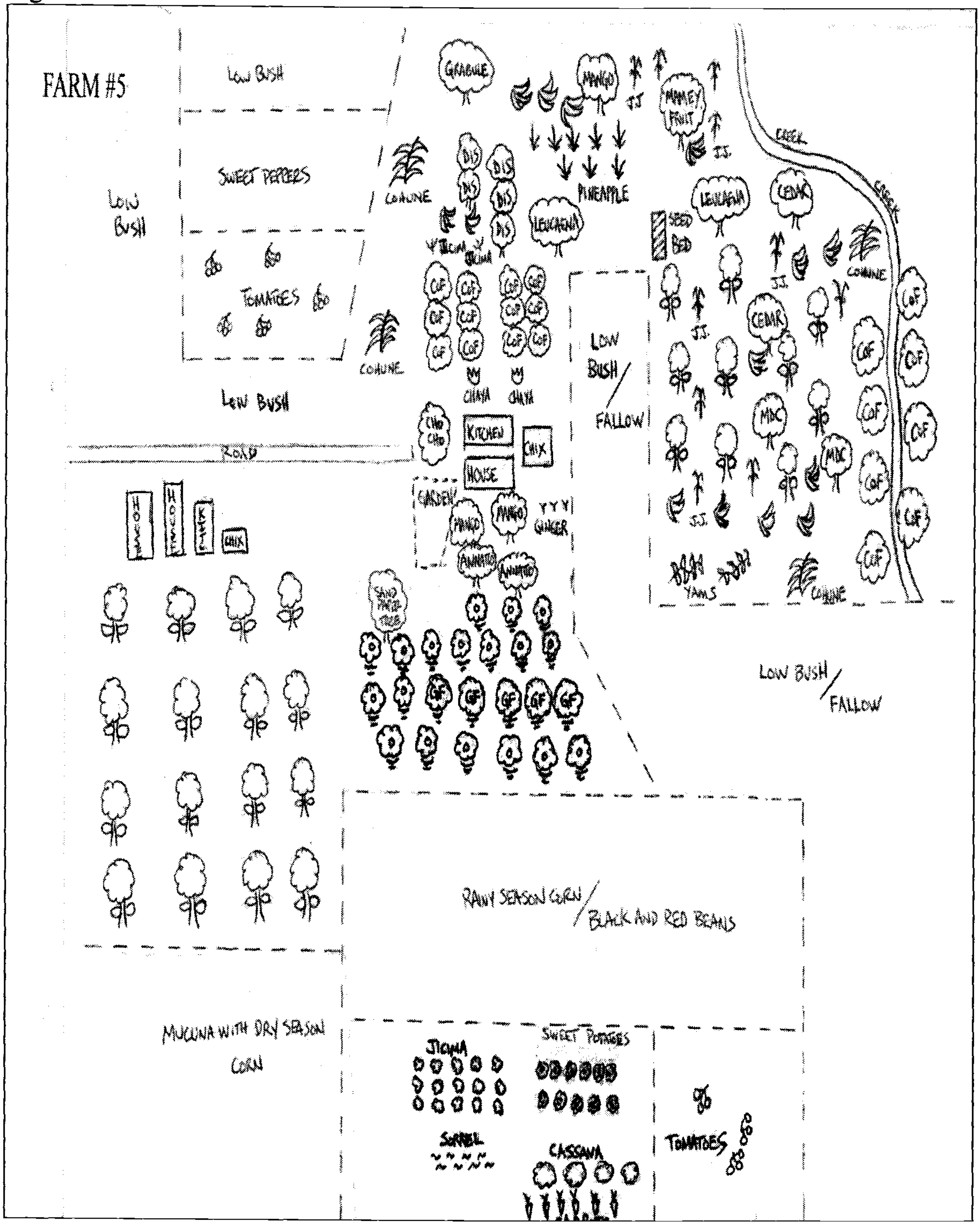
**Household labor:** father (sons are too young)
**Farmland:** 50 acres of leased land, six acres of pasture (no lease), 1 mile from village
**Cultivation techniques:** slash and burn, slash-and-mulch, cover crops, intercropping
**Cacao:**
1280 hybrid trees; 10'x10'; 18 yrs. old; South East group; one balente (similar to cacao)
Shade trees: laurel, salmwood, cabbage bark, cedar * (plantain is planted in cacao)
Average yield: 1300 lbs. in year 2000; 100 lbs. in year 2001
Weeding: six days for one person
Pruning: four days for one person (6 days after hurricane)
Harvesting: two days for one person
Hurricane damage: fair- shade trees blown over, many of the cacao trees are still standing (can attribute to proper pruning techniques), cacao was bearing well at time of visit
**Main crops:** banana, plantain, mucuna, dry and rainy-season corn, cassava, black and red beans, (habenaro peppers *(Capsicum frutescens)* and cabbage are grown with the pepper group on a different section of land)
**Other plants:** tomato, chaya, oregano, mint, cilantro (*Eryngium foetidum*)
**Trees:** orange and grapefruit

**Animals and livestock:** four cows, chickens, one hybrid pig
**Other income:** pepper group crops, timber trees in cacao

**Farm #5**

**Household labor:** father and son
**Farmland:** 40 acres with no lease, 2.5 miles from village (farm is adjacent to house)
**Cultivation techniques:** slash and burn, chemical fertilizers, pesticides, and fungicides applied on tomato, cabbage, and sweet peppers (all hybrid varieties), intercropping
**Cacao:**
150 hybrid trees; 12'x12'; eight yrs. old;
50 local trees; 12'x12'; eight yrs. old
1000 hybrid trees; 8'x8'; 20 yrs. old; Mopan Group
<u>Shade trees:</u> cedar, cabbage bark, *shu-vu, poch-teck,* hog plum (*Spondias mombin),* cotton tree (*Ceiba petandra)*
<u>Hurricane damage</u>: extensive- approximately 50% of cacao trees had fallen down, most original shade trees had also fallen down, cacao field had not been cleared since hurricane and trees were bearing poorly
**Main crops:** jippy jopa, cabbage (500), tomatoes (1500), sweet potato *(Ipomoea batatas),* pineapple, rainy and dry-season corn with mucuna, ginger, black and red beans, yams, pineapple, cassava, banana, plantain, sorrel (*Hibiscus sabdariffa*), carrots, sweet peppers *(Caspicum annuum)*
**Other plants:** mint, chives, *ma-buy, chi-ki,* chaya, cow's foot (*Piper autitum),* cho-cho (*Sechium edule*), jackass bitter *(Neurolaena lobata)*
**Trees:** 70 coffee, dismodium, bitter tree, hog plum, jack ass bitter, mango, grabule, mamey apple (Calocarpum sapota), coconut, annatto, orange, grapefruit, sand paper tree *(Curatella Americana)*
**Animals and livestock:** chickens
**Other income:** none

Figure 9.3 Farm #5



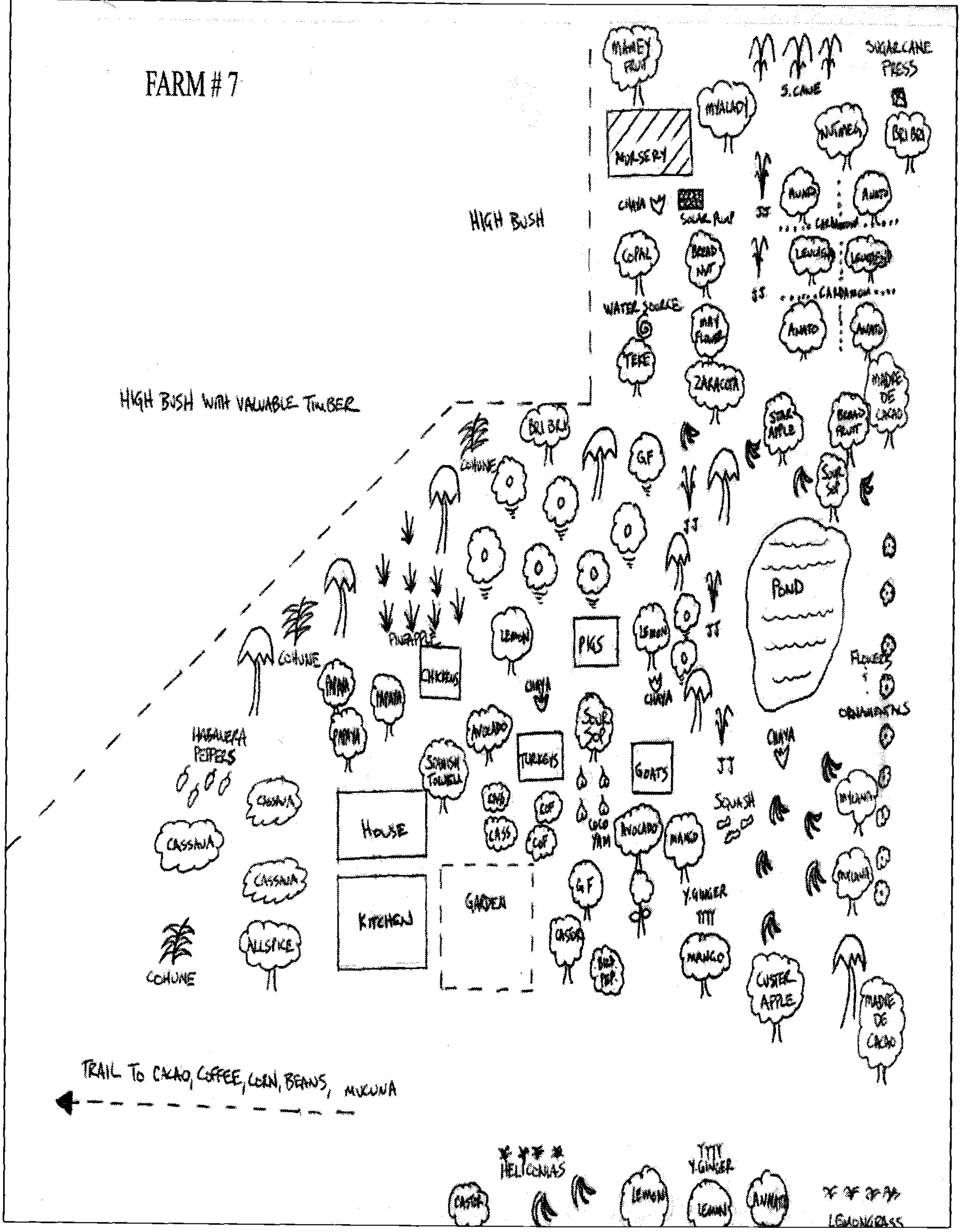
**Farm #6** (San Pedro Columbia)

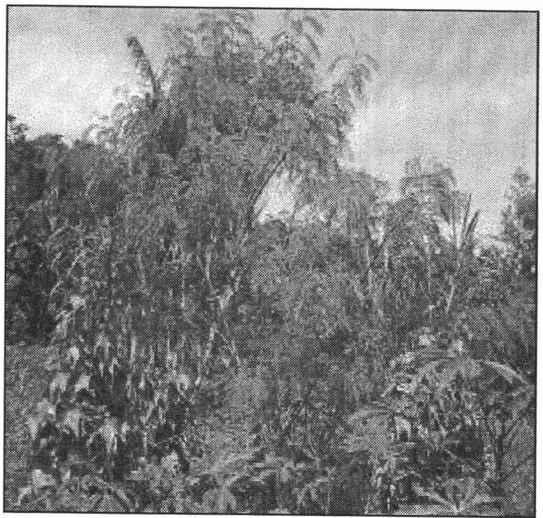
**Household labor:** father with no sons working on farm
**Farmland:** 50 acres not leased, 2.5 miles from village (farm is adjacent to home)
**Cultivation techniques:** slash and burn, slash-and-mulch
**Cacao:**
300 hybrid trees; 15'x15'; 18 yrs. old
1,000 hybrid trees; 10x10; two yrs. old
1,000 local trees; 15'x15'; 50 years old (planted by father; 10 trees are *criollo* variety)
Shade trees: hog plum, mango, grabule, leucaena, ramon, cedar
Average yield: 100 lbs. per acre
Hurricane damage: extensive- all shade trees and a majority of cacao trees had also fallen down
**Main crops:** cassava, plantain, jippy jopa, dry and rainy-season corn, red and black beans, ginger, mucuna, pineapple
**Other plants:** *calaloo*, chaya, mint, lemongrass (*Cymbopogon citrantus*), cilantro, cow's foot
**Trees:** orange, tangerine, grapefruit, lemon, mango, mamey apple, annatto
**Animals and livestock:** chickens
**Other Income:** none

**Farm #7**

**Household labor:** two sons and father who is a part time butcher
**Farmland:** 50 acres leased, 4.5 miles from village (farm is adjacent to house)
**Cultivation techniques:** slash and burn, slash-and-mulch, cover crops, intercropping
**Cacao:**
400 hybrid trees; 12'x12'; 19 yrs. old; Cedar group
Shade trees: cedar, cabbage bark, leucaena, bri bri, salmwood
Hurricane damage: fair- cacao trees had been pruned properly and were bearing well and only half of the shade trees had fallen down
**Main crops:** local and yellow ginger, sugarcane, tomatoes, rainy and dry-season corn, beans, mucuna, tomatoes, peppers, cabbage, plantain, banana, cassava, jippy jopa, pineapple, squash, sweet potatoes, yams, cardamom (*Amomum subulatum)*
**Other plants:** chaya, *chi-ki*, castor bean, cow pea (*Cajunus Cajun*), cow's foot, jack-ass bitter, chives, lemongrass, bird peppers (*Capsicum annuum*)
**Trees:** annatto, avacado, coffee, orange, grapefruit, mamey apple, custer apple, star apple, guava *(Psidium guajava)*, sour sop *(Annona muricata)*, breadnut (*Brosimum alicastrum)*, breadfruit *(Artocarpus attilis)*, jackfruit *(Artocarpus integra)*, mango, nutmeg *(Myristica fragrans)*, allspice, teke, cedar, leucaena, mahogany, mylana, myalady, spanish towel, bri bri, coconut, copal, lemon, madre de cacao, zarcota, castor
**Animals and livestock:** local and hybrid pigs, chickens, geese, turkeys, goats
**Other income:** nursery (cacao seedlings, fruit, and hardwoods), animals and livestock, part-time butcher, and sugarcane press

Figure 9.4 Farm #7



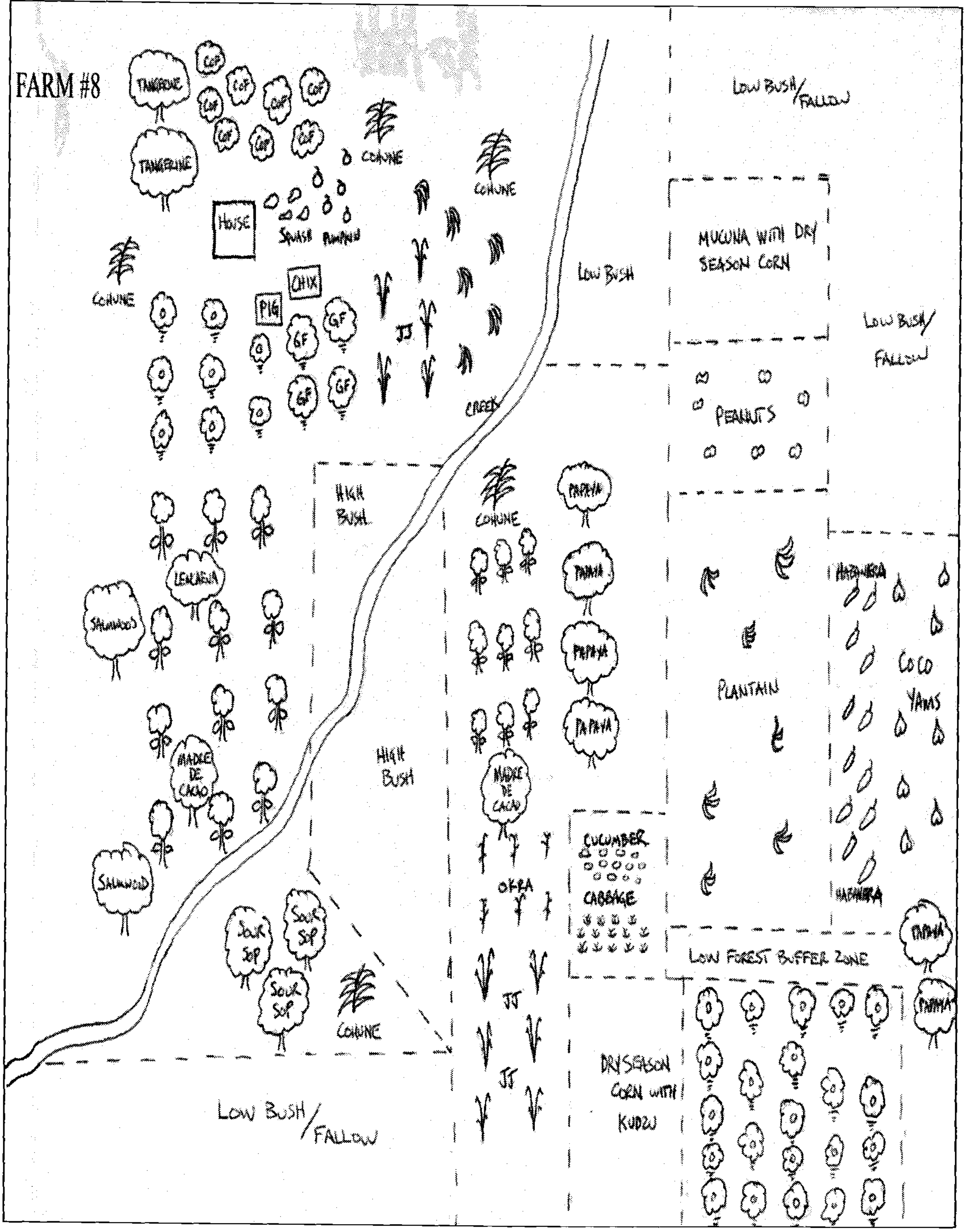



Figures 9.5 and 9.6. Some examples of farmer diversification strategies. Left: a large leucaena tree (in the background) has been planted among yams, cassava, sweet potatoes, and sugarcane. Right: beehives were placed around bananas and sapodilla trees. Honey production can provide farmers with additional incomes; however, this practice is on the decline due to the presence of Africanized bees throughout Belize.

**Farm #8** (Crique Jute)

**Household labor:** father and one son (son only helps during weekends)
**Farmland:** 50 leased acres, 0.5 miles from village (farm is adjacent to home)
**Cultivation techniques:** slash and burn, slash-and-mulch, cover crop, intercropping
**Cacao:**
1000 hybrid trees; 10'x10'; 15 yrs. old
Shade trees: leucaena, salmwood, madre de cacao * (annatto is planted in cacao)
Average yield: 900 lbs. in 2000; 70 lbs. in 2001
Pruning: every 2 months- takes 4 days for one man
Weeding: two times a year- takes 20 days for one person
Harvesting: takes five people one day- second day is husking
Hurricane damage: extensive- severe loss of shade from fallen shade trees, cacao trees looked unhealthy and were bearing poorly
**Main crops:** okra (*Hibiscus esculentus*), kudzu, red and black beans, rainy and dry-season corn, mucuna, banana, plantain (200), jippy jopa, peanuts *(Arachis hypogaea)*, cucumber, cabbage, squash, pumpkin *(Cucurbita* spp.*)*, coco yam (*Xanthosoma violaceum*)
**Other plants:** none
**Trees:** coffee (100), annatto, papaya, grapefruit, orange, soursop, custer apple, tangerine
**Animals and livestock:** chickens, one pig
**Other income:** none

Figure 9.7 Farm #8



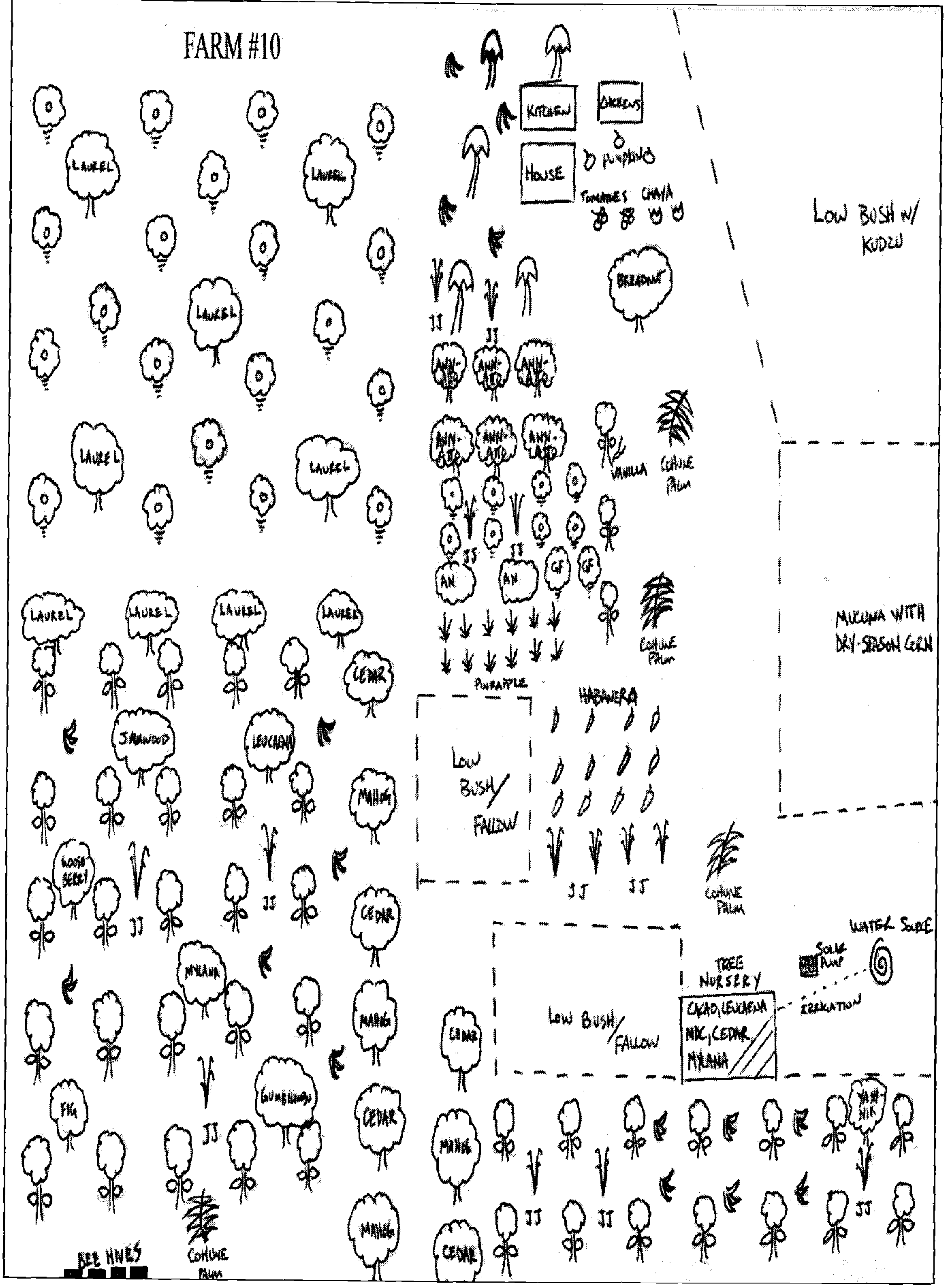
**Farm #9**

**Household labor:** father (sons too young to farm)
**Farmland:** 25 acres with no lease, 1 mile from village
**Cultivation techniques:** slash and burn, slash-and-mulch, cover crop, chemical fertilizers and pesticides applied to peppers, cabbage, and tomatoes
**Cacao:**
60 local trees; 15'x15'; 25 yrs. old (planted by father);
25 hybrid trees; 12'x12'; two yrs. old
Shade trees: *sou-cha*, bri bri, cohune palm *(Orbigyna cohune)* * (ginger is planted in cacao)
Hurricane damage: fair- shade trees were intact, older cacao trees had fallen and were bearing poorly
**Main crops:** rainy and dry-season corn, habanera peppers, cabbage, tomatoes, bananas, black and red beans, mucuna
**Trees:** oranges
**Other plants:** none
**Animals and livestock:** chickens
**Other income:** none

**Farm #10** (San Antonio- Toledo District)

**Household labor:** one father and two sons (part time)
**Farmland:** 50 acres of leased land, 1.5 miles from village (farm is adjacent to home)
**Cultivation techniques:** slash-and-mulch, cover crop, chemical fertilizer and pesticide used on peppers, intercropping (plants laurel trees in citrus orchard to attract bees)
**Cacao:**
1700 hybrid trees; 10'x10'; 16 yrs. old
Shade trees: salmwood, mylana, cohune, laurel, *yash-nik*, fig, gooseberry, gumbolimbo, breadfruit
Weeding and pruning: every three months
Hurricane damage: fair- many cacao trees were standing and bearing well (the result of proper pruning), 50% of shade trees had been lost and only half of the cacao field had been weeded
**Main crops:** dry and rainy-season corn, pineapple, 200 habanera, corn, mucuna, gudzu, banana, pumpkin *(Cucurbita* spp.), tomato, jippy jopa
**Trees:** annatto, mylana, cedar, mahogany, breadnut, laurel, orange and grapefruit (seven acres), coconut
**Other plants:** vanilla, chaya, chives
**Animals and livestock:** chickens
**Other income:** 6 bee colonies, nursery (cacao, madre de cacao, cedar, leucaena)

Figure 9.8 Farm #10



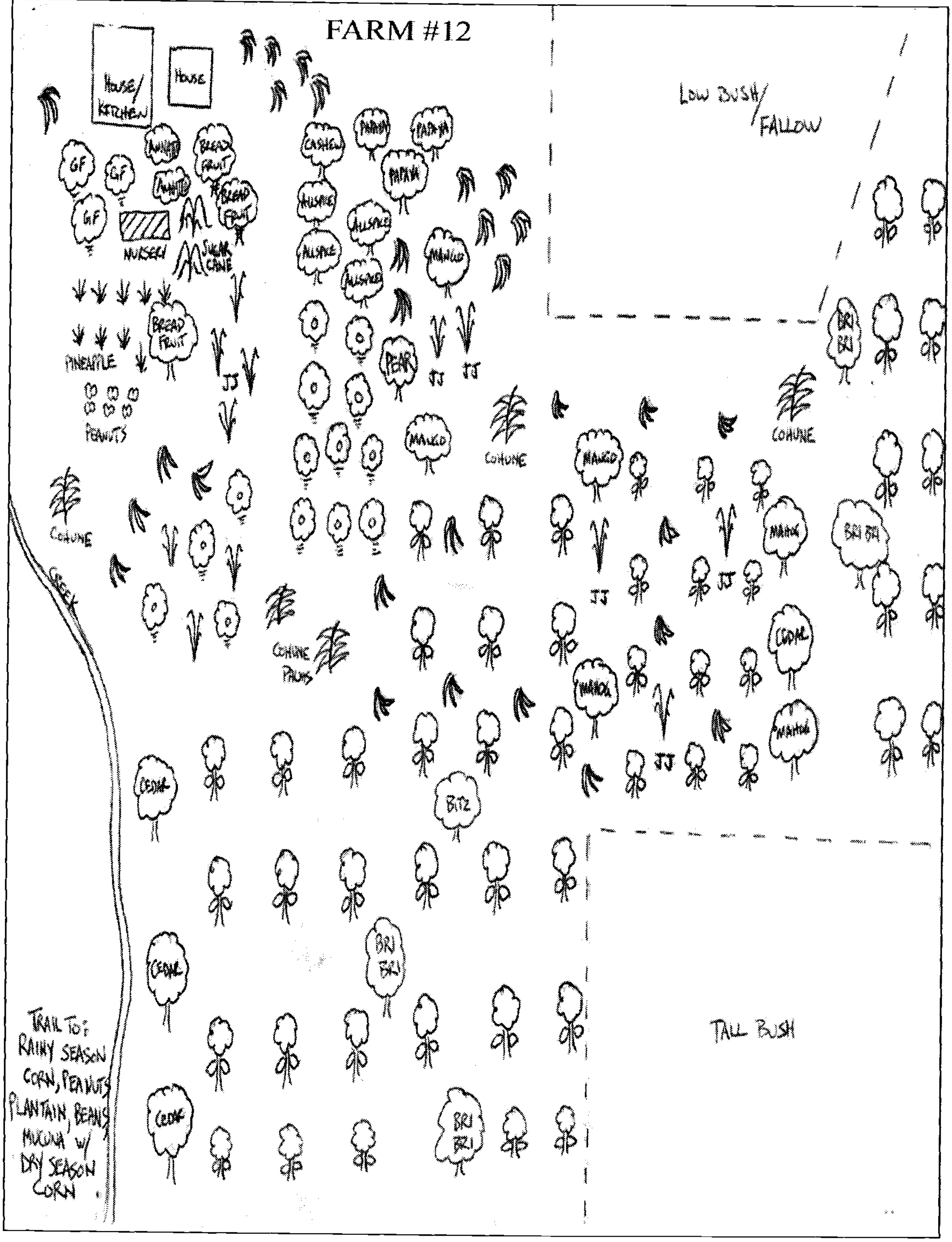
**Farm #11**

**Household labor:** father and four sons
**Farmland:** 25 acres are leased, 35 acres with no lease, two miles from village
**Cultivation techniques:** slash and burn, slash-and-mulch, cover crop, intercropping (plants ginger and pumpkin with corn)
Cacao:
2,900 hybrid trees; 10'x10'; 18 yrs. old; Green Creek group
Shade trees: cabbage bark, cohune, salmwood
Pruning: four times per year
Weeding: two times per year- takes five men working for three days
Average yield: 900 lbs. prior to hurricane
Hurricane damage: extensive- most of shade trees and cacao had fallen over and the cacao trees were bearing poorly
**Main crops:** rainy-season corn (two acres) and dry-season corn, mucuna, plantain (900), pineapples (300), ginger, pumpkin, tomatoes (1200), cabbage (1000), sweet potatoes, sweet peppers
**Other plants:** *ma-buy*
**Trees:** orange and grapefruit (in home garden)
**Animals and livestock:** chickens, 11 hybrid pigs
**Other income:** harvesting pigs and hauling lumber for the Green Creek group

**Farm #12**

**Labor:** two brothers and their three sons
**Farmland:** 50 acres with no lease, 1 mile from village (farm adjacent to home)
**Cultivation techniques:** slash and burn, slash-and-mulch, intercropping
**Cacao:**
117 hybrid trees; 16'x16'; 1 yr. old
500 hybrid trees; 10'x10'; 10 yrs. old
Shade trees: *bitz*, bri bri, cedar, mahogany
Weeding: takes four men four days to clean one acre of cacao- this is done every four months
Average yield: 100 lbs. for the mature trees
Hurricane damage: extensive- large cedars and other shade trees had fallen on cacao trees, which were bearing poorly
**Main crops:** banana, plantain, sugarcane, yellow ginger, red and black beans, peanuts, rainy and dry-season corn, mucuna, cucumber, tomato, plantain, pineapple
**Other crops:** *chi-ki*, chaya, bird peppers
**Trees:** orange, mango, grapefruit, breadfruit, cashew (*Anacardium occidentale*), annatto, pear, papaya, allspice
**Animals and livestock:** chickens

Figure 9.9 Farm #12



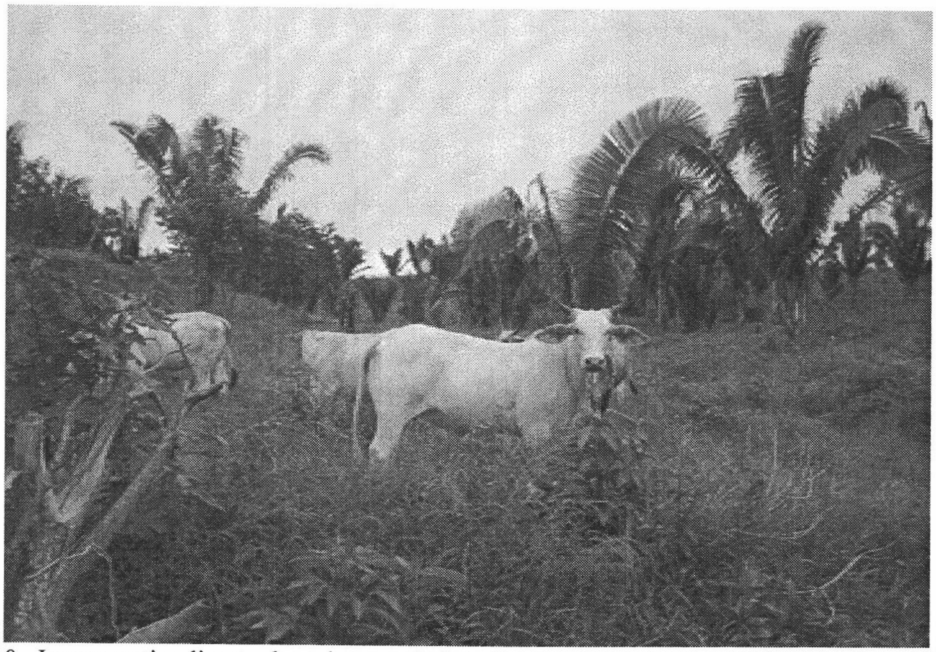
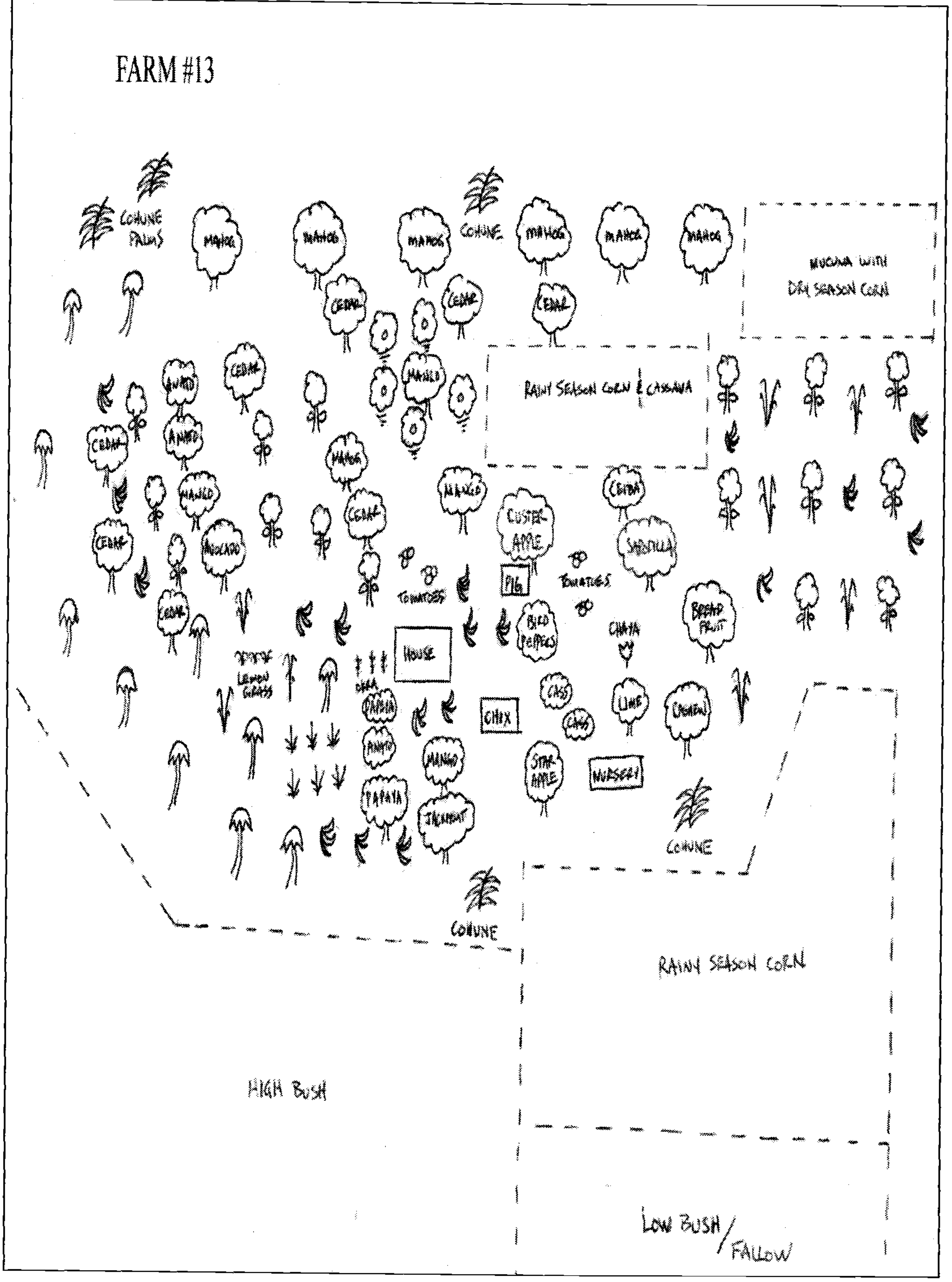


Figure 9.10. Incorporating livestock such as cattle into farming systems is a well-known diversification strategy among smallholders. These cattle were found grazing in a pasture on farm #4 outside of San Jose Village. Mopan farmers have been reluctant to raise cattle because of increasing land pressure, low market prices, and the presences of diseases and poisonous snakes.

**Farm #13**

**Household labor:** father (sons all too young to farm)
**Farmland:** 25 acres with no lease, 4 miles from village (farm is adjacent to house)
**Cultivation techniques:** slash and burn, slash-and-mulch, cover crop, intercropping (plants cassava in corn)
**Cacao:**
75 local trees; 15'x15'; six yrs. old
<u>Shade trees</u>: annatto, orange, mahogany, cedar
**Main crops:** rainy and dry-season corn, red and black beans, pineapple, mucuna, tomato, banana, cassava (grows in corn), sweet peppers, okra, marigold, jippy jopa, banana
**Other plants:** pacaya palm, chaya, marigold, lemongrass
**Trees:** avocado, breadfruit, coconut, custer apple, jackfruit, tangerine, tambran, peach palm (*Bactris gasipaes*), hog plum, grabule, dismodium, annatto, sour orange, grapefruit, papaya, mango (early and late varieties), mahogany, mylady, satika, sapodilla, ceiba
**Animals and livestock:** chickens and local pigs
**Other income:** nursery (fruit trees and ornamentals), seed production

Figure 9.11 Farm #13



**Farm #14**

**Labor:** father (son too young to farm)
**Farmland:** 15 acres with no lease, 2 miles from village
**Cultivation techniques:** slash and burn, cover crop
**Cacao:**
700 hybrid trees; 8'x8'; 20 yrs. old; Mopan group
Shade trees: cabbage bark, hog plum, madre de cacao
**Main crops:** banana, plantain, tomatoes (2-3000), cabbage (1,000), rainy-season corn and 6 acres of dry-season corn with mucuna, red and black beans
**Other crops:** none
**Trees:** coffee, orange
**Animals and livestock:** chickens
**Other income:** none

**Farm #15**

**Household labor:** father and son
**Farmland:** 25 leased acres, 2 miles from village
**Cultivation techniques:** slash and burn, slash-and-mulch, cover crop
**Cacao:**
900 hybrid trees; 10'x10'; 20 yrs. old
Shade trees: cedar, cabbage bark, mango, orange
Average yield: 700 lbs. before hurricane; 100 lbs. after hurricane
**Main crops:** rainy and dry-season corn, mucuna, red and black beans, peanuts, sweet peppers, cabbage, tomatoes, plantain, banana, yams (planted with corn), red onions
**Trees:** mango, orange
**Other plants:** none
**Animals and livestock:** chickens
**Other income:** none

**Farm #16**

**Household labor:** father and 4 sons
**Farmland:** 10 acres with no lease, 2.5 miles from village
**Cultivation techniques:** slash and burn, slash-and-mulch, cover crop
**Cacao:**
500 hybrid trees; 12'x12'; 20 yrs. old; Western group
Shade trees: cohune, hog plum, cabbage bark
**Trees:** orange, grapefruit
**Main crops:** rainy and dry-season corn, mucuna, tomatoes, cabbage, sweet peppers, banana
**Other crops:** none
**Animals and livestock:** chickens
**Other income:** none

**Farm #17**

**Household labor:** father (sons are too young to farm)
**Farmland:** 15 acres with no lease, 1 mile from village
**Cultivation techniques:** slash and burn, slash-and-mulch, cover crop
**Cacao:**
600 local trees; 15'x15'; 45 yrs. old (planted by grandfather)
Shade trees: mango, mommy apple, coconut, cohune palm, mahogany, cedar, orange, tangerine, grapefruit, cashew * (banana and sugarcane are also grown with cacao)
Average yield: 200 lbs. per year
**Main crops:** rainy and dry-season corn, mucuna, sweet peppers, red and black beans, banana, plantain, red and black beans
**Trees:** orange, mango, mamey apple, grapefruit, tangerine
**Other plants:** none
**Animals and livestock:** chickens
**Other income:** none

Table 9.1 Farm-site Statistics

| | |
|---|---|
| Total number of hybrid trees | 12,472.0 |
| Total number of local trees | 1,835.0 |
| Mean number of trees per farmer | 994.5 |
| Mean age of trees | 23.9 |
| Mean yield per acre * (from 11 farmers, before hurricane, in lbs.) | 248.4 |
| Percentage of farmers with leased land | 41.0 |
| Percentage of farmers who belong to a group | 47.0 |
| Total acreage of agricultural holdings on 17 farms | 616.0 |
| Mean acreage of agricultural holdings | 36.2 |
| Mean distance from home to field (in miles) | 0.7 |
| Mean distance from field to village (in miles) | 1.8 |

Table 9.2 Data from 17 Cacao Agroforestry Systems

| Farm | Trees | Variety | Spacing | Age | Shade trees | Group | Lease | Extras |
|---|---|---|---|---|---|---|---|---|
| 1 | 1000 | Hybrid | 10x10 | 15 | bri bri, calabash, leucaena | None | N | |
| 2 | 1000 | Hybrid | 12x12 | 15 | cabbage bark, salmwood, macapal, gumbilimbo, *trash-awa* | West | N | |
| | 100 | Hybrid | 15x15 | 2 | mylana, leucaena, mahogany, salmwood, madre de cacao, lemon | None | Y | |
| | 30 | Local | 15x15 | 2 | | | | |
| 3 | 500 | Hybrid | 10x10 | 8 | soursop, cohune, hog plum | None | N | |
| | 20 | Local | 15x15 | 25 | soursop, cohune, hog plum | | | |
| 4 | 1280 | Hybrid | 10x10 | 18 | laurel, salmwood, cabbage bark, cedar, leucaena | South-East | Y | Plantain |
| 5 | 1000 | Hybrid | 8x8 | 20 | cedar, cabbage bark, hog plum, cotton tree, *poch-tek, shu-vu* | Mopan | N | |
| | 150 | Hybrid | 12x12 | 8 | cabbage bark, cedar, cohune, madre de cacao | None | N | Banana |
| | 50 | Local | 12x12 | 8 | | None | N | |
| 6 | 300 | Hybrid | 15x15 | 18 | hog plum, mango, grabule, ramon | None | N | Nursery, Criollo variety |
| | 1000 | Hybrid | 10x10 | 1 | leucaena, cedar | None | N | |
| | 1000 | Local | 15x15 | 50 | * no data | None | N | |
| 7 | 400 | Hybrid | 12x12 | 19 | cabbage bark, salmwood, leucaena, bri bri | Cedar | Y | Nursery |
| 8 | 1000 | Hybrid | 10x10 | 15 | leucaena, madre de cacao, salmwood | None | N | Annatto |
| 9 | 25 | Hybrid | 12x12 | 2 | bri bri, cohune, madre de cacao | None | N | Ginger |
| | 60 | Local | 10x10 | 25 | bri bri, cohune, madre de cacao | None | N | Ginger |
| 10 | 1700 | Hybrid | 10x10 | 16 | salmwood, mylana, cohune, laural, fig, gooseberry, gumbilimbo, ramon, *yash-nik* | None | Y | Nursery, Vanilla |
| 11 | 2900 | Hybrid | 10x10 | 18 | cabbage bark, cohune, salmwood, madre de cacao, gumbilimbo | Green-Creek | Y | |
| 12 | 500 | Hybrid | 12x12 | 10 | inga, *bitz*, cedar | None | N | |
| | 117 | Hybrid | 16x16 | 1 | inga, *bitz,* cedar | None | N | |
| 13 | 75 | Local | 15x15 | 6 | annatto, orange, mahogany, cedar | None | N | |
| 14 | 700 | Hybrid | 8x8 | 20 | cedar, cabbage bark, hog plum, madre de cacao | Mopan | Y | |
| 15 | 900 | Hybrid | 10x10 | 20 | cedar, mango, orange, cabbage bark | Mopan | Y | |
| 16 | 500 | Hybrid | 12x12 | 20 | cohune, hog plum, cabbage bark | West | N | |
| 17 | 600 | Local | 15x15 | 45 | mango, mammy apple, cohune, orange, grapefruit, tangerine, calabash, cedar, mahogany, cashew | None | N | Banana, Sugar-cane |

# 10. Discussion of Farm-site Data

Figures 10.1 through 10.9 and the following discussions illustrate in better detail the data that were collected on the 17 diversified Mayan farms. Not all plants and trees are listed in the graphs. I only included the most common species that were cultivated among all farmers in the sample.

Figure 10.1

Most Frequently Planted Shade Trees for Cacao

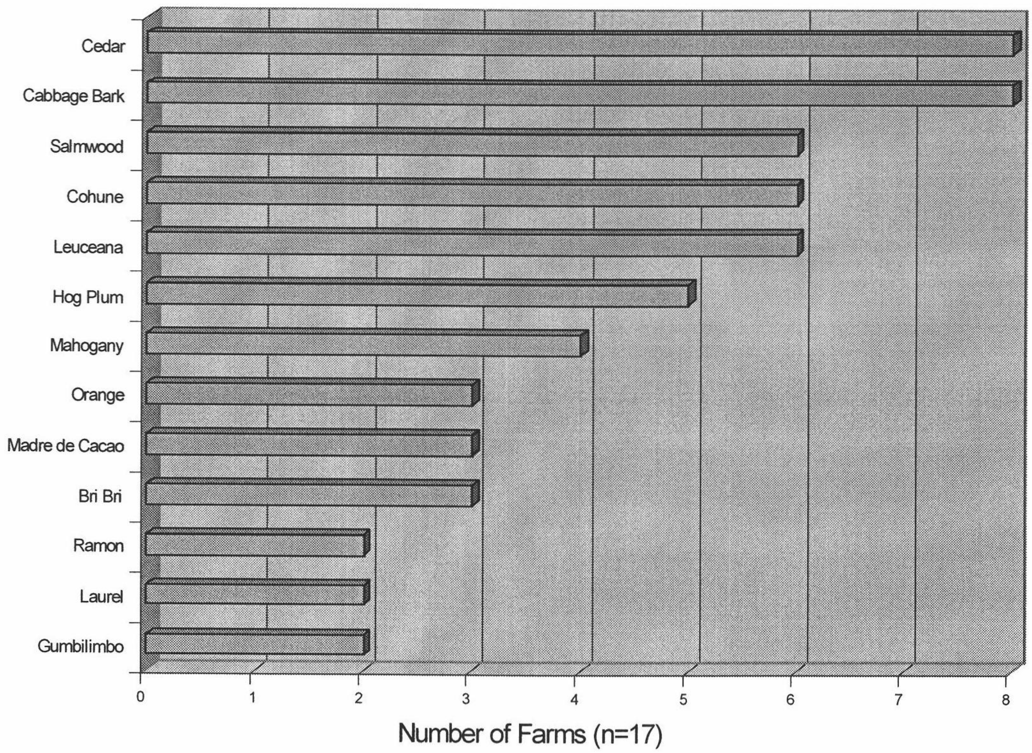
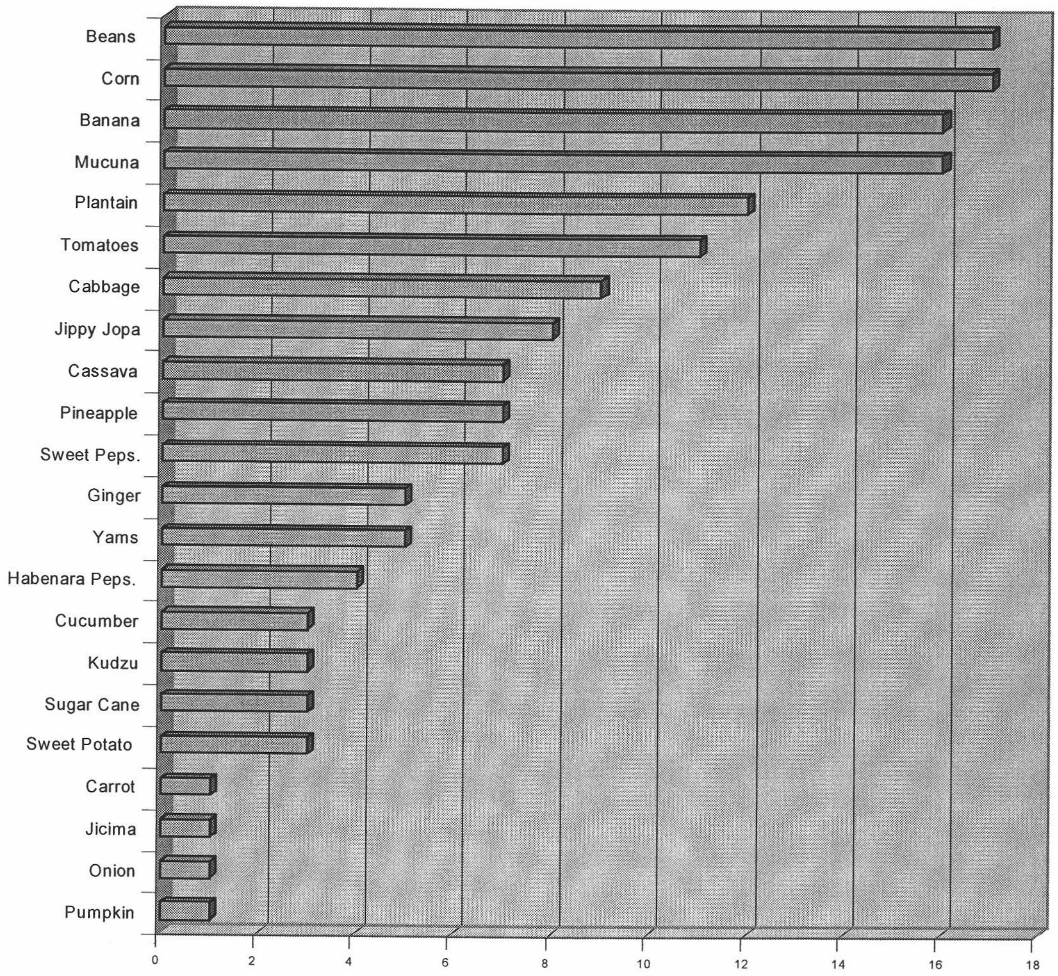


Figure 10.1 shows that cedar, cabbage bark, salmwood, cohune, leucaena, and hog plum are the five most popular shade trees chosen for farmers' cacao systems. Cedar has a high economic value when harvested; however, it loses leaves in the dry season, which can expose the cacao trees to too much sunlight. Cabbage bark and leucaena are leguminous and non-deciduous trees that help to fix nitrogen to the roots of cacao trees in an organic system. Cohune palms are common throughout secondary forests because they are resistant to fires. This is one reason why they are so prevalent in abandoned *milpas*. Mayan farmers often incorporate cohune palms into their *milpas* and cacao systems because they provide shade and shelter, their leaves can be used for thatched roofs, and the soft inner layer of the tree can be harvested for food. Salmwood trees are often used for lumber because they are highly resistant to termites. Hog plums frequently appear in the secondary vegetation of abandoned *milpas*, so they may have been selected primarily for shade purposes. All of these trees would work quite well together within a cacao agroforestry system.

The next most frequently planted shade trees were orange trees, madre de cacao, bri bri, ramon, laurel, and gumbilimbo. These trees were each found on three different farms. Orange trees can be eaten or sold, but they make poor shade trees because of their short height and vigorous consumption of soil nutrients. Madre de cacao trees are easy to plant (they are often used as live fences) and contain nitrogen-fixing properties; however, they are also deciduous and do not adequately shade cacao trees during the dry season. Bri bri is also a nitrogen-fixing tree and is used throughout diversified cacao systems in Costa Rica. Ramon trees produce nuts that provide animals with a food source, thus preventing pest damage to cacao trees and other crops grown in the system. Laurel trees are economically beneficial in a cacao agroforestry system because they produce high-grade lumber and can be harvested in less than 15 years. They also attract bees if farmers choose to keep hives near their cacao trees. Gumbilimbo is a common tree found in Belizean forests and has medicinal properties as well (see appendix B).

Figure 10.2
Most Frequently Planted Main Crops




Number of Farms (n=17)

Figure 10.2 indicates the frequency in which main crops were planted within the sample of 17 farming systems. As expected, corn and beans were planted on all of the farms. Rice would have also been a frequently planted main crop if it weren't for hazardous fire conditions resulting from Hurricane Iris. Bananas and mucuna were found on 16 farms, whereas plantains were found on 12 farms. Bananas and plantains are an important food source to households, require low levels of labor to plant and harvest, and can be sold as a cash crop in the Punta Gorda market. Most farms had bananas and plantain planted sporadically throughout *milpas* and cacao systems; however, farm # 11 and farm # 8 had incorporated a large number of plantains (900 and 200, respectively) into their overall farming systems. The high occurrence of mucuna in the data set could be the result of increasing land pressure in the reservation system and the growing popularity of dry-season corn. This statistic shows that many Mayan farmers have successfully adopted a sustainable legume and corn rotation technique that fits well into their traditional planting cycles.

The sixth and seventh most frequently grown main crops are tomatoes (11 farms) and cabbages (nine farms). Most vegetables were either cultivated in kitchen gardens or grown commercially using synthetic inputs. Farm # 5 had the most extensive tomato and cabbage growing operation, which included 1500 and 500 hybrid plants, respectively. The farmer yielded approximately 1150 lbs. of tomatoes in this system, which sold for a total of US $575 in Punta Gorda. Cabbages are also an important cash crop because they sell for the same price as tomatoes (US 50 cents per pound). Both of these vegetable crops require the use of expensive fertilizers and pesticides when cultivated commercially.

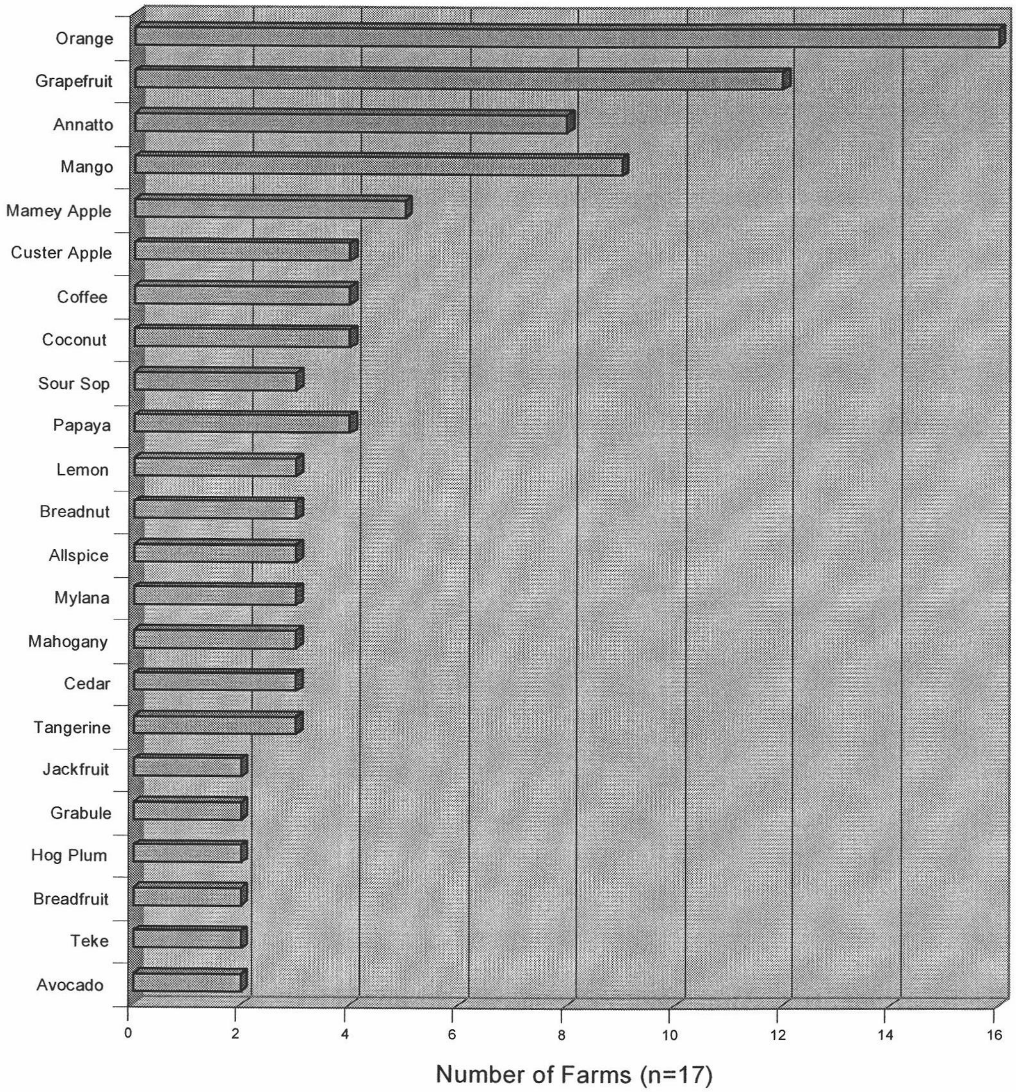
Jippy jopa, cassava, pineapple, and sweet peppers are the next most frequently planted crops. As mentioned earlier, jippy jopa is cultivated widely for its young shoots, which can be eaten or used to make baskets. The over harvesting of this crop in the past decade may be the reason why eight farmers in the sample decided to cultivate the plant. Farmer # 2 grows hundreds of jippy jopa in his botanical garden and sells the seeds to farmers in nearby villages. Cassava was found on seven farms and is mostly grown for a food source, although there is a market for this root crop in Punta Gorda. The plant is frequently found in kitchen gardens and *milpas* because it does not exhaust the soil of nutrients. The young leaves of the cassava plant are also edible and rich in vitamins. Pineapple was found on seven farms and is mostly grown for home use because of their lengthy harvest times (up to two years). Farm # 11, however, is an exception because the 300 pineapple plants were grown specifically for the Punta Gorda market. Farmers are often skeptical of planting pineapples because there have been many instances in San Jose where these crops have been stolen. The 300 pineapples found on farm # 11 were hidden away in a small clearing surrounded by thick brush and secondary growth. Sweet peppers were found on seven farms as well, and this crop is grown primarily for the market. Sweet peppers also sell for US 50 cents per pound. Like most other vegetable crops, these plants need fertilizer and pesticides to be grown together in large numbers.

Ginger and yams were each grown on five farms, whereas habanera peppers were grown on four farms. Ginger is mostly cultivated for flavoring teas and soups, although the root can also be sold for US 50 cents per pound. The plant grows well in the shade and is sometimes found within cacao agroforestry systems. Yams are also often planted in cornfields because they climb up the stalks and do not compete with the corn. They continue to grow well after the corn has been harvested, which allows for a more productive *milpa*. Harvested habanera peppers are placed in a jar with onion, garlic, and some water and used as a spicy condiment that is added to soups, beans, and rice. Habanera peppers are cultivated as cash crops by the San Jose pepper group (2000 plants) and on farm # 12 (200 plants).

Figure 10.3 on the next page lists the most frequently planted tree crops, which include both fruit and timber trees. Orange trees were the most popular, as they were grown on 16 farms. Grapefruit trees were only found on 12 farms. Many of the older farmers in the sample are members of the Citrus Grower's Association (CGA). The CGA encouraged farmers to plant citrus products (mainly oranges and grapefruits) for export in the early 1980's; however, prices eventually dropped because of competition from large citrus farms that had sprung up along the Southern Highway. Nonetheless, farmers still maintain their orange and grapefruit trees and either sell their product to the CGA or to the market in Punta Gorda. There is no current organic market for citrus in southern Belize.

Figure 10.3

Most Frequently Planted Tree Crops




Annatto and mangos were found on eight and nine farms, respectively. The high frequency of annatto trees is most likely contributed to the fluctuating market for the crop over the past 20 years. Farmers may be reluctant to chop down these trees because of their hopes that a good market will arrive in the near future. The Green and Black's company has mentioned purchasing organically grown annatto for the food coloring industry, but this has yet to happen (Samms 1998). Mangoes are mainly grown for consumption and are found primarily in kitchen gardens.

Most of the other tree crops shown in Figure 10.3 are fruit trees that are grown primarily for subsistence purposes, with the exception of several hardwoods (cedar, mahogany, and teke), coffee, and allspice. Cedar and mahogany trees were found growing on 3 different farms (not including cacao systems), while teke was found on two farms. The relatively overall low occurrence of these timber trees may be the result of unstable land tenure within the reservation system or forestry laws that prohibit the harvesting of mahogany trees without a permit (although they can still be cut and burned). It is interesting to note, however, that the farms in which each of these valuable tree species had been planted contained leases. This shows that farmers who have obtained leases for their land felt more secure about planting hardwoods for non-commercial timber production. Because these trees may take up to 40 years to mature, farmers sometimes plant them for their sons to harvest.

Coffee and allspice are crops that can be sold in local markets. Coffee trees were grown on four farms in relatively large numbers. Coffee trees do not grow well in the low elevations of the Toledo District, so the commercial production of this crop is rare. However, coffee beans can be sold to neighboring villages and to tourists in Punta Gorda. Many of the older Mayan villagers prefer the locally grown coffee to the imported beans from Guatemala. Allspice, which was found growing on three farms, is another tree that has potential to be a significant cash crop. Allspice is used in many parts of the world to flavor foods and beverages and the tree contains medicinal properties as well (see appendix B).

Figure 10.4

Diversity of Farm Animals and Livestock

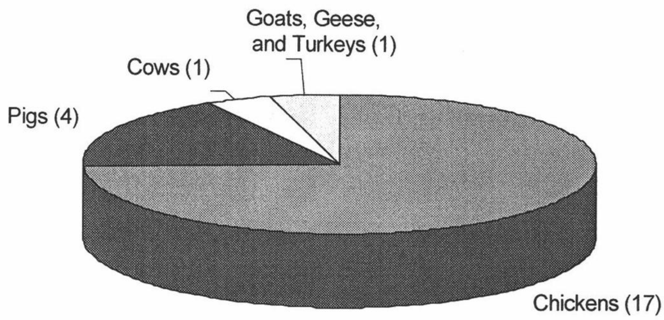



Figure 10.4 represents the diversity of animals and livestock found on the documented farms. The most common farm animals were chickens, which were raised of all 17 farms, and pigs, which were found on four farms. Chickens are raised in large numbers for their continual supply of eggs and meat. They are also beneficial in controlling insect populations around the household. Pigs are less common in San Jose than in other larger Mayan villages such as San Antonio and San Pedro Columbia. After the Mopan settled in San Jose, they decided not to let pigs run free in their new village because of the damage that was caused to farmers' crops. If a person wants to raise pigs, they must keep them closed up in pens. Because there is a lack of pig farming in San Jose, farmers must travel to neighboring villages to purchase pigs that are slaughtered for communal labor parties and festivals.

It is surprising that there is only one farmer in the sample who raises cattle. This farmer had set aside six acres of his leased land for his cows to graze on. He planted and harvested rice, and then sowed African star grass seeds to make a pasture. Cabbage bark and san juan trees were kept in the field to shade the cows from the hot sun.

I never directly observed or heard about any other cattle herds in or near San Jose Village during my research. During the 1980's, a heifer program was initiated that provided Mayan farmers with a start up herd of cattle to grow beef for a Guatemalan market. This program was unsuccessful because farmers had to give back their first young calf to the organization. Apparently, farmers could not get ahead, as young calves are often killed by venomous snakes and diseases.

Goats, geese, and turkeys were all found on one farm. Goats are kept for their fresh milk, which is rare to find in a village with no dairy cows and no electricity. Most villagers purchase dried milk at the store. Geese are raised primarily for their large eggs, whereas turkeys are used as a food source.

Figure 10.5

Preferred Cultivation Techniques on Documented Farms

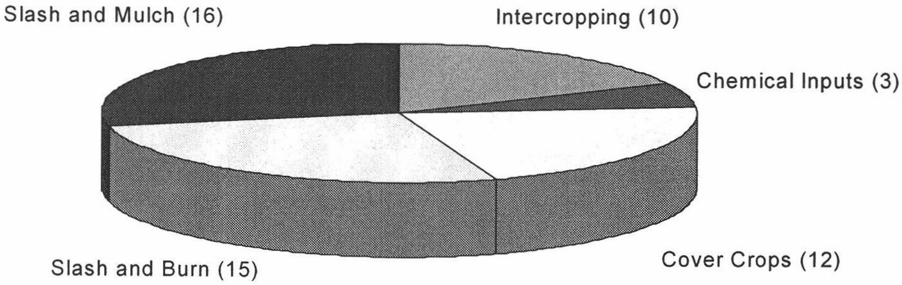



Figure 10.5 examines the different types of cultivation techniques Mayan farmers use. Slash-and-burn is still a popular method of cultivation (used on 15 farms) because it is necessary for planting rainy-season corn on fallowed lands. Secondary bush is also sometimes burned for the planting of vegetable crops to kill unwanted pests. Slash-and-mulch techniques were employed on 16 farming systems. This is a more sustainable method of clearing bush because it provides a thick layer of decomposing mulch that fertilizes the plants, therefore limiting the use of synthetic fertilizers. The dry-season corn and mucuna rotation is the most frequently used slash-and-mulch system; yet, other

cultigens such as bananas, cassava, beans, and pumpkins are often planted in the stubble of the previous year's cornfield or in a slashed-and-mulched section of land.

Cover crops (found on 12 farms) typically consist of mucuna, kudzu, *vega*, and sweet potatoes. These crops are most often planted in the dry season because they cover the surface of the ground and help keep high moisture levels within the soil. Leguminous cover crops also fix nitrogen into the soil, which greatly improves crop yields in the following rotation cycle.

Intercropping is a traditional Mayan technique that was used on 10 farms (not including cacao systems). As previously mentioned, intercropping improves biodiversity and allows for multiple crops to be harvested at different times to offset risk. Some examples of intercropping from the documented farms include the following: leucaena trees planted in a cornfield; pumpkin and ginger planted in a cornfield; laurel trees planted with citrus; and bananas, cassava, sweet potatoes, yams, or various other fruit trees planted together within a common area.

Only three farmers used chemical inputs on their crops. All of those farmers were cultivating hybrid varieties of tomatoes, cabbages, and peppers in large numbers for the market. These plants need plenty of nutrients and a pest defense system to produce good yields. Many Mayan farmers do not use chemical inputs because they are too expensive. An alternative approach is to grow local varieties of plants that are more resistant to pests and require less fertilization.

Figure 10.6

'Other Plants' Most Frequently Cultivated

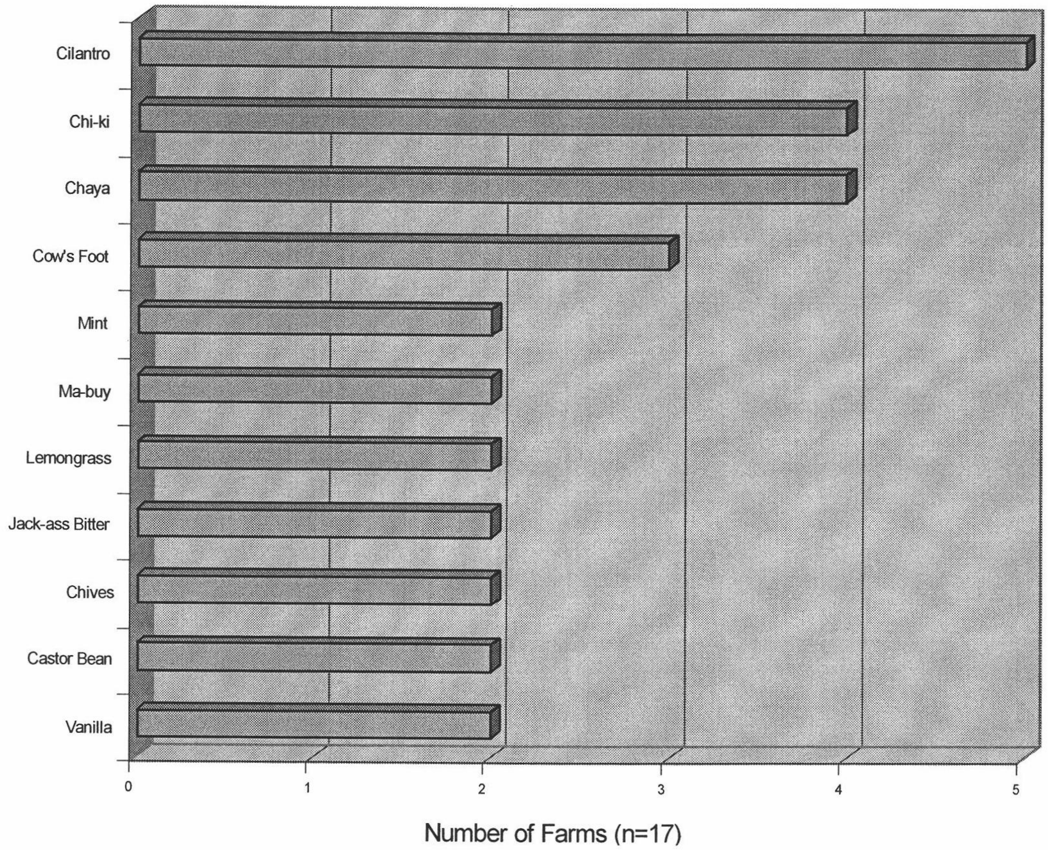



Figure 10.6 represents the frequency in which 'other crops' are planted in the sample. These plants and herbs are typically found growing in small numbers in kitchen gardens and *milpas*. Cilantro and culantro (the wild variety) are two similar herbs that are cultivated extensively for home use. They were found growing on five farms and are an essential ingredient in Mayan foods. *Chi-ki* and chaya were found on four farms, mostly growing close to the house or in secondary bush. *Chi-ki* is a species of *helconia* that often grows wild in disturbed landscapes such as fallowed *milpas.* The hard tops (flowers) can be boiled and eaten and the seeds are sometimes collected and planted in disturbed landscapes that border *milpas*. *Chi-ki* can be sold in Punta Gorda for up to US 50 cents per pound. Chaya is also a popular plant, as its nutritious leaves can be picked, boiled, and eaten. Chaya can be planted easily by cutting off a piece of stem and sticking it in the ground.

Cow's foot is another herbaceous plant that was found on three farm sites. It has a pungent odor and is often used when cooking fish. The rest of the plants were each found on two farms. Mint, lemongrass, and jackass bitter (medicinal) are used to make herbal teas. *Ma-buy* is another species of *helconia* that produces edible seeds. Although these plants are mostly found in open forests, farmers plant sometimes plant the seeds near their homes and *milpas*. A five-gallon bucket of seeds fetches US $2.50 in Punta Gorda. The castor bean is also a medicinal plant that was found growing in kitchen gardens. The leaves can be used to cure sores and rashes (see appendix B).

Vanilla was found growing under some cacao trees on farm # 10. Vanilla is a species of orchid that was traditionally cultivated by the ancient Mayas and used as an ingredient in the cacao beverage. It demands a high price in the market because it is difficult to grow. Vanilla requires adequate amounts of shade and must also be hand pollinated for it to flower successfully. There has been some talk among cacao farmers of growing vanilla organically within cacao agroecosystems; however, the plant forms many vines that would interfere with the pruning of tree branches. It would also require high levels of labor to pollinate the plants.

Figure 10.7

Additional Incomes for Mayan Farmers

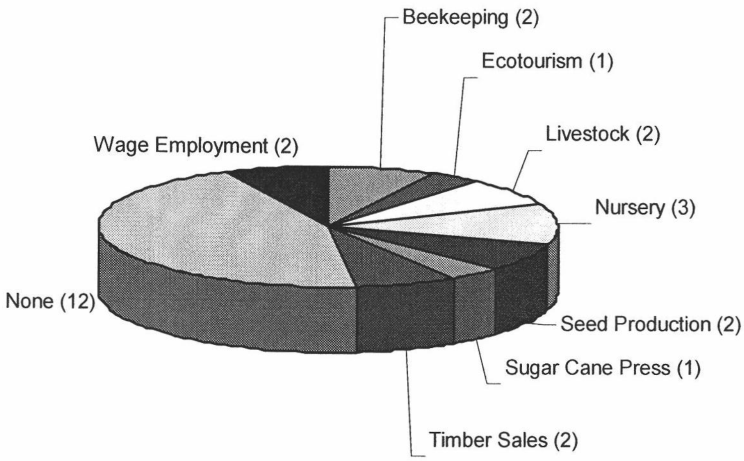


Figure 10.7 illustrates an array of on and off-farm economic opportunities for Mayan farmers. The graph shows that 12 farmers rely solely on agricultural production for their incomes, whereas only two farmers rely on wage labor to earn cash. Bee keeping, nurseries, selling livestock, and seed production are also popular choices for diversifying incomes, as these activities can be easily incorporated into a farming system. Only one farmer in the sample is involved in ecotourism (see farm # 2), although more farmers may choose to engage in this type of sustainable development in the future.

Figure 10.8

A Comparison of Immediate Labor Resources and Farm Size

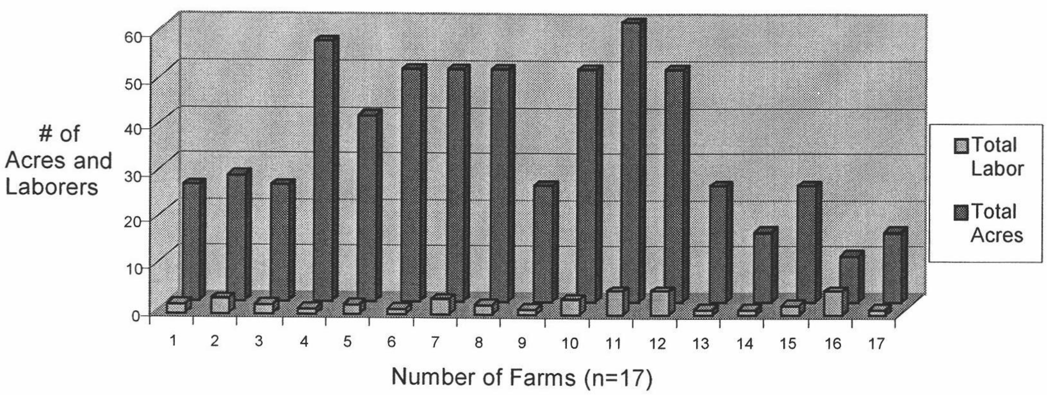



Figure 10.8 compares immediate labor resources (within a single household) with farm size. Farm # 11 and farm # 12 use the largest amount of household labor (five men) on farms that are 60 and 50 acres, respectively. Farm # 7 and farm # 10 have the second largest household labor sources (three men) on farms that are both 50 acres. Of all four of these farms, only farm #10 is located far from the household (see figure 10.9). This may indicate that farmers who cultivate their crops on lands adjacent to the household generally have a higher source of labor than farmers who maintain fields far from their homes.

Farms # 4, 6, and 8 have total acreages of 56, 50, and 50, respectively, but they also have a very low labor source of one man on each farm, with exception to farm #8 (part-time help from one son). Although these solo farmers plant *milpa* crops, they rely more heavily on agroforestry systems to produce cash crops because they do not require as much labor. For example, farm # 4 has 1280 cacao trees, as well as oranges, grapefruits, and plantains. Farm # 6 has 2300 cacao trees in addition to oranges, tangerines, grapefruits, lemons, mangos, mamey apples, annatto, and plantains. Farm # 8 has 1000 cacao trees, 100 coffee trees, 400 orange trees, and also annatto, grapefruits, tangerines, plantains, papayas, sour sop, and custer apples.

Figure 10.9

A Correlation Between Crop Diversity and Location of Farm Site

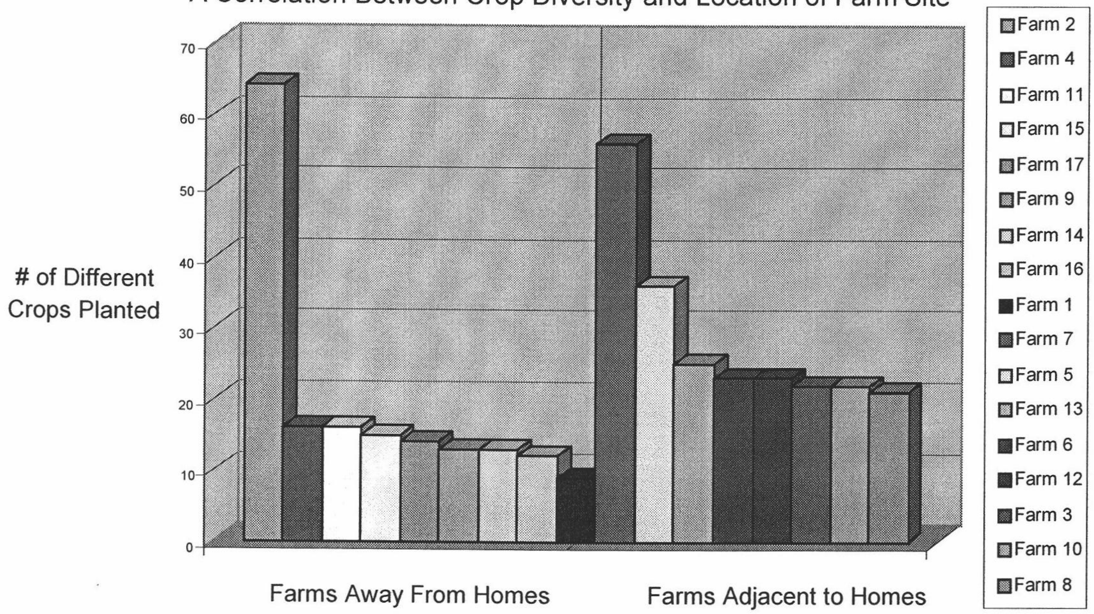



Figure 10.9 shows the correlation between crop diversity and location of farm-site. With exception to farm # 2, each farm that is located far from the household (at least one mile) has fewer different varieties of cultivated plants and trees. The reason farm # 2 is so diverse is because it is being used as a botanical garden for ecotourism purposes. Farms that lie adjacent to households have almost twice as many types of crops planted as the other farms. Again, this trend may be attributed to the following

factors: ease of transporting seedlings; more secure land tenure through leases and the visual presence of a house (Netting 1993); a larger source of household labor, more knowledgeable farmers (pertaining to ecology, plant varieties, IPM, agroforestry, and intercropping strategies); and larger investments into the agricultural system.

## Type A and Type B Farming Strategies

Mopan farmers employ different strategies for choosing which crops to plant and how many acres of land they wish to cultivate. Based on my observations, there appear to be two different types of farmers in San Jose, type A and type B. Type A farmers often live within the village where they maintain small kitchen gardens and plant their *milpas* on distant, non-leased sections of reservation land. These farmers often lack sufficient financial resources to invest in labor, agrochemicals, seeds, and agroforestry systems. Thus, type A farmers typically cultivate local varieties of *milpa* crops for subsistence uses and sell whatever is leftover to the market. This farming strategy lacks diversification, as there are limited numbers of vegetables or tree crops that are found in the system. Corn, beans, and rice are staple crops that are planted throughout the year, yet it is not unusual for a type A farmer to have a section of cacao on an additional parcel of land. Type A farmers are also more likely to have a second source of income, which usually consists of a form of wage labor or shop keeping (Field Notes 1-6-0-2).

As opposed to type A farmers, type B farmers cultivate many different varieties of fruit, vegetable, and timber crops. These farmers generally have a leased title to their land, build their homes within close proximity to their fields, and have invested heavily in the production of permanent tree crops such as cacao, citrus, coffee, and valuable hardwoods. This strategy, however, requires a considerable amount of cash and labor resources, which makes type B farmers higher up on the socio-economic ladder than type A farmers. Vegetable production on a type B farm typically consists of hybrid varieties of tomatoes, cabbages, and peppers that are grown using synthetic inputs. Corn, beans, and rice are also planted on large parcels of land to sell in Punta Gorda and Guatemalan markets. Type B farmers also plant many varieties of fruits such as pineapple, plantain, mango, banana, mamey apple, papaya, annatto, etc.

Type B farming strategies have many advantages over the former. First, household members enjoy a healthier diet because fruits can be harvested throughout the year for consumption. Second, there are greater economic opportunities in a type B farming system. Fruit crops sell for a decent price at the market in Punta Gorda. It is also important to note that if one or two crops fail, there are others that can be sold to offset any losses. Third, cacao and hardwoods are planted to ensure the farmers' sons and daughters will have a more secure economic future. Trees such as mylana, white mahogany, and laurel can be harvested between 10 and 20 years. Longer maturing trees like mahogany, cedar, and teke are required to grow up to 40 years before they can be harvested. These trees will eventually provide a family with a substantial amount of cash to reinvest in the farming system.

Another benefit of a type B diversified farm is that it may help to limit out-migration by preserving traditional and sustainable agricultural techniques. Boys grow up learning how to plant and maintain many different species of crops. The traditional agricultural knowledge that is accrued will be useful if young men decide to start their own farms. The ecological and botanical information that is passed down through generations of farmers may help young men establish highly diversified farms. If there is a gap in this system, future Mayan farmers may face problems of household labor shortages, declining soil fertility, erosion, and pest infestations, as well as environmental damage and health concerns from relying heavily upon synthetic inputs for agricultural production.

During my interviews with young men who lived within the confines of San Jose Village, the majority did not wish to pursue farming as a profession. They complained about the long walks to the *milpa*s, low market prices, and the hard work it takes to make a decent living. However, my participants who worked on their fathers' diversified farms outside of the village wanted to be farmers themselves. Instead of leaving the village in search of employment, they wanted to help maintain the family farm and eventually start one of their own. These young men were also interested in taking over their fathers' cacao fields and planting additional cacao and timber trees on new sections of land.

It is more common to find agricultural diversity in farm-household compounds near the outskirts of San Jose; however, some farmers who live in the village and must walk a considerable distance to their farms have also developed highly diversified agricultural systems. One farmer planted a variety of crops on four different sections of land that were all between one and two miles away from his house in the village (see farm #14). He also owned several acres of cacao in the Green Creek area. With the help of his three sons, this farmer cultivated the following crops during the 2002 planting season: 1000 plantain; 300 pineapple plants; 1200 tomato plants; 1,000 cabbage; 700 sweet peppers; sweet potatoes; red and black beans; rainy-season corn intercropped with ginger, pumpkin, and mucuna; and dry-season corn with mucuna. One of his sons also owns 11 hybrid pigs that he sells locally and to the market in Punta Gorda.

This example shows how an aggressive farmer who lives in the village is able to maintain an economically viable and diversified farming system even if his land is not leased or close to his home. This farmer, however, had the help of his three strong boys to assist with much of the planting, weeding, pruning, and harvesting that is involved in maintaining a diversified farm. Many older farmers in San Jose do not have that luxury, as it is uncommon to find a group of teenage brothers who have all decided to remain in the village and work on the family farm. In addition, unlike many other young boys in the village, my informant's sons were hard workers and did not mind traveling long distances each day to the fields.

# 11. Analyses and Discussion of Survey Responses

(The survey form and results are located in appendix G)

Questions #1 and #2

Table 11.1 Occupation and land use among students' fathers

| Occupation and land-use category | # of responses |
|---|---|
| Farmer | 38 |
| Non-farmer | 0 |
| | |
| Farms on reservation land | 30 |
| Farms on leased land | 1 |
| No response | 7 |

The fact that all 38 students' fathers are farmers indicates that San Jose is still predominately an agricultural community. Although some men find part-time work as shopkeepers, ministers, butchers, etc., farming is the primary method for obtaining income in San Jose Village.

Only one student responded that their father leased his farmland. Given this information, there are several reasons why I think many Mopan farmers do not lease lands for growing staple crops. First, one could conclude that the traditional common-pool swidden system is still highly functional within the reservation system. Because the population of San Jose has not dramatically increased over the past decade, the traditional shifting cultivation land-use system that is monitored by the village *Alcalda* appears to be relatively stable. During my research, I rarely observed any conflicts over property rights or issues concerned with land use for agriculture. Each farmer whom I worked with knew who would be cultivating each piece of fallowed reservation land within three miles of the village.

The second reason why I believe that farmers do not lease land is because a leased title is too expensive for them to afford. US $1.50 per acre each year is a high price for Mopan farmers to pay if they choose to cultivate large sections of land. This expense is deemed unnecessary if farmers can grow their crops on reservation lands free of charge.

A third reason why Mopan farmers may be reluctant to lease their land is because of the forestry laws that prohibit an individual's ownership of valuable hardwoods such as mahogany, cedar, and teke. Even if a farmer has a lease, anyone can apply for a permit to harvest trees on that land. Therefore, farmers have few incentives to lease lands if they want to plant timber trees.

Question # 3

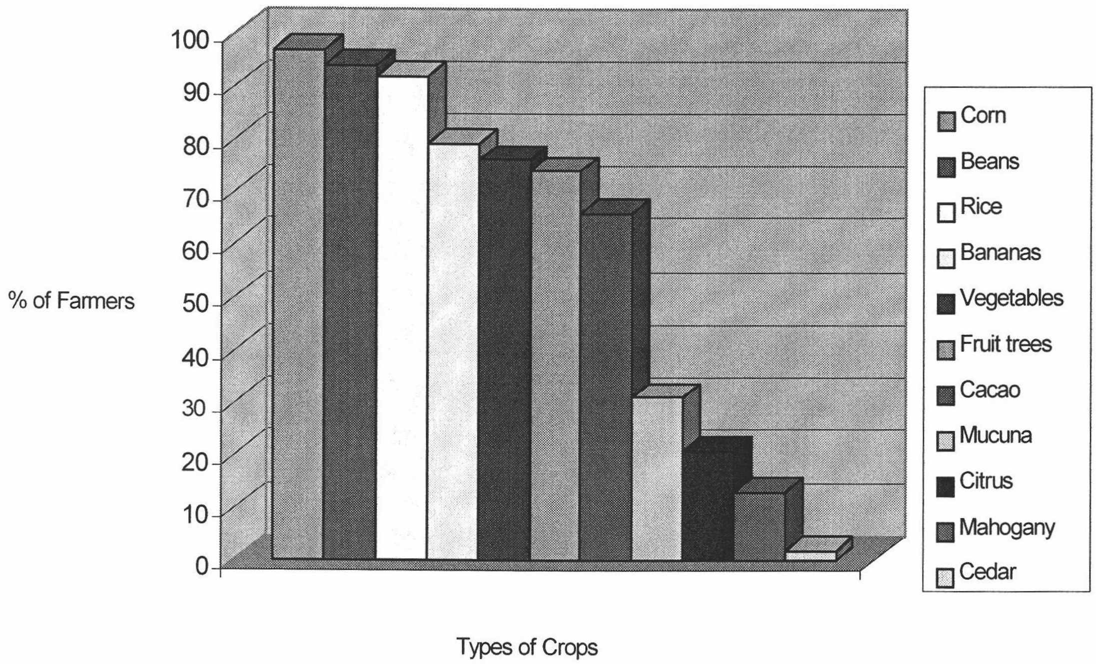
Table 11.2 Crops students' fathers plant

| Types of crops | # of responses |
|---|---|
| Corn | 37 |
| Beans | 36 |
| Rice | 35 |
| Vegetables | 29 |
| Banana | 30 |
| Mucuna | 12 |
| Cacao | 25 |
| Cedar | 1 |
| Mahogany | 5 |
| Citrus | 8 |
| Fruit trees | 28 |
| Other | 0 |

Most of the farms I documented were those of expert farmers who cultivated a wide variety of annual and perennial crops. This question was intended to supplement my data concerning the "typical," or type A farmer in San Jose. Figure 11.1 represents the frequency of different crops that were planted by 38 Mopan farmers.

Figure 11.1

Frequency and Types of Crops Planted by Students' Fathers




The graph above indicates that most of the students' fathers plant staple crops such as corn, beans, and rice. Bananas, vegetables, fruit trees, and cacao are also frequently planted. The lowest percentages of crops planted were citrus, mahogany, and cedar trees.

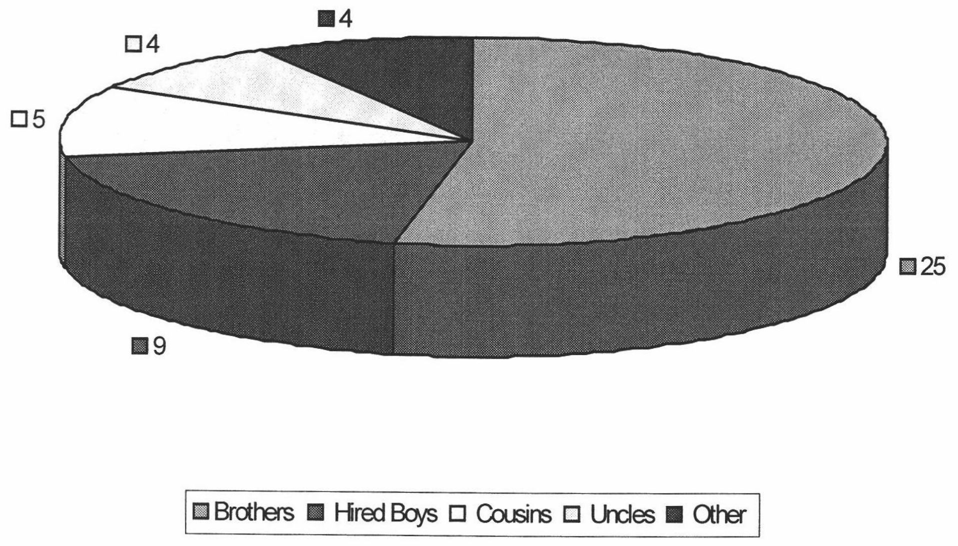
These data help to show that farmers in San Jose are not very interested in the planting of hardwood trees for timber production. This is probably true for several reasons. As mentioned before, there are no guarantees for harvest rights on trees that grow on reservation or leased lands. It also takes up to 30 years to harvest the more valuable timber species. Few of these farmers are thinking that far down the road. Finally, the extraction, processing, and selling of these large trees takes a large amount of resources and labor that few farmers can afford.

There is an interesting comparison between the percentage of farmers who plant cacao (66%) and citrus trees (21%). The high percentage of farmers who plant cacao trees is most likely attributed to the profitable organic market for chocolate beans. In contrast, there is no such organic market for citrus products. The price for citrus products has dropped in the past decade due to competition from large and corporate owned citrus farms along the Southern Highway.

Question # 4

Figure 11.2

Labor Resources on the Family Farm




According to Figure 11.2, farmers' sons contribute much of the labor on the family farm (25 responses). This valuable source of labor, however, is diminishing as Mopan boys attend high school, leave the village to seek employment, or join the Belize Defense Force. The second most frequent answer was that hired men provide labor on the farm (nine responses). This shows that there is indeed a shortage of available young men for labor. Cousins (five responses) and Uncles (four responses) are also important labor resources that are utilized in labor-exchange groups.

Questions # 5 and #6

Table 11.3 Student labor resources

| | Number of students who help on the farm | When students help: After school | Weekends | Holidays |
|---|---|---|---|---|
| Boys | 18 | 5 | 12 | 13 |
| Girls | 17 | 5 | 10 | 13 |

It is surprising to see that 17 out of 20 girls help with the weeding and planting on the family farm. In this survey, girls help out on the farm just as much as the boys do. Weekends and holidays are the time periods when boys and girls are most likely to provide farm and household labor. There is a clear division of labor in Mopan villages, in which men and boys farm and women and girls share domestic responsibilities. However, it appears as if male and female roles have become less rigid as the Mopan live in a more modern society. For example, a large number of girls volunteered for an after school organic gardening program that was sponsored by Plenty Belize. While talking to some of these girls, I learned that many of them wanted to have a small farm or large garden of their own to take care of, regardless of what their fathers thought. Women may have more responsibility taking care of crops in the near future if men are forced to leave the village for wage-type jobs.

Figure 11.3. These Mopan girls in San Jose are working on an organic gardening project with a Peace Corps Volunteer. Kitchen gardens were traditionally maintained by women and provide an important family food source.

<u>Questions # 7 and # 8</u>

Table 11.4 Number of students' older brothers

| Number of brothers | # of responses |
|---|---|
| 0 brothers | 9 |
| One brother | 8 |
| Two brothers | 6 |
| Three brothers | 3 |
| Four brothers | 5 |
| Five brothers | 0 |
| Six brothers | 2 |
| Seven brothers | 1 |

Table 11.5 Number of brothers who attended high school

| Number of students' brothers who attended high school | # of responses |
|---|---|
| 0 brothers | 23 |
| One brother | 8 |
| Two brothers | 1 |
| Three brothers | 0 |
| Four brothers | 1 |

The Mopan's agrarian culture places a high value on young males because they provide an economic security to households in the form of agricultural labor. Young men are often encouraged by their fathers to stay in the village and help in the fields, although this trend is slowly changing. The data from tables 11.4 and 11.5 indicate that 16 out of 68 total brothers (24%) attended high school. This statistic is important because it reflects the attitudes of young men in their decisions to either farm for a living or find jobs outside of the village. If a large group of boys in San Jose decides to go to high school in Punta Gorda, then a valuable labor source becomes lost from family farms. When these boys leave the village to pursue their education, they are less likely to return and provide full-time labor on the family farm (Field Notes 11-2-02). Fathers may then be forced to hire outside labor, which many cannot afford, or rely on labor-exchange groups for assistance in planting and harvesting crops.

Question # 9

Young men typically start their own farms at the average age of 18. This is also the age when young people marry and begin to have children. During interviews with young men between the ages of 15 and 20, I was told that it was difficult to find fertile land that was available within a two-hour walking distance from the village. The competition among young farmers for suitable agricultural land has placed additional stress on forest resources and on the swidden-fallow rotations. For example, the building of a house requires harvesting specific types of trees that will not rot from heavy rains. Some species of these trees are becoming rare and can only be found near the Columbia Forest Reserve (Field Notes 09-29-02). Cohune palm leaves and vines for thatching must also be chopped in large numbers if the house is to have a traditional thatched roof. Young Mopan men must take into account all of these factors when deciding whether they want to farm on their own land, help farm on their father's land, or leave the village in search of wage employment.

Question #10

Table 11.6 Students' future plans

| | Go to High School | Do not go to high school |
|---|---|---|
| Boys | 18 | 0 |
| Girls | 18 | 2 |

Table 11.6 indicates that of the 38 students who participated in the survey, all but two girls replied that they wanted to go on to High School. A large number of Mopan children attending High School in Punta Gorda may bring about both positive and negative impacts on the San Jose community. The benefits are that the Mopan are furthering their education and have an opportunity to increase their standard of living. Sending a child to school, however, is very expensive for the average Mopan family.

The annual costs incurred during a school year for each children are the following (in U.S. dollars): activity fee $75; registration $25; security $6; books $200-300; and uniforms $10-15. Although the Government of Belize pays $35 for tuition and provides free transportation to and from school, these costs are still fairly high (Personal communication, Justino Peck, 09-24-02).

In addition to the costs of sending a child to school, a valuable source of household and farm labor becomes lost when sons and daughters are away from home. This places additional stress on the family because they may not be able to afford to hire additional laborers. Out-migration rates will also most likely increase as more educated men and women move to towns and cities in search of employment.

Question #11

Table 11.7 Boys' and girls' desired occupations

| Desired occupations | Boys | Girls |
|---|---|---|
| | # of Responses | |
| Construction | 4 | 2 |
| Logging | 1 | 0 |
| Farmer | 1 | 0 |
| Mechanic | 3 | 0 |
| Computers | 9 | 8 |
| Business | 8 | 12 |
| Banana farm | 2 | 0 |
| Teacher | 4 | 3 |
| Doctor | 1 | 0 |
| Belize Defense Force | 1 | 0 |
| Police | 1 | 0 |

Figure 11.4

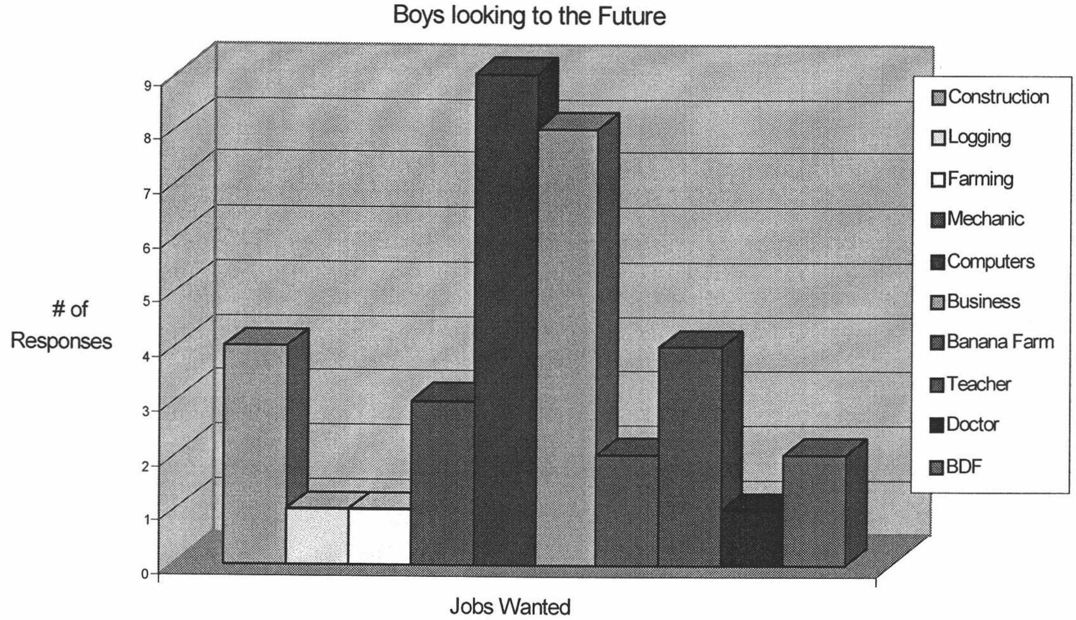



Figure 11.5

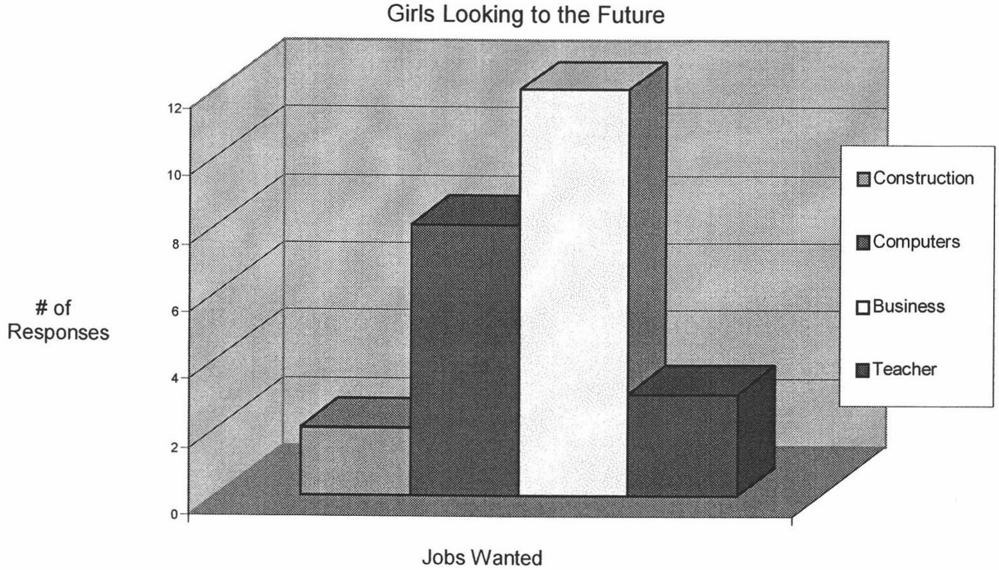



Table 11.7 and Figures 11.4 and 11.5 show both the girls' and boys' responses to what kinds of jobs they would like to have when they grow older. The graph for the

boys indicates that the top desired professions are in computers, business, construction, and teaching. Only one boy wanted to become a farmer. The top two responses for girls were business and computers. These data show that many of these young students are not interested in living a traditional agrarian village life. Children in this age group have been introduced to a more modern lifestyle from their visits to the more progressive town of Punta Gorda. During these visits they have an opportunity to watch television and use computers, neither of which are available in San Jose. If these students want to find employment opportunities that they chose in the survey, then it may be necessary for them to leave village. One of the benefits to out-migration, however, may be that young Mopan men and women will be better educated and more informed about issues concerning their people and culture. They may also be able to earn some extra money to send to their families who remain in the village.

During my stay in San Jose Village, I learned that the Toledo Maya Cultural Council was trying to acquire the funding and support to start a high school in San Antonio Village for Mopan and Kekchi students. The building of this school could have several benefits to the Mayas. The transportation costs would be much lower for families because of the close proximity of the school to many of the Mayan villages. In addition, students would return to the village much sooner to help their fathers and mothers with farming and household chores. If a high school is to be built in San Antonio, it is my opinion that the curriculum should be oriented towards fields of study that are more suited to the Mayan people. For example, students could learn about agricultural markets, agroforestry systems, sustainable logging operations, or the tourism industry. These are job opportunities that would help the Mayas compete economically in a rapidly developing area without having to permanently leave their villages.

Question # 12

Table 11.8 Crops students want to plant

| Types of crops | Boys # of Responses | Girls |
|---|---|---|
| Corn | 14 | 6 |
| Beans | 14 | 5 |
| Rice | 15 | 6 |
| Vegetables | 17 | 17 |
| Banana | 11 | 11 |
| Mucuna | 6 | 8 |
| Cacao | 8 | 5 |
| Cedar | 6 | 6 |
| Mahogany | 6 | 6 |
| Citrus | 8 | 3 |
| Fruit trees | 8 | 9 |
| Other | 0 | 0 |

Although only one student replied that he wanted to be a farmer, 30 out of 38 students circled answers pertaining to what types of crops they were interested in planting. It is becoming more common in San Jose, as well as in other Mayan villages, for men to be part-time farmers and also pursue wage employment opportunities. If these men are required to leave the village for this work, then their wives, sons, daughters, and relatives help with farm maintenance. This may be the reason why 13 out of 20 female students responded that they were interested in planting staple crops and fruit trees.

As more Mopan men migrate in search of employment, it makes sense for them to invest more heavily into agroforestry systems. Crops like cacao and fruit trees require far less overall labor than vegetables and grain crops. Trees only need to be planted once and can be harvested for up to 40 years. Weeding also becomes less frequent because the shaded forest canopy limits aggressive vegetative growth. The only major time consuming activity involved with maintaining trees is pruning and harvesting. These tasks, however, can be done just a few times a year.

Figure 11.6
Crops Boys Want to Plant

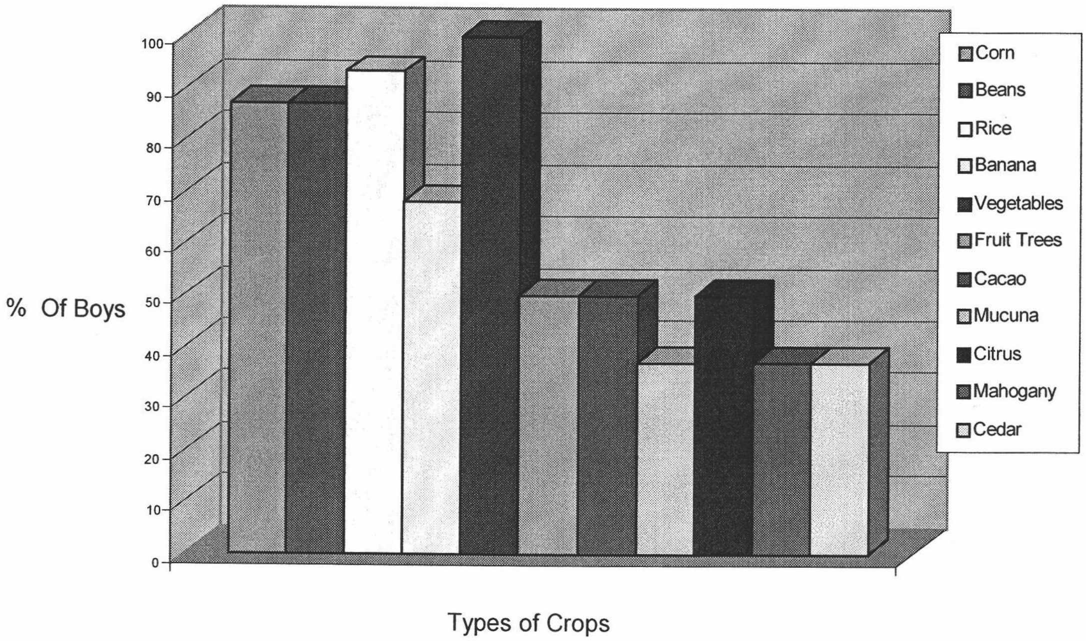
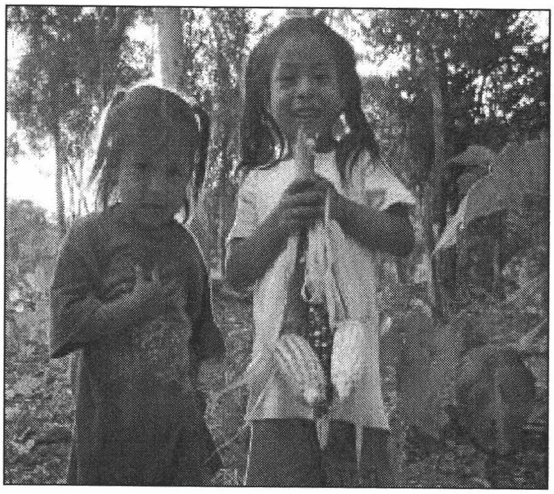
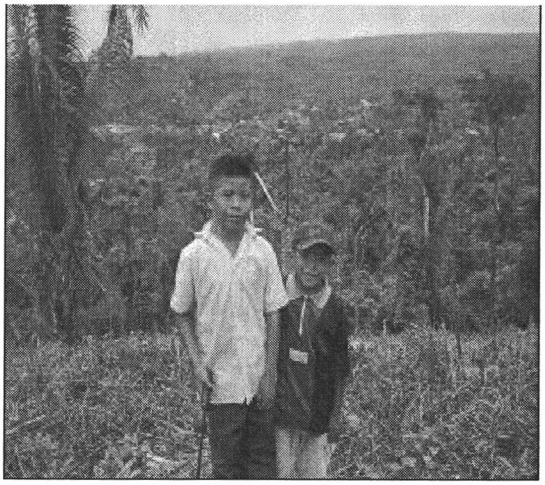



Figure 11.6 indicates what types of crops the boys are most interested in planting. The graph shows that boys are most interested in planting traditional crops such as corn, beans, rice, bananas, and vegetables. Fewer than 50 percent of male students wanted to plant fruit trees, timber trees, or mucuna. When compared to the graph of what the students' fathers plant (see figure 11.1), there is a similar trend of the graph sloping downwards from left to right. This may suggest that boys want to plant crops similar to those of their fathers. When boys work with their fathers they learn a great deal of information about how specific crops are planted and cared for. Young men may therefore be hesitant to want to plant crops or trees they are not familiar with. Trees such as mahogany, cedar, and cacao may also be refused because young farmers are looking for a quicker return on their labor investments.

Question # 13

The average time it took for students to walk to their fathers' farms was 50 minutes. The distance between households and farms in San Jose has been an important component to my research. I discovered that crop selection and diversity decreases the farther one has to travel to the farm (See figure 10.9). As mentioned previously, farms that were located adjacent to Mopan homes contained the greatest amount of diversity as opposed to farms that were over a mile away from the home. Men tend to visit distant farms less frequently, thereby limiting the amount of time they spend checking plants for diseases, chopping weeds, applying fertilizers, or watering seed beds.





Figures 11.7 and 11.8. Left: Two Mopan girls are holding three ears of sacred corn. The mauve colored corn in the middle has become rare because Protestant religious groups have discouraged its cultivation. The mauve corn was once used in traditional Mayan rituals and blessings and is often associated with witchcraft. Right: Two Mopan boys posing at the top of a hill overlooking San Jose Village. Although the boy on the left is holding a machete, it is unlikely that he will become a full-time farmer like his father because of better educational opportunities and the lure of higher paying jobs in nearby towns and cities.

# 12. Conclusion and Recommendations

Agricultural diversification strategies mentioned throughout this paper have helped the Mopan in San Jose Village cope with problems of deforestation, changing socio-economic conditions, and an unfavorable political climate. Mopan farmers have diversified their farming systems by adopting new crop varieties, developing more sustainable agricultural techniques, increasing the production of cash crops, and adjusting their traditional labor systems. These adaptation strategies have enabled the Mopan to preserve many of their traditional agricultural practices, despite their acculturation into a modernized Belizean society.

The findings in this study are relevant because they can be applied to farming communities throughout underdeveloped countries. If marginalized agrarian societies can diversify their agricultural practices, they may become more successful in achieving sustainable development. Environmental conservation may lead to future logging operations and ecotourism ventures, as well as the ability for farmers to produce cash crops without the problems of erosion and declining soil fertility. The revenues from these activities may help to improve health care and education throughout impoverished rural communities. They may also provide farmers with incentives to invest in diversification projects that will ultimately improve the economic stability of their agricultural systems.

The Mopan's agricultural diversification strategies deserve much attention because they have provided a means for farmers to overcome many environmental and economic hardships. One of the ways in which Mopan farmers have adapted to environmental constraints is by supplementing swidden agricultural practices with slash-and-mulch techniques, agroforestry systems, and intense vegetable production. The use of cover crops such as the mucuna bean has allowed farmers to cultivate dry-season corn year after year in the same field without losing soil fertility. This intercropping technique also helps to increase fallow lengths in secondary forests that are used for planting rainy-season corn and rice. Longer fallow periods enhance biological diversity and improve animal habitats in secondary forests, thus ensuring access to game animals, medicinal plants, and building materials.

The Mopan's reliance upon agroforestry systems has also helped to conserve the remaining high forests located outside of San Jose Village. These forests may eventually be exploited for timber products or ecotourism projects. The planting of fruit and timber trees has helped Mopan farmers to increase their revenues over a longer period of time because these farming systems do not require heavy expenditures in labor and agrochemicals.

The cultivation of cacao among Mopan farmers is a diversification strategy that has proved to be an important political and economic venture as well. The fair-trade and organic cocoa market that exists in southern Belize has encouraged Mayan farmers to invest in the production of shade-grown cacao. The increased planting of cacao trees has led to a major conservation movement in which thousands of acres of land have been incorporated into a diversified and organic agroforestry system. Although this strategy has resulted in the removal of land from the common pool, it may help to strengthen land tenure claims in the long run and provide a much-needed source of income to Toledo Mayan communities.

The commercial planting of cacao trees also inspired Mopan men to form into cooperative farming groups. The presence of farming groups in San Jose has led to improved economies, a more organized labor system, Mayan-controlled logging operations, and new political associations with the Government of Belize and NGOs in the Toledo District. The communal structure of these groups allows Mopan farmers to pursue seasonal off-farm employment, as it is a common practice for other members to maintain and monitor a farmer's crops in his absence. Furthermore, the passing down of cacao trees and leased parcels of land to members' sons helps to limit out-migration and preserve the Mopan's traditional agrarian knowledge.

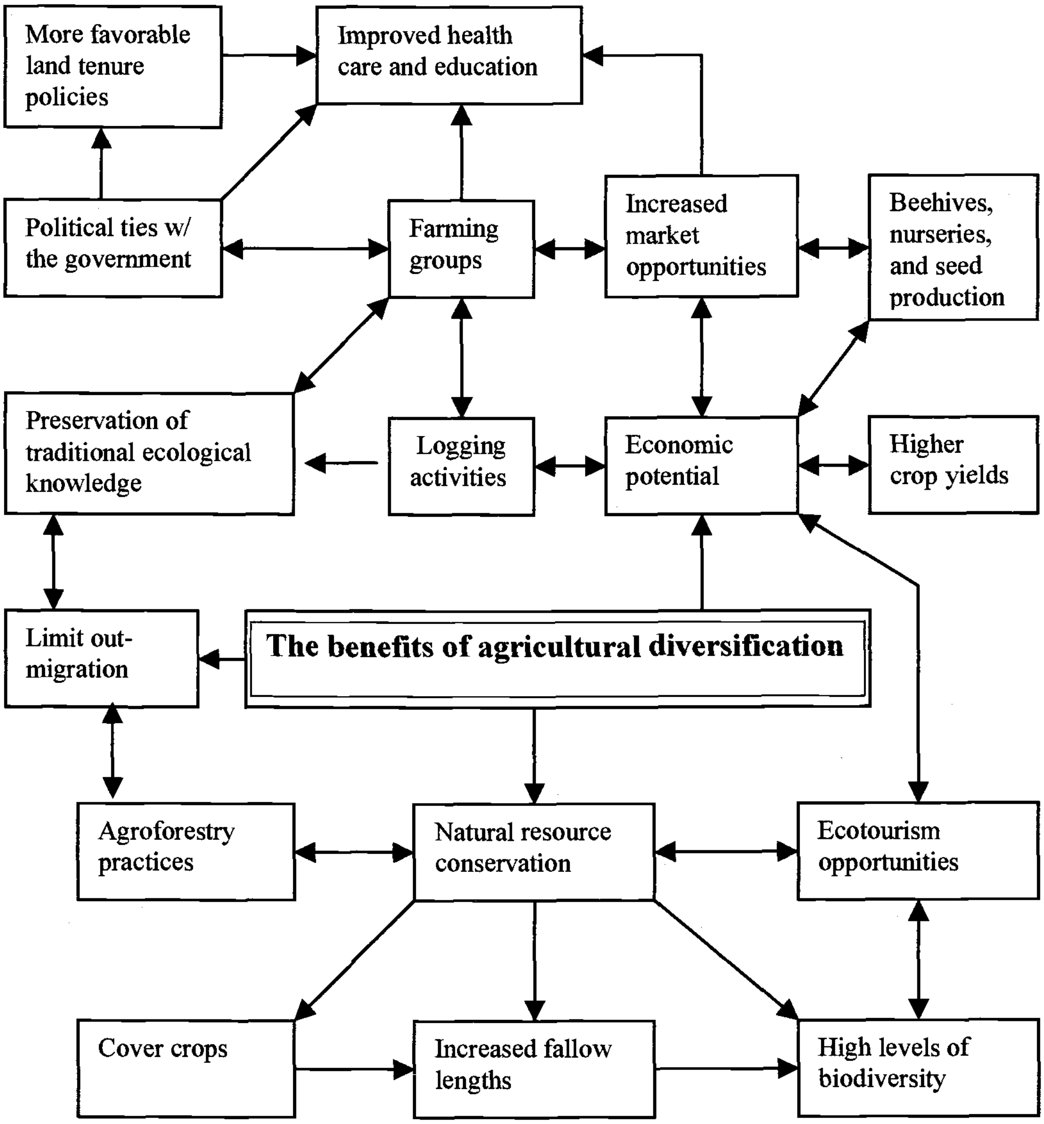
Ecological theories were explored in Chapter eight to describe how cultural, economic, environmental, and political changes influenced the Mopans' agricultural practices and access to forest resources. The Mopan's integration into a modernized Belizean society led to a modification of traditional labor systems. As out-migration became more prevalent, older farmers joined cooperative groups to develop agroforestry systems that required low levels of labor. They also adopted hybrid crop varieties and synthetic chemical packages to increase crop yields. This strategy allowed farmers to limit the sizes of their *milpa* plots, thereby conserving labor resources that were redirected towards planting highly marketable crops such as tomatoes, cabbages, and peppers.

The Mopan's increased production of cash crops for expanding markets was an adaptation to a changing economic system. This agricultural intensification process led to deforestation and shortened fallow lengths in secondary forests near San Jose Village. Some farmers responded to these conditions by purchasing leases and developing more permanent and sustainable agricultural systems. This diversification strategy has proved beneficial for wealthier, type A farmers; however, the removal of lands from common-use reservation areas has caused animosity among type B farmers who lack the financial resources to purchase leases and invest in their farming systems.

Political ecology theory was discussed to describe the Mopan's political affiliations with the Government of Belize. The Mopan's future access to agricultural lands and forest resources is largely dependent on their ability to secure land tenure within the reservation system. Agricultural diversification strategies cannot benefit Toledo Mayan communities if farmers perceive substantial risks and do not want to invest in agroforestry and other sustainable cropping systems. Although the Toledo Mayas have the support of NGOs and legal organizations, the GOB's recently introduced development schemes may further marginalize Mayan populations, similar to the examples given of other indigenous communities in the tropics.

Figure 11.1 illustrates the dynamic socio-economic, political, and environmental interactions that occurred when Mopan farmers began to diversify their agricultural systems. This diagram shows that diversification practices have helped Mopan farmers improve debilitating environmental conditions, increase their incomes, preserve traditional knowledge, stabilize land tenure, and forge new political relationships with the Government of Belize.

Figure 12.1 The benefits of agricultural diversification in San Jose Village



## Summary of the Farm-site Data and Survey Responses

When examining the farm-site data listed in Chapter nine, the high frequency of vegetable crops, cacao, and other fruit trees that are cultivated by Mayan farmers indicate that there is a strong desire to engage in agricultural markets. Because some of these markets are highly volatile, it is necessary for farmers to plant a variety of crops to eliminate risk. The data also show that farmers are increasingly interested in other income generating strategies such as collecting wild plants (*helconias*), establishing plant and tree nurseries, seed production, bee keeping, and raising farm animals. The production of harvestable timber trees is another option for farmers who want to increase their incomes; however, adoption rates are considerably low (particularly among poorer farmers who cannot afford a lease) due to unstable land tenure in the reservation system.

The discussion of documented Mayan farming systems explains how agricultural diversification strategies help to strengthen land tenure claims, improve household diets, and promote the generational transfer of traditional knowledge. A major finding in this study was the differentiation between farming systems that were adjacent to households and those that were a considerable walking distance from homes. Farm-household compounds were shown to have a more diverse selection of crops, a larger source of household labor, and additional income generating activities (see figure 10.9). Farmers who lived adjacent to their farms often leased their land, thereby investing more heavily into the production of vegetable and tree crops. Children who live on these farms are also more likely to participate in farm and household labor activities. This is an important finding because out-migration presents serious labor shortages of young men and women in rural farming villages. As young boys and girls spend more time on the family farm, they learn how to cultivate a variety of crops and gain experience gathering wild foods and medicinal plants that are more prevalent near households that lie on the outskirts of the village. This knowledge becomes valuable when these children grow older and start farms of their own.

The high levels of crop diversity found in Mayan farm-household compounds are significant in this research because they can be applied to existing political ecology theories. When evaluating private versus common property resource-use strategies, it becomes apparent in this study that there is a direct correlation between farm diversity and individual ownership (in the form of leased titles) of lands. The data show that that leased farmlands and farm-household compounds contained more diverse cropping systems. Given this information, one way in which researchers, NGOs, and extension agents in Toledo and other underdeveloped countries can promote agricultural diversification is by encouraging farmers to purchase leased titles to their lands. This can be accomplished through loans, grants, or other monetary resources that may be available to poor farmers. Once farmers feel more secure on their land, they may be more willing to adopt diversified agroforestry practices that incorporate cacao, coffee, hardwoods, fruit trees, and shade-tolerant plants into a sustainable system.

The responses from the survey indicated that many Mopan students were not interested in pursuing traditional village occupations. Their exposure to a contemporary Belizean culture has led to a decline in the transfer of traditional knowledge between generations. In addition, their infatuation with modern ideologies and non-agricultural employment opportunities is a major concern for Toledo Mayan households. Older farmers must bear the costs of education, transportation, and imported goods. They also lose a valuable source of farm and household labor if their children decide to leave the village in search of employment. If farmers are able to diversify their agricultural holdings and increase their incomes through engaging in more consistent and higher paying markets, then their sons may be more inclined to follow in the same direction. This may help to preserve a source of traditional knowledge that has been passed down among many generations of farmers.

Another interesting finding in the survey results was the high percentage of farmers who cultivated crops on non-leased sections of reservation land. This trend corresponds to the relatively low percentage of timber trees, mucuna, and citrus crops that were planted by the students' fathers because of unstable land tenure, high investment costs, and the risks associated with planting permanent tree crops. Cacao appears to be the most favorable cash crop, and this is probably due to the formation of farming groups and the secure market that exists for organically grown cocoa beans.

## Additional Research of Agricultural Diversification Studies

Future studies of diversified agricultural practices may help researchers and policy makers initiate programs that help smallholders overcome many of the dynamic socio-economic and environmental conditions that exist in marginalized agricultural communities. Anthropologists have developed a unique ability to holistically approach this topic and can therefore offer many contributions to this field of study and its theoretical applications. In many cases, indigenous agricultural practices are closely linked to inherited cultural behaviors and specific ecological settings. Thus, researchers must be cautious when disseminating new technologies and cultivation techniques to farmers in traditional societies.

In the Toledo District of southern Belize, additional research of agricultural diversification strategies should build upon what has been presented in this paper. I have closely examined many of the factors that have contributed to the Mopan's changing agricultural systems; yet, it would be beneficial if my conclusions were tested more thoroughly using a robust sample size and more specific scientific measurements. For example, measuring soil fertility in cornfields planted with a cover crop of mucuna would indicate the amounts of nitrogen that were fixed into the soil from the mucuna beans. This data could then be measured against nitrogen levels found in non-mucuna, rainy-season cornfields that were planted in both five and 10 year fallows. The results would help to determine the overall sustainability of each of the systems.

Data could also be collected concerning average household incomes and labor inputs for each type of crop that is cultivated. Analyzing the differences in labor used to cultivate *milpa* crops and cacao would help researchers understand how agroforestry systems benefit household economies. If planting permanent tree crops were shown to produce more income using less labor over a given period of time, then household farming practices should be orientated towards the planting of diversified agroforestry systems. This strategy would also prove beneficial in helping households cope with the effects of out-migration.

Research into available and potential agricultural markets would also benefit this study. Understanding how markets come about, where they are specifically located, and why they sometimes collapse would help Mayan farmers become more selective when choosing crops to plant. In addition, a close examination of how agricultural information and new technologies are disseminated from extension agents to farmers would yield new insights as to how the Belizean government's policies and political agendas affect Mayan farmers in rural Toledo communities. This may help to explain why farmers choose not to purchase leases, plant timber trees, or adopt new agricultural technologies.

## Securing the Future of Mayan Communities in Southern Belize

Throughout this paper I have outlined many of the problems that Toledo Mayan communities face as they become fully integrated into a foreign economic system. There are solutions; however, it will take massive coordination efforts on behalf of the Mayas, NGOs, and government agencies in order to reach them. The two major issues that these players must resolve concern land tenure in the reservations system and development policies initiated in the Toledo District. If these attempts are not successful, the Toledo Mayas may become further marginalized, similar to other indigenous farming groups that were mentioned throughout this paper.

The single most important concern for the Toledo Mayas is a land title that guarantees legitimate rights to forest resources on established reservation lands. Without this title, the Mayas will no longer have control over their own fate. Instead, their future will lie in the hands of a Belizean government that has a history of exploitation via profit-driven and culturally insensitive development schemes. Having secure land tenure will enable the Mayas to invest in large-scale agroforestry projects. The planting of permanent tree crops in reservation areas that lie adjacent to *milpa* plots will help to secure land tenure and conserve important forest resources that can be exploited for sustainable logging or ecotourism ventures. The Mayas should also depend more heavily on dry-season corn as a cash crop as opposed to rainy-season corn. Dry-season corn can be successfully intercropped with mucuna, which I have shown to be a highly sustainable agricultural technique. In addition, the continuous cropping of dry-season corn and mucuna opens up new sections of secondary forests and fallows that can be planted with cacao, citrus, hardwoods, and other fruit trees.

Even if the Mayas do not receive a title to their land, they can still partake in commercial agricultural production. To ensure that farmers have minimal risks, they need the support and funding from NGOs such as TCGA, SHI, SAGE, Plenty Belize, and BEST. If these NGOs can help organize Mayan farmers into cooperative groups and provide funding for equipment and labor, then the Mayas may have a window of opportunity to develop their lands before the government does. If there is eventually going to be agricultural development in the Toledo District, it would be far better (for the Mayas) to have Mayan-owned companies producing goods rather than foreign-owned companies. There is even the potential to tap into other organic markets with bananas, citrus, beans, annatto, and vanilla. The Mayas could then incorporate their traditional cultivation techniques into the commercial production of fruit trees, much like they have done with cacao. Such a system would be highly sustainable, as opposed to a monoculture that lacks diversity and requires the use of synthetic inputs.

In the section Ecotourism Opportunities for the Toledo Mayas, I discussed how ecotourism ventures have not been very successful in the Toledo District. As highways improve and the District becomes more accessible to tourists, I believe that ecotourism can become an important component to sustainable development projects in Mayan villages. However, the TEA guesthouse program alone will not improve economic conditions in Mayan villages because of the limited accommodations that are available for tourist groups. The TEA should be examining other resources to promote tourism, possibly through attracting student groups from developed countries who are interested in learning about sustainable tropical agriculture. Mayan families who maintain diversified farms adjacent to their homes could capitalize on such ventures by building guesthouses on their land. Farm # 2 is an example of such an activity, although a guesthouse had not yet been built because of the hurricane. Students could work on these farms for school credit or as an internship (much like I did at the Chaa Creek

Resort). They would provide an invaluable source of free labor for older farmers whose children have left the village in search of wage employment. In addition, students could learn about traditional agricultural techniques, organic methods of cacao production, and the Mayan culture.

Another way in which Mayan farmers could use their traditional knowledge to generate an additional source of income is through the cultivation of medicinal plants and herbs. Many of the commonly used medicinal plants are becoming harder to find as a result of agricultural expansion and the subsequent decline of high forest areas. It is possible that some of these wild plants could be cultivated in shaded kitchen gardens, agroforestry systems, or in fallowed *milpas,* and sold to villagers, tourists, or to a growing international herbal market. The commercial production of these plants may also prevent the over harvesting of rare and exotic species that are threatened or endangered.

The diversification of agricultural systems is extremely important if Mayan farmers want to continue to cultivate cash crops for the market. Agroforestry systems, swidden fields, cover crop techniques, intense vegetable cultivation, seed production, nurseries, beehives, and small-scale cattle and livestock operations can all contribute to farmers' incomes and the preservation of a traditional way of life. It is also important that farmers become knowledgeable about market economics (trends, surpluses, purchasing contracts, government policies, etc.). The Toledo Mayas should also initiate new sustainable development programs, increase contacts with NGOs and extension workers, seek new educational opportunities, establish creative political agendas, and engage in more secure and profitable agricultural markets. If the Mayas can organize themselves into a robust political entity, then they may be able to look to the future with hope, determination, and success.

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# Appendix A

## Internship project at Chaa Creek Resort, Cayo District

The Maya farm project was started approximately two years before my arrival in Belize. Mick and Lucy Fleming, the owners of the resort, purchased 33 acres of land in 1998 that was to be used as a demonstration farm for visitors and guests. The couple built a thatched house and chicken pen and hired a Mayan family from San Jose Village to plant and maintain a variety of traditionally grown crops. Staple crops such as, corn, beans, rice, vegetables, cacao, and other fruit trees were cultivated using both traditional and organic techniques. The crops were to be consumed by the family, and additional harvests were either sent to the resort's kitchen or sold at local markets. The owners wanted to use the organic foods in their restaurant to reduce their dependence on imported produce and to generate additional income via tours of the farm.

During the weekdays, I worked with a 24 year-old Mopan Mayan farmer from San Jose Village and observed his methods of planting and caring for the crops. I documented all of the crops grown as well as the names of medicinal plants that were used by the family. The farmer also taught me many Mopan Maya words and phrases, which proved to be beneficial for my future research in San Jose. In addition to researching plant names and cropping techniques, I also helped to coordinate the flow of produce from the farm to the kitchen. To do this, I kept records of all the crops that were planted and harvested. I also implemented a plan to establish new groves of fruit trees on a few acres of land that had previously been used to graze cattle.

When I arrived at Chaa Creek, there were not any defined goals that I was supposed to meet. It was up to me to create an agenda and formulate a plan for the future of this project. I had noticed right away that there were mixed feelings among managers and staff concerning the Maya farm. Most thought it was a waste of money, and that inevitably, the project would fail. There were also some prejudices towards the Mayan family that was running the farm.

Another major concern of the project for the Chaa Creek staff was the exploitation of the Mayan family through persistent tourist interactions. In the past, guests had commented that they felt sorry for the family because of their basic living conditions (as compared to the plush and modern rooms at the resort). Some guests had even sent packages of clothes and toys to the family once they returned to their affluent countries. In order to maintain the privacy of the family and to shield tourists from a 'radical glimpse' into the third world, I decided that the house and kitchen should be off limits to educational tours of the farm. I proposed that a small kitchen area should be built (using traditional materials) near the *milpa* (cornfield) and away from the house. The kitchen would enable tourists to see how traditional Mayan foods are processed and prepared without them having to view the family's "primitive" ways of living.

# Appendix B

## Common Mopan medicinal plants and their uses

| Common Name | Scientific Binomial | Medicinal Uses |
|---|---|---|
| Allspice | *Pimienta gorda* | Boil leaf and use as tea to treat stomach aches |
| Annatto | *Bixa orellana* | Leaf mixed with water relieves diarrhea and dysentery |
| *Ash poche* | | Mix with begonia plant, dry, and grind leaf to cure snakebites |
| *Bela-tit* | | Boil leaf and drink as tea to treat chest pains and heartburn |
| Buttonwood tree | *Piper amalango* L. | Bark is used to treat dysentery, snakebites, and can also be used as a sedative |
| Calaloo | *Phytolacca icosandra* | Highly nutritional plant that can be boiled and added to foods |
| Castor bean | *Ricinus communis* | Rub the leaf on a babies skin to relieve sores or rashes |
| Cedar tree | *Cedrela mexicana* | Bark is used to treat bruises, internal injuries, and abdominal pains |
| *Chahom gahom* | | Roots are chopped, boiled, and drank to alleviate stomach pains |
| *Chi-chi be* | *Sida rhombifolia* | Mash leaves and place on infected area to relieve pus and swelling |
| *Chuku pok-che* | | One of two plants that when combined they stop a woman's menstrual cycle |
| Cockspur tree | *Acacia cookii* | Straining ants from the water and drinking relieves mucus congestion in infants; bark and root slows snake venom, boil and bathe to help acne and skin conditions |
| Cojotone | *Stemmadenia donnell-smithii* | Place white tip of leaf into a beef worm hole in skin to kill the parasite |
| *Cool-tze* | | Chew on stem and spit out when one has yellow urin |
| Culantro | *Eryngium foetidum* | Tea from steeped leaves is used to relieve indigestion, vomiting, and diarrhea |
| Custer apple | *Annona reticulata* | Raw fruit pulp heals skin boils; tea made from leaves heals mouth sores; add sugar to tea and use as cough syrup |
| Fecenstile | | Boil bark to make a steam bath for back aches and pain |
| Fiddlewood tree | *Vitex gaumeri* | Boil leaves in water and bathe in to pass the chills of malaria |
| Fig tree | *Ficus* sp. | Sap is used to treat skin fungus, boils, and ringworm; latex is applied to cotton and stuffed in tooth which will break in one hour |

| | | |
|---|---|---|
| Ginger | *Renealmia aromatica* | Tea made from leaves and root helps strengthen immune system |
| Guava tree | *Psidium guajava* | Gargle with the leaf to help cure mouth sores and bleeding gums |
| Gumbolimbo | *Bursera simaruba* | Counter for poisonwood; tea is used to treat internal infections, skin sores, and colds and fevers |
| Hog plum tree | *Spondias mombin* | Used as a "fever tester" to detect sickness; the bark and leaves of the wild tree are used in a wash to relieve sores, bites, and rashes |
| *Ila-toush* | | Fan leaves on skin to help close sores; also helps to control bleeding |
| Jackass bitter | *Neurolaena lobata* | Tea is used for intestinal parasites, bathe wounds or infections, lice, and dysentery; boil the roots to cleanse the blood |
| Life everlasting | *Gnaphalium polycephalum* | Tea from leaves relieves headaches, bruises, swellings, cuts, coughs, sore throat, flu, weakness, and asthma |
| Madre de cacao | *Gliricidia sepium* | Boil bark and use to smooth irritated eyes; mashed leaves are a poultice for wounds, boils, and diaper rash; put leaves in bath water to help babies sleep |
| Oregano | *Latana involucrata* | Leaves are boiled and mixed with black pepper; the tea helps a woman give birth |
| Papaya | *Carica papaya* | Crushed fruit and seeds are put on wounds and infections; eat the fruit to help constipation, indigestion, and high blood pressure |
| Provision tree | *Pachira aquatica* | Bark can be used as a blood tonic; tea made of bark is used for anemia, high blood pressure, and fatigue |
| Red head tree | *Jamelia patens* | Mash leaves and rub on skin to cure sores and swelling |
| *Sa-men* | | Boil leaves and drink the tea when dehydrated or never hungry |
| Samwood | *Cordia alliodora* | Boil the bark to alleviate allergies |
| Scoggineal | *Opuntia spp.* | Boil leaves and drink tea to relieve headaches |
| Sensitive plant | *Mimosa pudica* | Tea made from leaves and branches is a relaxant, pain reliever, and helps insomnia; mash leaves to cure toothaches |
| *Sham-kroot* | | Boil leaves to make a tea to relieve headaches |
| Snake plant | *Sansevieria trifasciata* | Chew on fresh leaf for snakebites; boil leaves for rashes and skin sores; put leaf juice in water and give to chickens to prevent disease |
| Sorosi | *Momordica charantia* | Boil leaves and drink the tea for a blood tonic; also helps cure yellow fever |
| Sour sop | *Annona muricata* | Tea made from leaves is used to treat rashes |

| | | |
|---|---|---|
| Tamarind | *Tamarindus indica* | Fruit pulp makes a laxative; a past is made from bark that is put on scorpion bites |
| Trumpet tree | *Cecropia obtusifolia* | A tea is made from the leaves to lower blood pressure |
| Wild chaya | *Cnidoscolus acinifolius* | Boil leaves for tea and mix with black pepper to make a blood tonic |
| Wild yam | *Dioscorea* sp. | Women eat tuber for birth control; contains sterioids |

# Appendix C

## Diversified cacao agroforestry systems in Costa Rica and Panama

At CATIE cacao nurseries, researchers used a simple grafting technique to propagate new seedlings, which was done by cutting off a section of bud wood (stem) from desirable trees at 2-3 months from the last flush. The graft was taken 2-3 inches from the bottom of the plant from the apical maristem, and then applied onto a five-month old seedling (Nesbitt 2002). This method of grafting from selected parent trees helps to improve yields and increase resistance to pests and disease. It also decreases the lead-time between planting and harvesting, as production can occur within 2 ½ years of planting (Nesbitt 2002). Without grafting, a seedling may take between 4 and 5 years to produce mature pods (Personal communication, Auxibio Sho, 11-07-02).

The first farm the TCGA group visited planted cacao trees at 4 x 4 meters apart and shaded them with salmwood (*Cordia alliadora*) and bri bri (*inga edulis* and various *inga* spp.) Banana and plantain were also inter-planted with the cacao trees. The use of grafted trees helped to keep the level of cacao low (7-8 meters tall), which made for easier management and harvesting. Regular maintenance of this system required approximately 30 man-days per hectare (Nesbitt 2002).

The second farm entailed a biodiversity-monitoring project that was initiated by CATIE and APPTA (Asociacion de Pequenos Productores de Talamanca). Regular visual monitoring was accomplished through counting birds and examining animal tracks in the soil. Beetle traps were also used to capture dung beetles, which indicate a presence of mammals in the forest (Nesbitt 2002). The shade trees planted in this system comprised of different species of indigenous bri bri trees. Shade grown bananas were also grown with the cacao and were exported to an organic market. ATTP has a total of 1067 members who produce a total of 176 tons of cacao per year (Nesbitt 2002).

The third farm was located in Panama, and consisted of cacao trees that were inter-planted with cassava, plantain, and salmwood. Cedar trees (*cedrella odorata*) were also planted along the edge of the cacao. In this agroforestry system, salmwood and cassava were planted first. The 70 salmwood trees per hectare could be harvested in 10 years and were considered the "bank account" of the operation (Nesbitt 2002). Cassava was also an important cash crop, which yielded 50 tons per hectare, as were bananas and plantains.

The fourth farm had 110 acres of cacao that was in conversion to an organic market. This farm differed from the others in that there was little shade in the canopy. The farmer applied 10 tons of compost per hectacre every two to three months. The compost was made with rock phosphate, manure, bone and blood meal, coffee pulp, sawdust, soil, and Chilean nitrate (Nesbitt 2002). There was also a banana style cable distribution system that allows easy harvesting and application of the fertilizer (Nesbitt 2002).

The fifth and last farm that was visited was EARTH, which is an undergraduate university specializing in tropical agriculture. The farm contained a diverse selection of crops, as well as farm animals such as water buffalo, pigs, and goats. There was also a low-tech biogas plant located on the farm, which converted sugar cane and manure into methane. The water hyacinth by-product had a 14% protein content and was used to feed the pigs (Nesbitt 2002).

The TCGA has also been interested in learning about new cloning technologies for cacao trees. The ability for Mayan farmers to plant clones would help to ensure the genetic characteristics of each tree, thereby improving yields and disease resistance. Cloning would also decrease production time from four to two years (Personal communication, Chris Nesbitt, 7-20-02). Although cloning may be a viable option in the future, the process is time consuming and expensive. In addition, cloned trees become plagiotropic, which means they lack the strong vertical spine and branching characteristics of seed-grown trees (Pacchioli 2001). The cuttings also lack a taproot, which makes them vulnerable to high winds and drought conditions (Pacchioli 2001).

Because of the limited success of cloning procedures, scientists have developed a method of producing exact genetic copies of desired cacao trees that is known as somatic embryogenesis (Pacchioli 2001). This technique involves the removal of tissue samples from cocoa flowers and placing them in a culture, where they are "pulsed" with hormones (Pacchioli 2001). The newly formed embryos are then converted into plantlets that retain the original orthoptopic, or tree-like structure (Pacchioli 2001). Although this new technology is quite expensive, it may be of great benefit in the future for the eradication of diseases that plague the cacao industry.

# Appendix D

## TCGA recommended pruning techniques for cacao trees

Pruning:

a. Three main objectives in pruning:
   1. to shape or form the young tree
   2. to maintain the shape of form of the tree and
   3. to renovate or rehabilitate a cacao tree after it has been allowed to lose its shape

b. When Pruning:
   1. Prune to permit walking under the canopy
   2. Prune to make all parts of the tree visible when working in a field
   3. Do not remove branches that are 4-5 feet above the ground if they are erect
   4. Do not reduce production by cutting off branches that can bear pods
   5. Do not prune when trees are bearing

c. Seedlings:
   1. Generally grow a single unbranched trunk at about 4-6 feet
   2. a jorquette develops with 3-5 lateral branches
   3. If first jorquette is below 4 feet, allow another primary chupon to grow
   4. When desired height is obtained, remove all other chupon

d. Clones/Budded:
   1. This tree produces several spreading main stems
   2. Drastic pruning 2-3 years delays early bearing
   3. Prune only branches to allow ease of management
   4. Try to obtain a capital V shape tree in pruning

These are three types of pruning:
1. Formation pruning
2. Sanitary pruning
3. Structural pruning

Formation pruning:
1. First 2-3 years of young trees life
2. Remove deformed and weak branches
3. Shaping the mature tree
4. This system differs for seedling, clones, budding

Sanitary pruning:

Because you will not be using chemicals in your fields, proper and timely pruning will help in pest and disease control.

1. Prune when there is no crop on the trees (May/June)

2. Remove all unwanted chupon and disease branches
3. Remove vines and parasitic plants
4. Remove ants and termites nest and old pods
5. Remove low hanging branches
6. Remove cross over branches
7. Remove all black pods

Structural Pruning:

When the cacao trees are planted and no pruning is done, this causes a lot of chupon and shade branches. The shape of the cacao trees is not properly maintained and not productive.

Shade and windbreaks:

Trees are important in cacao fields, permanent shade trees (eg. leucaena, guanacaste, bri bri) should be 20 X 20 yards apart. Shade trees bring up nutrients from the ground and also enrich soil by fixing nitrogen in cacao. Windbreak recommended for cacao is mahogany, nargusta, cedar, and mamey apple as an economic venture. Cacao is sensitive to and can be damaged by constant direct sunlight. Therefore, overhead shade and windbreaks are very important in complete management practices.

There are three types of shade in a well-managed cacao field:

1. Overhead shade from shade trees (immortelle)
2. cacao trees canopy shade and
3. shade from middle ground cover

The level of overhead shade depends on:

1. The age of the cacao tree
2. the amount and distribution of rainfall
3. the day of clear sky
4. soil fertility and soil moisture retention and
5. shade from hills and valleys

a. Benefit of shad and windbreaks by:

Reducing or regulating:

1. direct sunlight, (50% sunlight and 50% shade)
2. Temperature, (50% heat, 50% cold)
3. Air movement and humidity
4. Environmental stress
5. Soil moisture loss
6. Weed growth

b. Advantage of shade trees in organic farming:

1. Cacao trees properly shaded increases effective uses of nutrients and soil moisture.

2. Shade trees bring up nutrients from the ground that shallow cacao cannot reach.
3. The roots of leguminous shade trees enrich soil by fixing nitrogen.
4. Overhead shade and windbreads are more effective in controlling weeds and pests.
5. Insufficient shade will result in defoliation, leaf flushing, and declining health and production.
   * First sign of stress from excessive sun and wind will include attack by thrips, beetles, termites and other insect pests.

c. Deciding what to use for shade trees

Cacao production requires both temporary shade for young trees and permanent shade for mature trees.

Types of temporary shade trees:
Plantains
Bananas
Pigeon Peas (*Cajunus Cajun)*

Types of permanent shade trees (leucena, guanacaste, bri bri)

1. Plant at least 4 types of permanent shade so that if disease attacks one variety all shade will not be lost.
2. Permanent shade should be about 20 yards X 20 yards apart in high cloudy areas and 45 X 45 yards in low, bright areas.
3. Tree will be dependent on size of mature tree crown.

# Appendix E

## Mopan bush doctors, rituals, and folklore

The influx of modern technologies and ideologies into Mopan society during the latter part of the twentieth century has conflicted with the generational transfer of rituals, folk tales, and other forms of traditional knowledge. Mopan stories have been passed down for many years; yet, many children are not very interested in learning about the "old ways" of living. I was fortunate to have found several informants who told me many of these stories that they had learned from their fathers and grandfathers. Mopan folklore represents an important link to the Maya's past and also portrays the spiritual relationships that exist between farmers, their crops, and the surrounding forests. Much of this folklore is associated with bush doctors and traditional healers.

Mopan bush doctors, or *pulyas* (Fink 1987), use plants and animals to perform rituals that make people sick or die. They also use animal sacrifices, incense, and prayer when performing their ceremonies (Fink 1987). This is known in the Mopan language as *obeit*. Typically, venomous animals such as snakes, spiders, bees, and scorpions are used as a medium to carry the bad spirit to the victim. Plants are also used as mediums in some of these rituals. The purpose of these rituals is to capture and hold captive one's *pixan*, or life essence. The victim of the *obeit* must employ another *pulya* in an attempt to rid off the curse. Thus, the two *pulyas* engage in a battle over the possession of the patient's *pixan* (Fink 1987).

If one wants to become a bush doctor, then he or she must find a teacher and pay them with labor and money (Fink 1987). The teacher's responsibility is to make sure the apprentice learns both the good magic, which is called *betic'a'qui* (healing with herbs)(Fink 1987), and the black magic (hurting or killing people by use of *obeit*). Bush doctors receive a decent compensation (between US $25-100) to perform each curse.

There are two different stories that detail one's initiation to become a *pulya*. In the first story, the apprentice must go out to the bush with his or her master at midnight. The apprentice must stand in front of a leaf-cutter ant nest and close his eyes, while the teacher goes off into the bush and begins praying. A large snake will come out of the nest and slowly wrap itself around the apprentice. If he or she moves or becomes scared, the snake will strike a deadly blow. However, if the apprentice shows no fear, the snake will take him or her underground for three days and teach them about the powers of snakes. After emerging, the apprentice will be able to handle snakes without being bitten.

The second story is about my informant's great-grandfather's initiation to become a bush doctor with two other men. All three men had been taught how to use medicinal herbs and plants to heal people from sickness caused by an *obeit* from a bush doctor. The next step was for them to learn the black magic, which involved three different tests. The first test was for the men to each hit a large tree with their fists three times. The three men and the teacher returned to each tree three days later. If the trees had fallen down, then the apprentices passed the test. If the trees were still standing, they failed and would be sent home. In this case, all three men had passed. The second test was that the men had to be bitten by snakes three times and heal themselves using the medicines found in plants and trees. All three men passed this test and were then able to heal snakebite wounds with their own saliva. The third test was to kill one of their enemies using an *obeit*. The men had to catch a live and venomous animal (snake, spider, or scorpion) and keep it in their homes for three weeks while they burned incense and prayed to the spirits. They then had to release the animal near their enemy's home and pray that he or she would become sick and die. My informant's great-grandfather did not pass this test because he did not have an enemy that he wanted to kill.

There are a few older men in San Jose Village who are bush doctors. I met one elderly man who used medicinal plants to treat children. A few other farmers whom I worked with also had an extensive knowledge of using plants for healing. Although I had heard of many instances in which people had been hurt or killed by an *obeit*, I never directly observed such an activity. There remains an air of secrecy concerning those types of practices, which may be attributed to the Mopans' conversion from Catholicism to Protestant religions. Traditional Mayan rituals that are performed by bush doctors are considered to be taboo because they are associated with devil worshipping and witchcraft.

Many of the younger generation of Mopan are not interested in learning about medicinal plants, as well as some of the older Mayan traditions. The majority of the boys whom I interviewed indicated that they would like to live a more "modern" lifestyle that is reminiscent of Punta Gorda and other towns located in the Cayo District. Mopan boys have become increasingly interested in finding wage employment in areas other than the agricultural sector. Many view farming as a poor way to make a living and are often reluctant to help their fathers in the field. This presents a problem for the Mopan because there are fewer instances where valuable cultural and ecological knowledge is disseminated to the youths. Thus, a vast storehouse of botanical information, folktales, and healing rituals may be lost when village elders pass away.

## Why the Mayas burn incense

The Mayas burn incense on the farm to keep the animals away from their crops. When the men are hunting, they burn incense and pray to the mountains for good luck in finding animals, shelter, and not running into a snake. The mountains are happy when the Maya burn their incense. However, only an older man can burn the incense. Young men can't use the incense because they are too dependent on their wives.

Incense is also burned to bless a new house that has just been built. A Catholic priest is called to perform prayers and bury the heart of a sacrificed chicken in the middle of the floor. Candles and incense are lit, and meat and tortillas are hung under the four main posts of the house. The cacao beverage is also sometimes used to wet the posts. Prayers are then offered to protect the home from the elements and bad spirits.

## The Catholic planting ritual

At around 4:00 am, a farmer takes his copal incense and goes to the center of his cornfield. He places three crosses in the ground and kneels down in front of the crosses and lights the incense. The three crosses represent Jesus, his disciples, and the Holy Spirit. The farmer prays to the middle cross and asks that he will receive a good crop from the soil. He moves the other two crosses to the edges of his field, where he prays to them for security. He asks that no animals or humans come and destroy his crops. The farmer then plants seven seeds in the shape of a cross in the middle of the field and then waits for his helpers to arrive. The next day after the men finish planting, he gathers the three crosses and takes them home to place in a shrine. The same crosses are used when praying for the health and safety of farm animals. If the farmer returns to the field and the corn looks sick and unhealthy, he must repeat the same ritual with the incense.

During the harvest, no incense is burned. The farmer prays that the winds do not break the corn and then thanks the mountains for protecting his field. He collects all of the ears of corn and stacks them neatly in rows in his house. If the farmer hears the sound of babies crying at nighttime, then it is because he failed to collect all of the corn in the field.

## Planting stories

If a farmer eats hot peppers and then goes to the field to plant plantain, the plants will grow poorly. If he eats hot peppers and plants pineapple, the pineapple will develop sores on the inside of the plant. If he drinks sweetened cacao before planting pineapple then the crop will taste very sweet. If he is angry while planting peppers, the peppers will grow to be very hot. If he plants cacao and then sleeps in a hammock, the cacao trees will develop worms and become stringy just like a hammock.

## Why maize comes in three different colors

Corn used to be pure white because it was protected in a cave. One day, two brothers came by the cave and decided to take some of the corn to plant in their field. When they were in the cave it started raining and thundering. The one brother said, "Let's go and plant the corn now." The other brother said, "No, it is already raining, so let's wait." After a while, the brothers left the cave with some of the corn and a bolt of lightening struck nearby. The intense heat from the lightening burned the corn, causing half of it to turn yellow and the other half mauve. The corn that remained in the cave stayed white. That is why corn comes in three different colors.

## Why there are white, black, and brown skinned people

There was once a king who had three servants who lived close to the river. One night, the three servants had a competition to see who could get up the earliest and take a bath in the river. The first servant got up very early and was the first to reach the river.

The king had laid out one piece of soap and one towel to be used by all three of the servants. The first servant got to use the soap and towel first, which made him have fresh, clean, and white skin. The second servant reached the river and had to use the leftover soap and towel, so he did not get very clean. This servant ended up with brown skin. The last of the servants to reach the river couldn't use the soap at all because it was gone. He swam around for a while, got out of the river, and had to dry off with the dirty towel. That is why his skin is black.

## Animal stories

If a man cuts a jaguar's paw and sucks out the yellow puss, he will be strong and tough like the jaguar. If a man needed to become powerful to face an enemy, he would smoke out a wasp nest and swallow the small wasps. If the man's enemy attacked, he could fight back with the power of many wasp stings.

The woodpecker is an old Mayan man that was stealing corn and was hit by lightening. The blood rushed up to his head. That is why woodpeckers have red heads and must knock before they get food. When birds fly high in the sky, then it will drizzle for two days. When chickens walk around in the rain looking for insects, then it will rain for two days.

## The meaning of dreams

If you dream of a pile of corn with the husks on them, then it means that someone will die for you. If you dream of beans then you are sad for something or someone. If you dream of a snake, you have an enemy. If you dream that dogs are trying to bite you, it means the police are after you. If you dream you successfully cross a flooded river, you will not get ill. If you dream that you fail to cross the river, you will become sick. If you dream that someone gives you food, then you will catch something when you are hunting. If you dream that you are having trouble climbing a mountain, it means that you will have a hard life. If you dream that you are successful in climbing the mountain, it means you will have a good life. If you dream that you have flowers in your hand, you will find a beautiful girl or boy and love them. However, if the image of the flowers fades away, then you will not stay with that person long.

## The story of the sooch-sooch bird

There was once a wicked woman who was a witch. One night her husband fell asleep and was awoken by noises coming from a nearby house. The next day, the husband approached his neighbor and asked him if he had heard any noises throughout the night. The neighbor told him to be suspicious of his wife because she may be secretly sleeping with someone in the village. After a couple of nights, the husband heard a *sooch-sooch* sound at 1:00 a.m. and noticed that his wife was not in bed. The very next night, the husband went out hunting close to his house when he heard the same sounds and saw his wife flying like a bird over the roof. When he rushed inside, all he found of his wife was her head. Her body had disappeared. The head started talking to him, saying, "you are my husband and you must help me and put my body and head together." The husband was so angry that he got some white lime that is made from *jute* (snails) and rubbed the base of her head with it to make sure it will never attach back to her body. Ever since then, at 1:00 am, the witch-bird flies off into the night making the sound *sooch-sooch*. Mopan children are warned that they should turn over from their back to stomach when sleeping if they hear that sound, so the witch will not come and take out their hearts. (There is an actual bird in Belize that makes a *sooch-sooch* call during the night.)

The story of Tata Goinda

*Tata Goinda* is short man that likes to find trouble at night. He has only four fingers and four toes and wears a big hat. If you are walking around in the bush at night he will ask to see your fingers. If you show him all five fingers, then you will faint and he will get you lost in the bush far from home. But if you show him only four fingers, he will let you be. *Tata Goinda* makes a whistling sound at night. Some say it is a bird, but it sounds like a human whistle. If you hear that sound and make a noise, a group of them will come and make you sick.

# Appendix F

## Examples of other marginalized agricultural societies in the tropics

There are many examples from tropical areas in the Far East in which agricultural development has affected indigenous communities. Newly introduced monocultures in Greenhill, Thailand have replaced traditional polycropping systems. This has led to an increase in crop pests and diseases, higher rates of malnutrition among indigenous communities, and the decline of an economically and ecologically valuable pig industry (Jian 2001). In Sabah, Malaysia, government policies to eradicate swidden farming in favor of a cash cropping system resulted in the construction of new roads, a reduction in fallow periods, and the removal of villagers from their traditional lands (Nyuk-Wo Lim and Douglass 1998). Relocating indigenous populations to new areas often prevents them from diversifying their agricultural holdings because they must rely on wage employment from large plantation-style farms (Ngidang 2002).

In Sarawak, Malaysia, government development schemes aimed at reducing swidden practices, rubber, and cocoa farming resulted in the transformation of communally owned lands to privatized oil palm plantations. Although this agrarian reform policy did improve the overall economic situation of Iban communities, there were some negative social and political consequences that resulted. The joint venture to privatize lands was initiated by Iban political leaders without the full support of the local population because villagers feared that if they opposed the venture, then they would be labeled as 'anti' government or 'anti' development (Ngidang 2002). Iban land tenure had also become threatened, as the agreement to replace swidden fields with oil palm plantations resulted in a 60-year lease in which land ownership was controlled by the private sector. Iban residents were therefore forced to work for cheap labor on the plantations rather than cultivating their own crops on native customary lands (Ngidang 2002).

# Appendix G

## The self-administered questionnaire and students' responses

1. Is your father a farmer? Y N
2. If yes, does he farm on leased land or reservation land? Leased Reservation
4. What kinds of crops or trees does he plant?

   Corn Beans Rice Vegetables Banana Mucuna Cacao

   Cedar Mahogany Citrus Fruit Trees Other___________
5. Do you plant and chop at the farm? Y N
6. If yes, when do you visit the farm to help?

   After School Weekends Holidays
7. How many older brothers do you have? ___________
8. How many of your older brothers have gone to High School? _______
9. Around what age do your older brothers start their own farms? ________
10. Do you want to go to High School? Y N
11. What kinds of work do you want to do after you finish school?

    Construction Logging Farmer Mechanic Computers

    Business Shrimp Farm Banana farm Other ____________
12. If you want to be a farmer, what kinds of crops or trees do you want to plant?

    Corn Beans Rice Vegetables Cedar Banana Mucuna

    Cacao Mahogany Citrus Fruit Trees Other ______________
13. How far do you have to walk to your father's farm? ________

## Responses to the questionnaire

### Question # 1

All 38 students responded that their father is a farmer

### Question # 2

30 students have fathers who farm on reservation lands. One student's father leases his farmland. Seven students did not answer the question.

### Question # 3

The following responses concern the types of trees and crops the students' fathers cultivate. Students were allowed to circle more than one answer.

Corn (37) Beans (36) Rice (35) Vegetables (29) Cedar (one) Banana (30)

Cacao (25) Mahogany (five) Cirtus (eight) Fruit Trees (28) Mucuna (12) Other (0)

### Question # 4

Each student circled an answer (or answers) that best described who helps plant and chop on the family farm.

Brothers (25) Uncles (four) Cousins (five) Hired Boys (nine)
Other (four) (one nephew, one wife, two none)

### Question # 5

17 girls replied that they help plant and chop on the farm. Three girls do not help.
All 18 boys replied that they help plant and chop on the farm

### Question # 6

Students were asked when they visit the farm to help. Each student was allowed to circle one or more of the answers.

| | | | |
|---|---|---|---|
| Girls' responses - | After School (five) | Weekends (10) | Holidays (13) |
| Boys' responses- | After School (five) | Weekends (12) | Holidays (13) |

Question # 7

Students were asked how many older brothers they have.

| | | | |
|---|---|---|---|
| 0 brothers (nine) | one brother (eight) | two brothers (six) | three brothers (three) |
| four brothers (five) | five brothers (0) | six brothers (two) | seven brothers (one) |

Question # 8

Students were asked how many of their older brothers have gone to High School.

| | | |
|---|---|---|
| 0 brothers (23) | one brother (eight) | two brothers (one) |
| three brothers (0) | four brothers (one) | |

Question # 9

The average age for which older brothers start their own farms was 17.8 years old.

Question # 10

When asked if the students want to go to High School, all 18 boys replied "Yes."
18 Girls wanted to go on to High School, while two girls did not wish to go.

Question # 11

Students were asked what kinds of work they wanted to do after they finish school. They were given eight choices of occupations that best represented employment opportunities for the Maya in the Toledo district. I also included a category of "other" so that students could write in an answer that was not written on the form.

Boys' responses:

| | | | |
|---|---|---|---|
| Construction (four) | Logging (one) | Farmer (one) | Mechanic (three) |
| Computers (nine) | Business (eight) | Shrimp Farm (0) | Banana Farm (two) |
| Other- Teacher (four) | Doctor (one) | Belize Defense Force (one) | Police (one) |

Girls' responses:

| | | | |
|---|---|---|---|
| Construction (two) | Computers (eight) | Business (12) | Other- Teacher (three) |

Question # 12

Students were asked what kinds of crops or trees they would plant if they wanted to be farmers. Although only one male student circled "farmer" on the survey, 30 out of 38 students answered this question.

Boys' responses:

| | | | |
|---|---|---|---|
| Corn (14) | Beans (14) | Rice (15) | Vegetables (17) |
| Cedar (six) | Banana (11) | Mucuna (six) | Cacao (eight) |
| Mahogany (six) | Citrus (eight) | Fruit Trees (eight) | Other (0) |

* two boys did not respond

Girls' responses:

| | | | |
|---|---|---|---|
| Corn (six) | Beans (five) | Rice (six) | Vegetables (13) |
| Cedar (one) | Banana (eight) | Mucuna (two) | Cacao (five) |
| Mahogany (two) | Citrus (three) | Fruit Trees (nine) | Other (0) |

* six girls did not respond

Question # 13

The average time it took for students to reach their fathers' farms was 50 minutes.