Pinabete

One Opportunity Toward the Sustainable Development of the Guatemalan Highlands

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ABSTRACT

With an estimated 14.3 million people, Guatemala has the highest population in all of Central America. In 1996, the Guatemalan government and the guerilla rebels officially ended their 36-year civil war with the signing of the Peace Accords. In the wake of this cease fire there was broad hope within the country that the political, social, and economic factors underpinning this bloody war would soon be remedied and a new and equitable development and lasting peace established. Guatemala largely remains a country divided along rural and urban, indigenous and ladino lines. Guatemala has the highest percentage of indigenous people in Latin America. The country has begun the demographic transition process. However, this demographic shift is lagging dramatically in the rural areas of the country. Approximately 52% of the population resides in rural areas where living conditions are some of the worst in the Western Hemisphere. These rural areas tend to be predominantly indigenous and continue to experience rapid population growth. Complex land tenure issues, social inequity and limited access to arable land have resulted in less than 1% of the population controlling 70% of the cultivated land. The growing rural population continues to clear large tracts of forest for use as farmland. This expansion of the agricultural frontier has resulted in 55% of the total land area being cultivated in an exploitative and unsustainable manner. This is particularly true in the Western Highlands, where topography is steep and concentrations of subsistence indigenous farmers are high.

This paper first provides a general survey of Guatemala, investigating historical, economic, social and political trends within the country. Then, the paper analyzes the management of *pinabete*, an endangered Guatemalan fir (*Abies guatemalensis*). The cultivation of this species is being promoted by the environmental agencies of Guatemala in effort to alleviate pressure upon the few remaining natural forested stands. This species is highly sought after for use as a Christmas tree during the holiday season. A financial analysis is conducted in the final section of this paper that investigates three different cultivation systems for this threatened species. The financial analysis of these three cultivation systems indicates that the commercialization of this species can be considered a financially efficient cropping alternative for farmers of the Guatemalan Highlands. Moreover, the incorporation of pinabete into a farmer's cultivation system assists in the conservation of this species, promotes soil conservation and enables farmers to diversify their revenue sources. The combination of income generation, inclusion of marginalized people, and natural resource conservation is key to the sustainable development of the Guatemalan Highlands.

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ACRONYMS AND ABBREVIATIONS

ARR Alternative Rate of Return
B/C Benefit to Cost Ratio
BANGUAT Central Bank of Guatemala
BANSEFOR National Bank of Forest Seeds
CAFTA Central American Free Trade Agreement
CBR Crude Birth Rate
CC Constitutional Court
CDR Crude Death Rate
CIA Central Intelligence Agency of the United States
CITES Convention on International Trade in Endangered Species
CONAP Advisory Council of Protected Areas
CPI Corruption Perception Index
CSJ Supreme Court of Justice
EAE Earned Annual Equivalent
ECODESA National Forest Seed Company
FCPA Foreign Corrupt Practice Act
FRG Frente Republicano Guatemalteco
FTAA Free Trade Area of the Americas
GDP Gross Domestic Product
INAB Guatemalan Forestry Service
IOM International Organization for Migration
IRR Internal Rate of Return
IRWR Internal Renewable Water Resources
IUCN World Conservation Union
MAGA Ministry of Agriculture
MENMAGUA Mesa Nacional Maya de Guatemala
MINUGUA Peace Accord Verification Mission of the United Nations
NGO Nongovernmental Organization
NPV Net Present Value
OECD Organization for Economic Cooperation and Development
PAC Civilian Patrol Unit
PINFOR National Forestry Incentive Program
PNC National Civil Police
PROFOR Pinabete Management Division of INAB
PROTIERRA Commission for Development of Land Property Rights
SEPRONA Natural Resource Protection Service
SEV Soil Expectation Value
SIGAP National system of Protected Areas
TLC Tratado de Libre Comercio
TSE Supreme Electoral Tribune
UFCO United Fruit Company

UNDP United Nations Development Program
URNG Revolutionary Union of Guerillas
USAID US Agency for International Development

CHAPTER 1. INTRODUCTION

1.1. Problem Statement

The establishment of pinabete plantations has been promoted by national institutions and development agencies as a potentially lucrative crop for rural farmers. However, little information exists regarding the financial returns generated by specific cultivation systems. Thus, it is difficult for farmers to assess the merits of establishing a pinabete plantation lacking this financial information.

1.2. Objectives

The objective of this study is to assess the characteristics and profitability of three different pinabete cultivation systems available to farmers in the Guatemalan Highlands. This financial analysis will also examine the role of various forestry incentives into these systems. The results from this analysis will assist farmers in quantitatively assessing the merits of three pinabete cultivation systems and facilitate the comparison with the returns generated from alternative land uses.

1.3. Study Outline

The study is divided into five chapters. Chapter 1 describes the general goals of the study and the organization of the paper. Chapter 2 is a detailed national survey of Guatemala. This section analyzes the historic, demographic, political, economic, and environmental dynamics relevant to the future development of the country. Chapter 3 provides an overview of pinabete and describes the institutions, policies and programs which affect its management. Chapter 4 describes three pinabete cultivation systems available to farmers, followed by a financial analysis for each system. Chapter 5 presents the results of the financial analysis. Chapter 6 summarizes the results of the financial analysis, and presents recommendations for extension, policy and future research regarding this threatened species.

CHAPTER 2. GUATEMALA SURVEY

2.1. Introduction

The name Guatemala is derived from the indigenous words *Guauhtemalla* and *Guhatezmalha*, which describe areas of vast forests and raging rivers. However, because of increasing population pressure on the natural resources this name may no longer accurately describe the landscape in its entirety. Guatemala is a country rich in culture and natural resources, both of which have suffered from a violent and destructive history. In the recent past, this violence had taken form in a long and bloody civil war. This period of war significantly destabilized political, economic, and cultural institutions all of which seemed to manifest themselves in some form upon the landscape. This section of the paper will survey the critical combination of historical, political, cultural and environmental issues that have resulted in the *Guauhtemalla* of today.

Figure 2.1. Map of Guatemala (*Source:* Encarta 2003).

2.2. Geography

Guatemala is approximately 109,000 square kilometers in size, or roughly the size of Tennessee, and is located south of Mexico in Central America (Figure 2.1). The country has both a Pacific and Caribbean coast and the bulk of its land mass is divided by two mountain ranges that run east and west. These ranges form three distinct regions within Guatemala: Pacific Coast, Highlands, and Petén. In spite of the country's relatively small size, there are wide variations in climate and moisture regimes between these three regions.

The Pacific Coast is a fairly narrow strip of land extending about 65 kilometers inland. This region is comprised of deep, fertile, volcanic soils which are extensively farmed and owned by relatively few wealthy landowners. Sugarcane, fruit production, and cattle grazing are the main agricultural commodities of the area. During the harvest season, indigenous populations from the Western Highlands migrate to this plain and work the fields while living in large labor camps.

The Highlands live up to their name with peaks topping out at well over 4,000 meters above sea level. The region is seismically active and experiences earthquakes regularly. Additionally, the majority of the country's 33 volcanoes are located in these mountains. This area is heavily

populated by the indigenous Maya. Some zones within these higher altitudes are well suited for the cultivation of coffee, which is the main cash crop produced in the region.

The Petén region is located in the northern most section of the country. This region is characterized by a rolling limestone plateau with a vast tropical rainforest. In fact, this is the largest virgin tropical forest north of the Amazon River (Beletsky 1999). Rainfall is in excess of 2,400 millimeters annually in some locations. This region is incredibly rich in biologic diversity with more than: 4,000 plant species (800 tree and 500 orchid species alone), 350 resident bird species, 57 snake species, and five cat species (Mahler 1999). However, the Petén's population of 360,000 is growing rapidly and land is being cleared for agriculture at a high annual rate.

2.3. History

In 1821, Central America proclaimed independence from Spain, which eventually lead to the creation of the sovereign state of Guatemala in 1839 (O'Kane 2000). Although independence was declared, many of the Spanish institutions were retained in practice. The newly formed government was controlled by people of Spanish ancestry, forming the *ladino* population. Prior to independence, large tracts of fertile land were colonized by the Spaniards in the name of the Spanish crown. Following independence this land grab continued, and the eviction or forced enslavement of the indigenous people from their native lands was justified under the pretext of religious salvation.

In 1877, President Justo Rufino Barrios implemented legislation further disenfranchising the indigenous population. With the growing world demand for coffee, the Guatemalan government sought to acquire land in the mountains. This land was previously deemed infertile, because the main export crops could not be grown there. However, coffee required the cooler climate found in the Highlands. Therefore, unbeknownst to the non-Spanish-speaking indigenous, legislation was passed in the capital by the ladino controlled government. Soon indigenous farmers in the Highlands were evicted by German, Swiss, and ladino coffee growers. The Guatemalan coffee empire grew rapidly and accounted for 80% of the country's economy in 1900 (O'Kane 2000).

The situation worsened from 1931 to 1944 under the dictatorship of Jorge Ubico. Under his reign a vagrancy law was implemented aimed at "punishing landless Maya if they did not work 150 days per year on plantations" (O'Kane 2000, p.15). Indigenous workers were required to carry a work log with them at all times, in which plantation owners recorded the days worked. If indigenous workers did not have this book in their possession at all times, they were arrested. Ubico then implemented Decree 1816, which legally "exempted landowners from the consequences of any action taken to protect their goods or land" (O'Kane 2000, p.16). This law in effect sanctioned the murder of any indigenous farmer that refused to work on a plantation. The indigenous people relocated to *pajuides*, temporary settlements in remote mountainous valleys, to avoid persecution. In these communities, they maintained their distinct cultural customs and languages, and from these remote outposts organized and led the occasional rebellion.

Many Guatemalans refer to the period of 1944 to 1954 as "The Ten Years of Spring." During this period dramatic social reforms were instituted, by President Juan Jose Arevalo. Under President Arevalo's leadership the indigenous were no longer forced to work on plantations and were allowed to form labor unions to bargain for a decent wage. However, foreign investors were infuriated by the effect these reforms would have on their profit margin. Companies such as the United Fruit Company (UFCO) voiced opposition to these changes, and used their strong financial and political muscle to disempower President Arevalo. UFCO played into the prolific McCarthyism mantra of the US government in the early 1950s, and promoted President Arevalo's changes as communist inspired. Soon other companies joined in, eventually collaborating with the ladinos and Catholic Church to oust Arevalo. In spite of the strong opposition, an actual communist was elected president following Arevalo's term. President Arbenz was elected in 1951, and soon implemented even more drastic land reforms. In 1952, the Guatemalan Congress passed Decree 900, the first real attempt at agrarian reform which authorized the reallocation of large expanses of uncultivated land to the indigenous (O'Kane 2000). Interestingly, this law only effected 1,700 landowners yet redistributed more than half of the land in Guatemala. Arbenz's communist leanings, coupled with his insistence of national sovereignty against strong foreign interests, quickly placed him in the disfavor of the US government and under the microscope of the Central Intelligence Agency (CIA).

In the summer of 1954, a CIA initiated overthrow forced Arbenz to resign. Following his resignation many Guatemalan military officials vied for control, eventually the US Embassy "installed" Army Colonel Carlos Castillo Armas. Armas "immediately initiated an anti-Communist witch-hunt throughout the country. Thus began the more than three decades of terror that have kept Guatemala in the international headlines, with a toll of at least 100,000 dead, 40,000 disappeared, and hundreds of thousands in exile" (O'Kane 2000, p.21).

The financially motivated ideals of foreign investors' original backing of the "anti-Communist" campaign began to erode as agricultural production decreased, and taxes were increased to fund the intensive military campaign. By the late 1980s, the international community began to refer to this civil war as the "Guatemalan Holocaust" (O'Kane 2000). With mounting international pressure, the Guatemalan government and the guerilla rebels signed a permanent peace agreement in 1996.

2.4. The Peace Accords of 1996

This permanent peace agreement was brokered by the United Nations, with support from the United States, Columbia, Mexico, Spain, Norway, and Venezuela. The accords were formally signed by the Government of the Republic and the Mayan Revolutionary Union of Guerrillas (URNG) on December 29, 1996. The primary objectives of the accords were to overcome the causes of the civil conflict and create a climate of stability for new development (MINUGUA, 2004). Summarized, the accords focused on and mandated a course of action in these ten areas:

1. Comprehensive agreement on human rights
2. Resettlement of the population groups uprooted by the armed conflict
3. Clarification of past human rights violations and acts of violence

4. Rights of indigenous peoples
5. Agrarian reform
6. Strengthening of civilian power
7. Decreasing and refocusing the role of the armed forces
8. Constitutional reforms and the electoral regime
9. Political integration of the URNG
10. Implementation, compliance and verification timetable for the peace agreements

The estimated cost to implement the Peace Accords in the mandated time horizon (1997-2000) was approximately $2.3 billion (USAID 2000). Both the URNG and the Guatemalan government agreed that the peace process required international oversight. As such, the United Nations created the Mission of Verification of the United Nations in Guatemala (MINUGUA). MINUGUA was created in 1994 on the mounting wave of international pressure for a peace resolution. The organization was primarily responsible for monitoring human rights abuses and pressuring the national government to implement the signed peace agreements. The peace process was slated to be completed by 2000, however, four years later much work remains. In November 2004, MINUGUA officially closed its offices throughout the country. Former MINUGUA spokeswoman Seda Pumpyanskaya indicated that poverty, inequality, and discrimination continue to plague the country. She went on to state that of the peace accords, "the agreements on indigenous and economic matters are the least fulfilled and need serious state policies" (Daniel 2004, p. 1). Eight years after the signing of the peace accords state sponsored violence has decreased, however, due to high poverty rates and weak institutions, organized criminal activity has increased.

2.5. Demography

The Population Reference Bureau defines demography as "the scientific study of human populations, including their sizes, compositions, distributions, densities, growth, and other characteristics, as well as the causes and consequences of changes in these factors" (Population Reference Bureau 2004, Glossary). This section is divided into two components. The first component discusses prevailing demographic theory, and attempts to illustrate the variables which underpin population growth. The second component describes and analyzes key demographic variables specific to Guatemala. The latter portion will first present the demographic data, and then analyze the current trends within the population while providing a larger historical and theoretical frame of reference for the ongoing transitions occurring within the country.

2.5.1. Malthusian paradigm

Thomas R. Malthus (1766-1834) was an Englishman who worked primarily as a political economist and Anglican minister. His theories on population growth have had lasting implications in the fields of demography, development, policy, and biology. He became involved in demography as a result of the deteriorating living conditions he witnessed in 19th century England. As presented in his *Essay on the Principle of Population* (1798), Malthus observed that the plants and animals of nature produced far more offspring than were able to survive. Malthus hypothesized that unless family sizes of the human population were regulated,

humans too would overproduce resulting in global famines. He believed that the worsening conditions in England were due to three main factors: overproduction of the young, exhaustion of the resource base, and the irresponsibility of the lower classes (Currais 2000).

Malthus believed that the human biological capacity to reproduce would surpass the natural resource base's ability to produce, or satisfy the exponentially growing demand for food and other resources. As an Anglican minister, he believed that the only way the human population was kept in check was by either "moral restraint" or by "positive checks." Moral restraint was largely the practice of postponing marriage until later in life, an increasingly common practice in 19th century Western Europe. Positive checks were caused by famine, disease, war, malnutrition, and pestilence. Malthus believed the other preventative checks that existed were immoral, these were: homosexuality, adultery, birth control, and abortion (Currais 2000). One government policy proposed by Malthus was to limit the family size of the lower-class in effort to ensure that all families could adequately support their children (Currais 2000).

The theories, ideas, and observations presented in Malthus' *Essay on the Principle of Population* gained widespread popularity among demographers, politicians, economists, and biologists. Eventually, his philosophies and theories grew to become known as the Malthusian paradigm. Succinctly stated, the main hypothesis of the Malthusian paradigm is the following: Humans will continue reproducing beyond the natural carrying capacity of the environment, and that the linearly increasing gains in production will soon be surpassed by the demand created by an exponentially increasing global population. Figure 2.2 provides a graphic representation of the Malthusian paradigm.

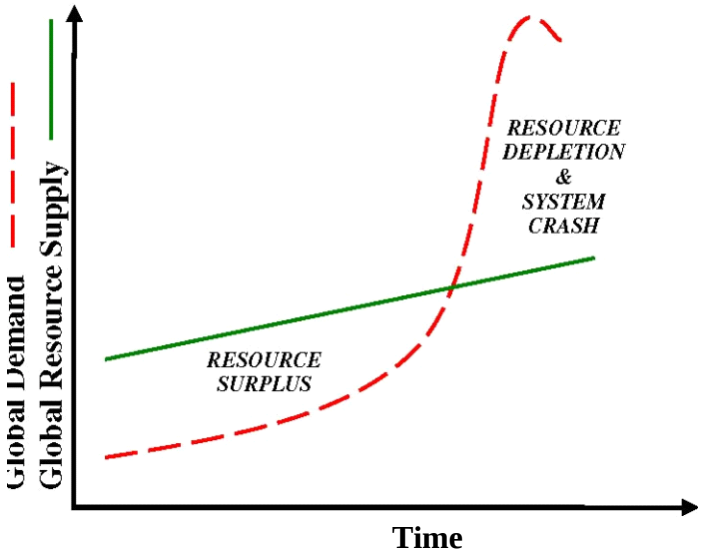

Figure 2.2. Representation of Malthusian paradigm.

The Malthusian paradigm gained momentum and popularity through the culmination of the environmental movement of the 1960s; looming famines in Africa, India, and Asia; and the publishing of Paul Ehrlich's 1968 book *The Population Bomb*. In fact, this modern day

Malthusian was so adamant about these theories that he: attempted to prevent food aid shipments to nations experiencing chronic famine that refused to enact fertility controls on their population; advocated the sterilization of all Indian men with more than three children; and predicted the starvation of hundreds of millions of people worldwide by the year 2001 (Overpopulation, n.d.). In 1972, the Club of Rome expounded upon these Malthusian theories, further promoting the notion of an imminent population crisis and eroding resource base in *The Limits to Growth: A Report to the Club of Rome 1972* (Meadows et al. 1972). The report focused on the population growth and resource depletion rates generated from a "systems dynamics" model developed at the Massachusetts Institute of Technology in order to model the effects of an exponentially growing world population.

2.5.2. Green Revolution

The world continued to experience growing populations, accelerated resource consumption, and famine into the 21st century. Fortunately, nowhere did any of the ominous predictions of the late 20th century come to fruition. In fact, the majority of famines experienced in the latter part of the 20th century correlate more with failed states than an overexploited resource base. As doomsayers published their reports and ran their models, a new movement was already well under way that would help to prevent these global atrocities from occurring. A trained forester, agronomist, and farmer from the University of Minnesota by the name of Dr. Norman Borlaug was working in the famine ravished countries of Pakistan, India, and Mexico—many of the same countries Ehrlich had written off in his book. Dr. Borlaug was leading the Green Revolution, a movement which dramatically increased crop yields through the intensification of agricultural practices. Figure 2.3 illustrates the adoption of these more intensified agricultural systems in Guatemala by the increased reliance on agricultural inputs such as fertilizer. Figure 2.4 illustrates the effects of the Green Revolution on worldwide cereal production.

In 1970, Dr. Norman Borlaug received the Nobel Peace Prize for his dramatic efforts to reduce global hunger and increase global food supply and food security. However, as Dr. Borlaug acknowledged in his Nobel Prize acceptance speech, the Green Revolution was only "a temporary success in the war against hunger and deprivation" going on to indicate the still urgent need to slow the "population monster" (McFarland 2003, p. 6). In effect, the Green Revolution had merely been a technical solution to artificially increase the planet's carrying capacity.

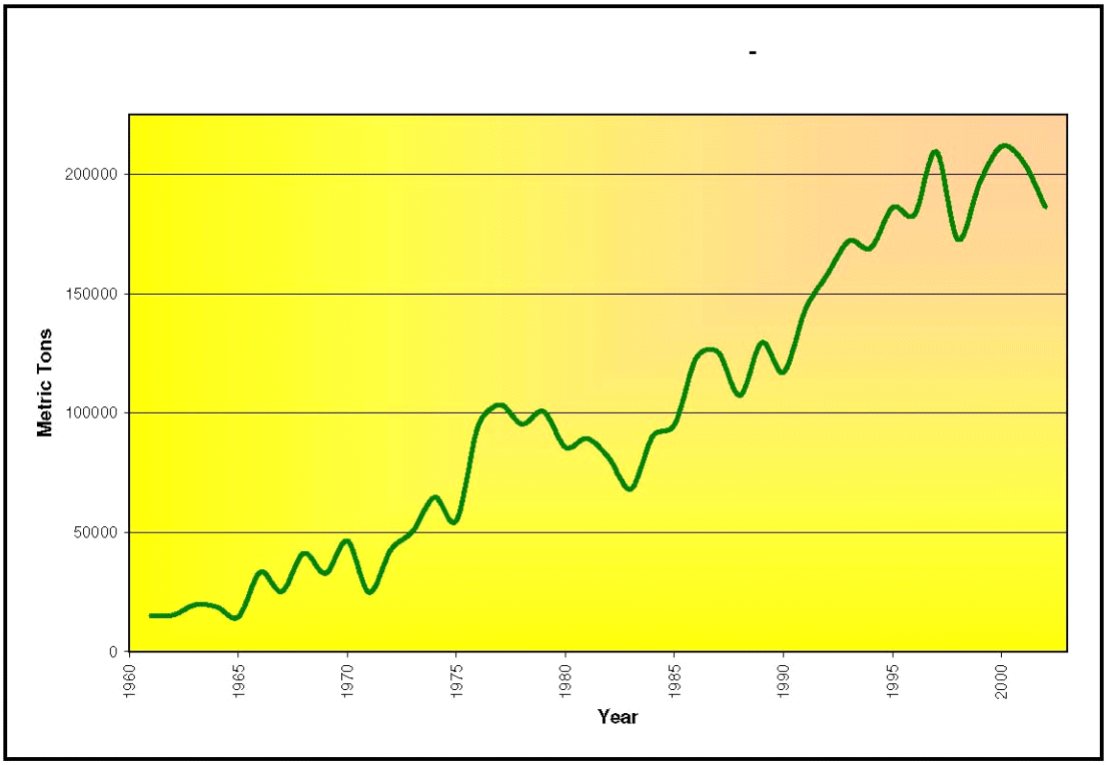

Figure 2.3. Total use of fertilizer in Guatemala, 1961-2002. (*Source:* FAOSTAT 2004)

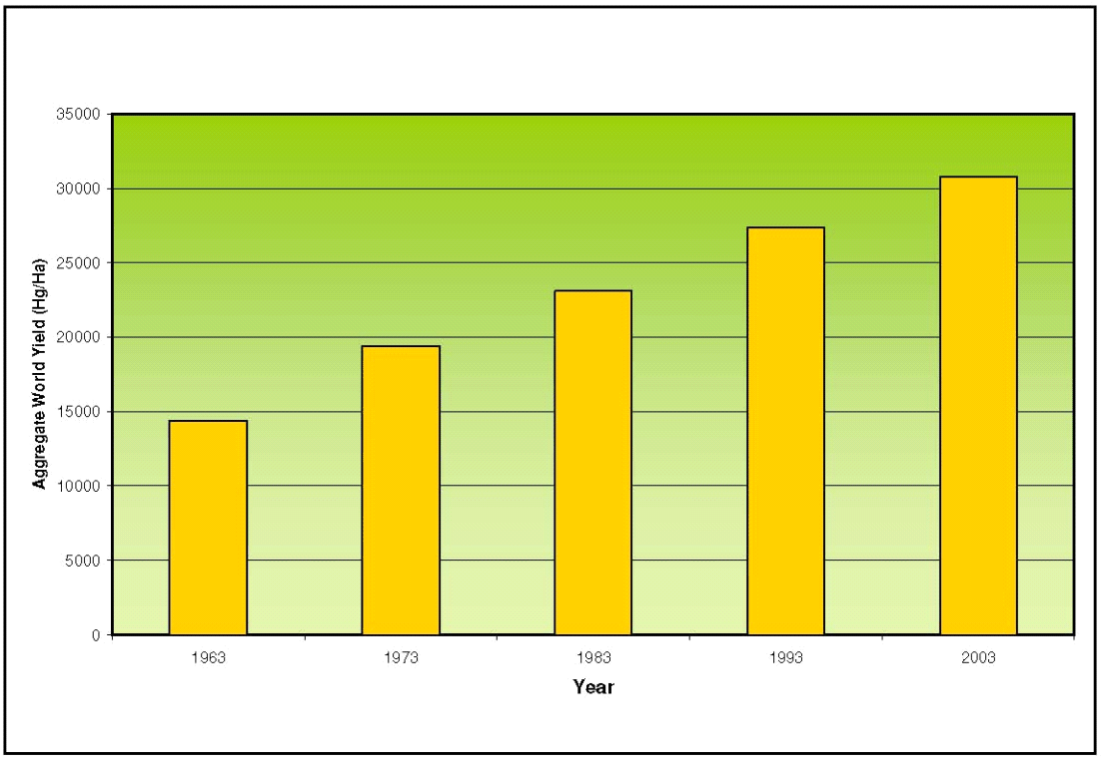

Figure 2.4. World cereal production, 1963-2003. (*Source:* FAOSTAT, 2004)

2.5.3. Demographic Transition

The Green Revolution increased mankind's ability to feed the population, but did nothing to slow the population monster. In 1929, the American demographer, Warren Thompson, began to observe and interpret the changes in birth and death rates experienced by industrialized countries over the previous 200 years (Montgomery, n.d.). His work evolved and came to be known as The Demographic Transition Model.

Proponents of the Demographic Transition Model argue that "the societies which undergo a process of modernization, progress from a pre modern regime of high fertility and high mortality to a post modern regime, in which both decrease" (Currais 2000, p. 88-89). In 1974, economist Julian Simon noted that the declining fertility rates witnessed in the post modern regime were due to factors of rational control; namely, higher education levels and advances in birth control among the population. The theory considers demographic variables (e.g., crude birth rates, longevity, and per capita income) as endogenous factors to population growth. Malthusianism views these same demographic variables as exogenous to the Malthusian model, meaning that population growth is more a biological phenomena not influenced by extraneous economic or social factors. The Demographic Transition Model consists of the following four stages (Montgomery, n.d.):

Premodern Phase

The first stage of the transition was experienced by every population on the globe through the 16th century, but exists today only in the least developed third world countries. The stage is characterized by both high birth and death rates, resulting in very slow population growth. Societies experiencing high mortality rates have virtually no incentive to control fertility as it serves as a means to overcompensate for the expected losses of offspring. The high mortality rates are due to: lack of education regarding healthcare and disease prevention; wide spread food shortages or crop failures; war; and water or food borne diseases due to poor hygiene and infrastructure.

Industrialization Phase

The second stage is also characterized by high birth rates, however, with a drastic decline in the death rate. Initially, this shift had been observed in Europe in the early 19th century owing to an improved water supply and advances in agricultural production. There is a geographic component to this phase as well, as the rural population begins to migrate to the urban areas. Versions of these same technological and infrastructural advances and the subsequent demographic impact continue to play out in the developing world. The rapid population growth in this stage begins when knew agricultural technologies are adopted producing higher crop yields and increasing food security. These rates are further accelerated by the improvements in public healthcare, specifically concerning children. Interestingly, the main decrease in mortality in this stage occurs in the 0-10 year-old age group. Thus, a marked transition in the age structure of the population occurs as the population becomes increasingly youthful. One effect of a younger population is that a greater percentage of the population is capable of reproducing, resulting in the subsequent population explosion experienced in this phase.

Maturing Industry Phase

The Malthusian and Demographic Transition theories part paths at this third stage. During this phase, advances in technology, healthcare, and infrastructure continue to lower mortality rates and increase longevity. However, this period of the transition is defined by declining birth rates. In fact, birth rates during this period will eventually fall to replacement levels. Demographers still are unclear on exactly why this occurs but the main factors are believed to be (Montgomery n.d.):

- Contraception: increased availability, affordability, usability, and acceptability
- Urbanization: increased costs associated with raising children
- Literacy: as women learn to read their role broadens beyond simply reproducing
- Longevity: increased confidence that children will live longer

Postindustrialism Phase

The fourth stage of the transition is characterized by stability, as both fecundity and mortality rates remain low (Genne 1981). Additionally, the distribution of the age structure of the population is older at this stage. In fact, such a small percentage of the population is in the reproductive stage of their life during this period that the population often begins to decline. An aging and declining population creates a cornucopia of new social and economic dilemmas, such as those being experienced in many European countries today.

2.5.4. Presentation of Guatemalan Demographic Indicators

This section will present key demographic variables specific to Guatemala. As is the case in many developing countries, the veracity of the data is often questionable. This is particularly true in Guatemala where large portions of the rural population do not participate in the national census. Lack of participation and under representation of small rural villages is often due to: fear of outsiders and government; language barriers; and geographic isolation. Although there often are discrepancies between the raw data from differing sources, the overall trends illustrated by the data tend to be consistent across all major sources. Data from the US and the Latin American region are presented in order to provide a context.

2.5.5. Analysis of Guatemalan Demographic Indicators

Using data from the United Nations Population Division and the Guatemalan government (*Instituto Nacional de Estadística*) it is possible to analyze recent demographic phenomena. However, it is important to discuss two aspects of the Guatemalan population that the aggregated data tends to mask.

First, the Guatemalan population is ethnically divided between the ladino and the indigenous populations. Although surveying methodologies differ among institutions, and are a great source of controversy, the groups are roughly defined as follows: The ladino ethnic group includes people of Spanish decent, assimilated Amerindians, or of a mixed ancestry between these two groups. Members of the indigenous group descend from pre-Columbian peoples and speak a Mayan language. Approximately, 55% of the population is classified as indigenous and 45% as ladino. These percentages offer little real information because the ladino ethnic designation is

both broadly and self defined, and in many areas people are hesitant to describe themselves as indigenous owing to the country's violent history against this ethnic group. The values do offer insight to the high percentage of indigenous people within the country as compared to the regional average which is 8%. In fact, Guatemala has the highest percentage of indigenous people in the Latin American and Caribbean region (GTZ 2004).

Second, the aggregated data hides the geographic and ethnographic variances between the ladino and indigenous populations. An extreme lack of parity exists across the socioeconomic indicators between these two populations, an aspect hidden in aggregated data. Many studies have analyzed the relationships between ethnic, rural, and poverty variables among the Guatemalan population. There is widespread agreement that these variables do in fact correlate. A recent study conducted by the nongovernmental organization the *Mesa Nacional Maya de Guatemala* (MENMAGUA), an umbrella association representing 26 indigenous groups involved in local development activities, further analyzed these relationships (De la Rocha 2001). In 1998, the MENMAGUA report indicated that 92% of the population that lives below the poverty level resides in rural indigenous areas. Additionally, the report indicated that only 11% of the indigenous population lived above this same poverty level (Feiring 2001).

In 2002, Timothy Gulden conducted a study analyzing the spatial and temporal patterns of violence during the Guatemalan civil war. One of the findings of this study was the high degree of segregation between the ladino and indigenous populations at the municipal level. This degree of polarization and the overall distribution of the indigenous population are illustrated in Figure 2.11. The figure also reveals that the majority of the indigenous population inhabit the northwestern section of the country, an area known as the Western Highlands. Whereas the ladino population tends to reside along the southern coast and eastern regions of the country. Gulden indicates that 76% of the population lives in municipalities which are more than 80% dominated by either the ladino or indigenous group.

Now, having acknowledged the high degree of variance within the population, and having a better understanding of the regional and ethnic disparities throughout Guatemala; one may begin to analyze the macrodemographic indicators—taking a grain of salt with each variable. As Figures 2.5 and 2.6 reveal, Guatemala has both a high overall population and an extremely dense population. In fact, the US State Department estimates the national population at 14.3 million people (US State Department 2004). Figure 2.5 illustrates the rapid population growth which began in the 18th century and continues today. The data gleaned from Figure 2.7 indicates that Crude Birth Rates (CBR) fell from the 1950s through the early part of the 21st century. The Crude Death Rates (CDR) have declined over the past 50 years as well, as seen in Figure 2.8. Although CBR and CDR have declined over the years, it is the disparity between the rates of these decreases that explains the exponential population growth experienced over the same period. From 1955 to 2005 the average natural increase, the difference between CBR and CDR, was 3% annually (Southgate et al. 2005). The US State Department estimates the 2004 population growth rate at 2.61% (US State Department 2004). Although, the data suggests that the natural increase peaked during the mid 1980s, Figure 2.7 reveals that Guatemalan Crude Birth Rates are well above the regional average. These variables suggest that Guatemala has

begun the Demographic Transition process, however, due to the high birth rates the country is still considered to be in the second phase of the progression.

Figure 2.9 supports this classification, revealing the youthfulness of the Guatemalan population. Interestingly, although regional data indicates a rise in the median age of the population, the median age in Guatemala has changed little since the 1950s. In fact, in 1955 the median age was 17.4 years old, 50 years later this increased to only 18.6 years of age. Information from the 2002 census indicates that 40% of the population is less than 14 years old (Instituto Nacional de Estadística 2004). This finding is significant, as median population age can be used as an index of population momentum. Figure 2.8 indicates that in 2005 the CDR in Guatemala will be 6.7 per thousand population, while in the US it is 8.3. These findings are indicative of the younger population of Guatemala than that of the US.

Figure 2.10 reveals two interesting trends. First, as throughout most of the world the Guatemalan population is becoming increasingly urban. However, the rate of the urbanization process appears to be occurring much more slowly when compared to the regional averages. For instance, in 1955 approximately 72% of Guatemalans lived in rural areas as compared to 55% throughout the Latin American region. In 2005, it is estimated that approximately 78% of the Latin American region will reside in urban areas. However, only 48% of Guatemalans will reside in urban areas. Although Guatemala is urbanizing, the majority of the population still lives in rural areas. As such, when one speaks of Guatemala it is important to distinguish between rural and urban Guatemala, as there exists a great disparity between the two. This is in contrast to many countries and regions, where when the urban population is surveyed the results are representative of the majority of the country—even in the 21st century the Guatemalan majority remain scattered in the hills.

It should be added that due to the rapid population growth the overall pressure on both urban and rural areas is palpable. The multitude of stresses experienced in rural areas is discussed in the following sections of this paper. However, a brief mentioning of the effects of a growing population in the urban areas is well merited. Guatemala has two large urban centers: Guatemala City and Quetzaltenango. Some effects of the intense population pressure on these and other smaller urban areas are summarized below:

- Infrastructural—water shortages, traffic gridlock, power outages
- Institutional—informal economic sector, illicit/pirated items, lack of governance
- Social—gang problems, drug addiction, increased abductions/kidnappings
- Environmental—smog pollution, lack of sewage treatment, smoldering landfills

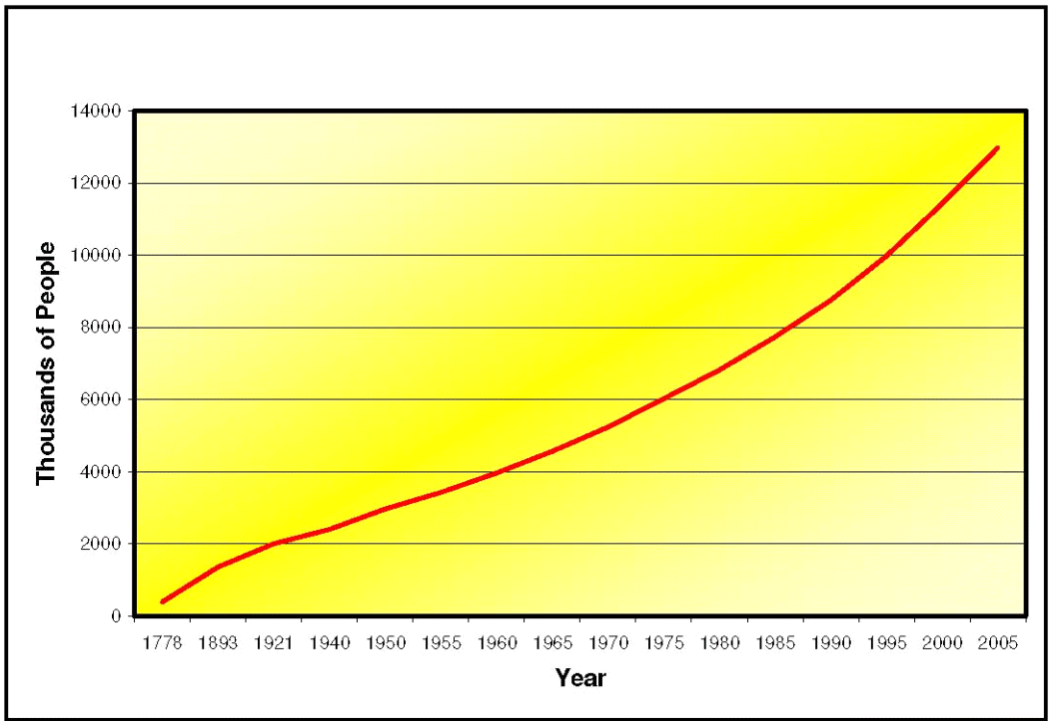

Figure 2.5. Guatemalan population growth 1778-2005. (*Sources:* United Nations 2002; Instituto Nacional de Estadística 2004)

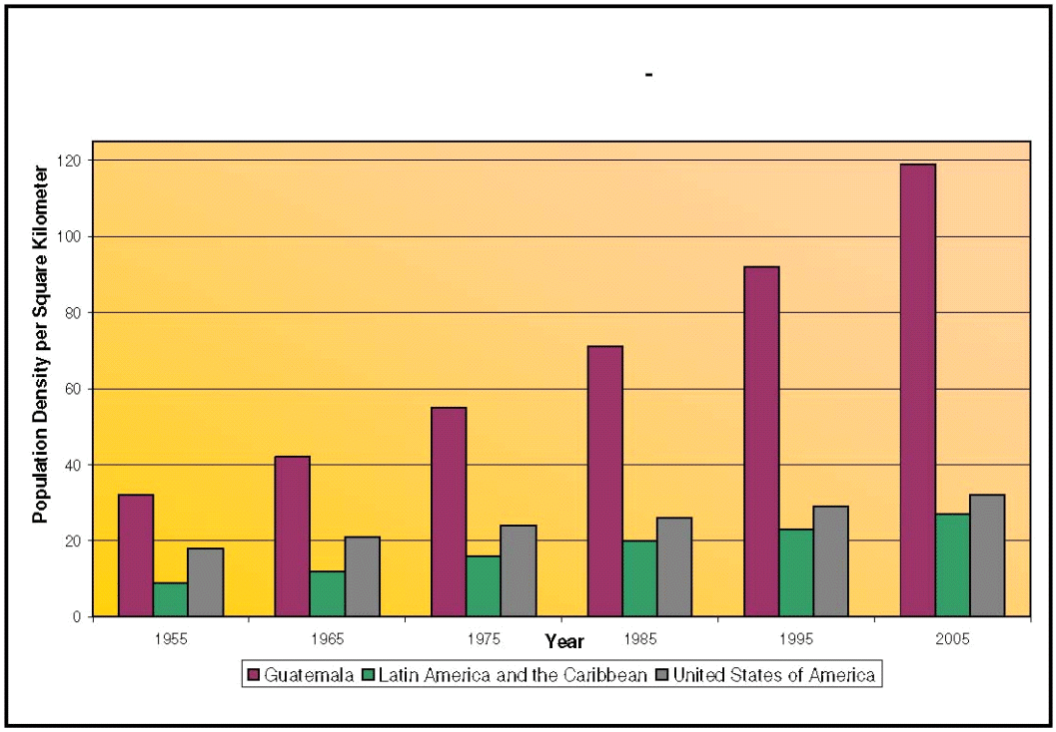

Figure 2.6. Population density 1955-2005. (*Source:* United Nations 2002)

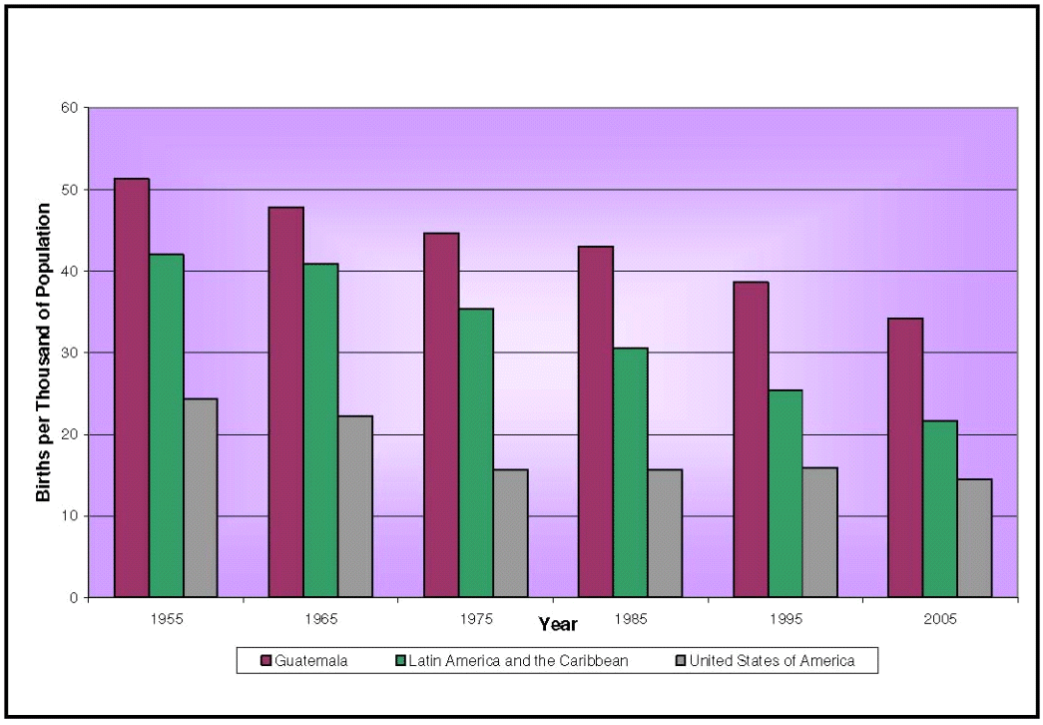

Figure 2.7. Crude birth rates 1955-2005. (*Source:* United Nations 2002)

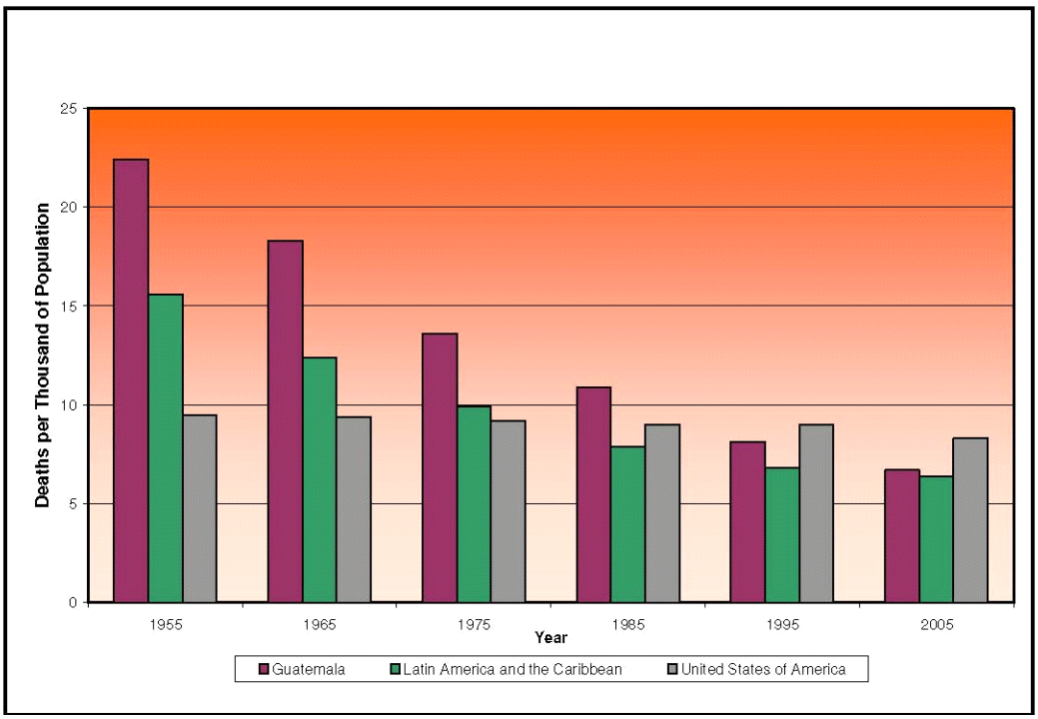

Figure 2.8. Crude death rates 1955-2005. (*Source:* United Nations 2002)

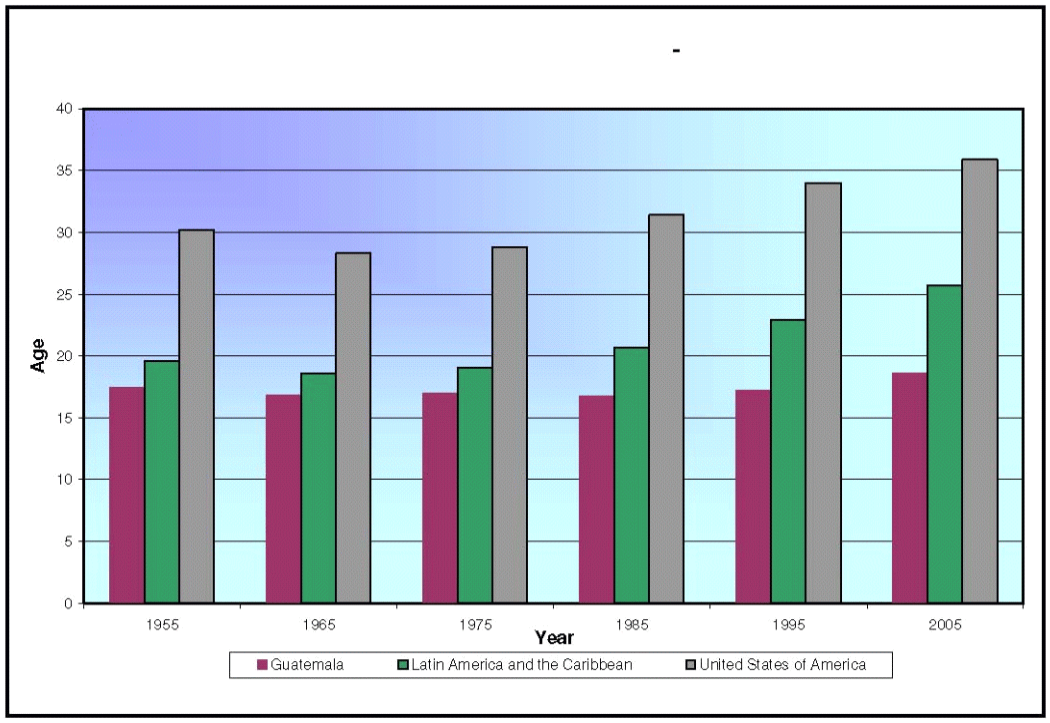

Figure 2.9. Median age of population 1955-2005. (*Source:* United Nations 2002)

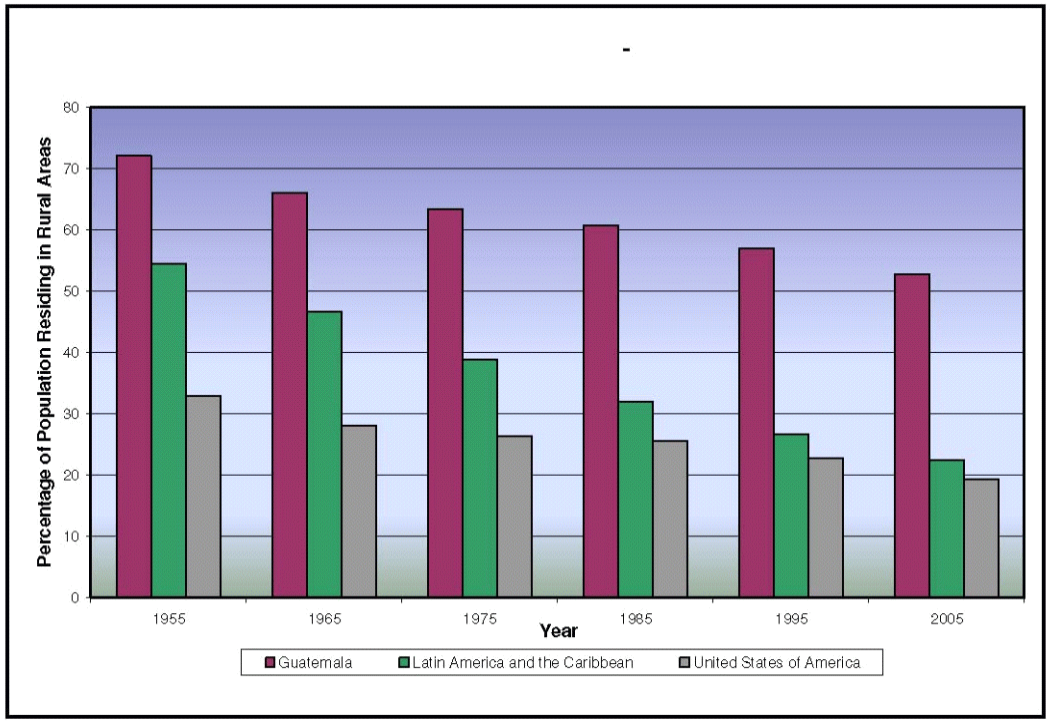

Figure 2.10. Rural population 1955-2005. (*Source:* United Nations 2002)

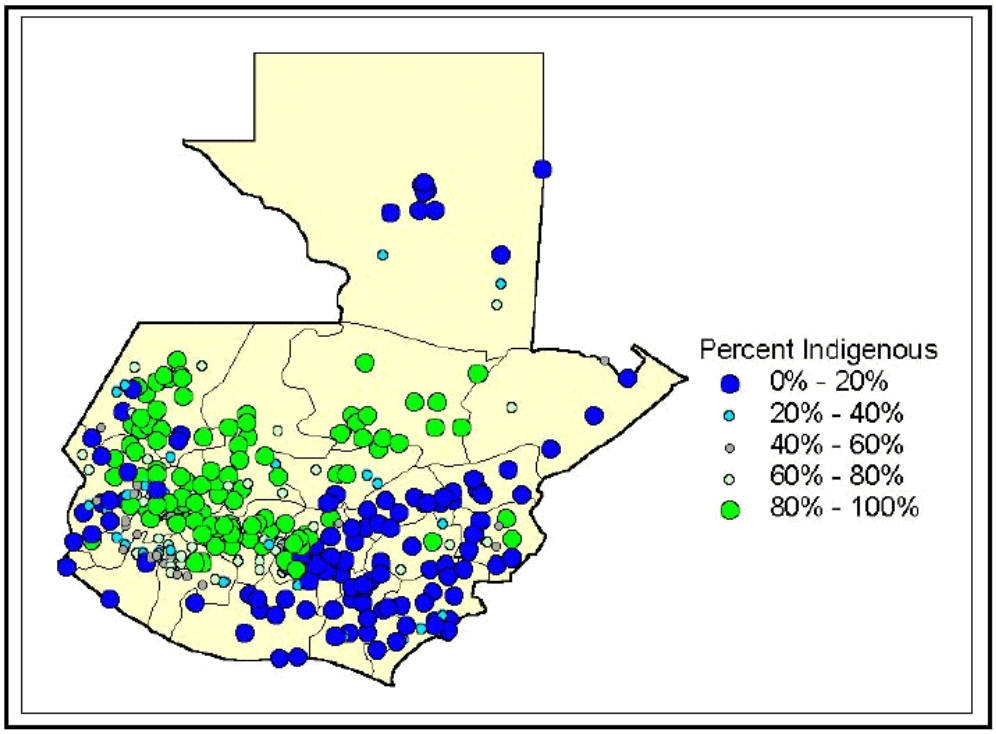

Figure 2.11. Map of ethnic distribution in municipalities. (*Source:* Gulden 2002)

2.6. Government

2.6.1. Separation of Powers

The signing of the Guatemalan Constitution in May 1985 created a constitutional democratic republic comprised of 22 administrative divisions, or *departamentos*. The governmental authority is divided among three independent branches: Executive, Legislative, and Judicial.

President Oscar Berger began his presidential term in January 2004. Presidents are elected by popular vote, and serve as both the chief of state and head of government. As president, the constitution permits Berger to serve only one four-year term. There are approximately 25 political parties throughout the country. Elections are held during the month of November. However, due to the high number of political parties the margins of victory after an election tend to be fairly narrow. A runoff, or second round of voting, is held when the results from the first round post with no absolute majority. This runoff election occurs in late December. The ensuing runoff vote is limited to the top two candidates based on the results from the first round. As can be expected, in the weeks between the first and runoff elections, a great deal of aggregating occurs as various political groups jockey for position and join forces.

The Legislative branch is framed within the unicameral Congress of the Republic. Currently, congress consists of 158 elected members which serve four year terms. The highest authority within the Judicial branch is the Constitutional Court. This court consists of five judges. Five separate authorities have power over the nominations, with each authority responsible for appointing one judge. The nominating authorities are the: Congress, Supreme Court of Justice,

President, Superior Council of the University of San Carlos of Guatemala, and the College of Lawyers.

2.6.2. Governance, Corruption, and Human Rights

As the previous sections have indicated, abuse of political power has occurred throughout Guatemalan history and did not end with the signing of the Peace Accords in 1996. Table 2.1 provides a snapshot of the current levels of corruption and limited freedoms experienced by Guatemalan society using data gathered from various international indices. Details specific to each index are discussed below.

Table 2.1. Corruption and civil freedoms.

Title of index	Year	Rating	Classification	Scale	Organization
Corruption Perception	2003	2.2	Corrupt	0 Corrupt – 10 Clean	Transparency International
Political Rights	2004	4	Partly Free	1 Free – 7 Least Free	Freedom House
Civil Liberties	2004	4	Partly Free	1 Free – 7 Least Free	Freedom House
Freedom of Press	2004	62	Not Free	0 Free – 100 Least Free	Freedom House

Corruption Perception Index

The German-based nongovernmental organization, Transparency International, calculates the Corruption Perception Index (CPI) by ranking 146 countries in terms of the degree to which corruption is perceived to exist among public officials and politicians (Transparency International 2003). The CPI focuses on corruption in the public sector, and defines corruption as the abuse of public office for private gain. The index is derived from 18 different surveys conducted by 12 independent institutions. These surveys are carried out among business people, country and risk analysts, local and expatriate residents, and academics.

Sadly, corruption in Guatemala has become commonplace throughout many institutional and political entities. The causes of these high levels of corruption tend to boil down to a lack of transparency and accountability. Though many international donors' intentions are noble, in many instances the money they contribute is poorly managed. In fact, frequently million-dollar projects lack a substantial verification component. This irresponsibility on the part of international donor agencies has created a climate for corruption to excel. Corruption in these large-scale projects takes on many forms. Often public officials are bribed, kickbacks are routine, project bids are noncompetitive or costs over inflated. It would be naive to think that these circumstances are unique to Guatemala. Given the disparity within the Guatemalan population and regionally low indicators for health and education, many of which are focuses of these international development projects, it is morally irresponsible for these large-scale projects to continue without first improving their internal transparency and accountability. When transparency is limited and where project verification is lax, corruption is rampant and the disparities between the empowered and the powerless become even more exaggerated.

In 1999, 35 members of the Organization for Economic Cooperation and Development (OECD) ratified the Convention Against Bribery of Foreign Public Officials in International Business Transactions. This mandate makes it a crime to offer a bribe to public officials in order to secure international business deals (OECD 2003). Prior to this convention only companies from the US

were forbidden to bribe foreign public officials, when in 1977, the US Congress passed the *Foreign Corrupt Practice Act* (FCPA). Investors from other countries would justify bribery in foreign markets in one of two ways: the principle of state sovereignty, or accept it as a "cultural norm" in developing countries. Investors from the US believed that they were operating with a distinct disadvantage when competing against investment firms from other countries. The climate for change ripened due to mounting pressure from US firms, the exposure of large corruption scandals in the press, and when the high cost of corruption became financially prohibitive to doing business. These forces coalesced in the late 1990s, and eventually led to the ratification of this antibribery convention. This treaty only deals with foreign investment, however, in developing countries a large portion of capital inversions are from overseas. Through the promotion of new accounting, auditing, and procurement procedures the convention attempts to establish a new level of morality in foreign investment. Hopefully, these new practices will have a rippling effect throughout the Guatemalan political and business worlds and also increase domestic transparency.

Political Rights Index

The Political Rights Index is determined annually by Freedom House, an international nongovernmental organization founded by Eleanor Roosevelt during the 1940s. The organization works to promote and monitor democracy throughout the world. The Political Rights Index has been published annually since 1955; it is the result of a year-long survey conducted by regional experts, consultants, and human rights specialists.

Information for the survey is derived from political parties, religious leaders, academics, trade unions, business people, human rights activists, journalists, political figures, and published sources (Freedom House 2004). This index strives to measure the existing political environment created by both state and nongovernmental factors, rather than on governmental legislation alone. Freedom House rates a country's political freedom on a scale of one to seven, with one representing the most free and seven the least free. This numeric rating is then classified into one of the following three categories: **Free** (1–2) A broad range of political rights are respected; **Partly Free** (3–5) Political rights abuses, corruption, weak law enforcement, political dominance, ethnic strife are common place; **Not Free** (6–7) Basic political rights are denied.

Interestingly, the 2003 report suggests that political freedoms in Guatemala are at their worst levels since the signing of the Peace Accords in 1996. Freedom House indicates that decline in the Guatemalan Political Rights Index is "due to the continuing decay of political institutions, the increase of corruption and lawlessness, and the reappearance of death squads" (Freedom House 2004, Country Ratings).

Civil Liberties Index

Freedom House also determines the Civil Liberties Index. The methodology used to calculate this index parallels that of the Political Rights Index. This index is also on a scale of one to seven, with one representing the most free and seven the least free. "Countries with a rating of one generally have an established and equitable rule of law with free economic activity. Citizens enjoy freedom of expression, assembly, association, and religion. A rating of two indicates some

deficiencies, but is still relatively free. A rating of three to five may indicate partial compliance with all of the elements of civil liberties; it may also indicate complete freedom in some areas coupled with complete denial in others. Countries with a rating of six enjoy partial rights, a few social and religious freedoms and some restricted business activity. A rating of seven indicates virtually no freedom" (World Resources Institute 2003, p. 3).

Since the signing of the Peace Accords, Guatemala has maintained a Civil Liberties Index rating of four. This consistently poor rating is based on several factors. For example, although the government does not interfere with academic freedom, academics have repeatedly been the targets of death squads. These assassinations began during the civil war and at some universities entire walls have been converted to memorials and are covered with the photographs of the slain professors and students. Even after billions of international dollars have been invested into the country following the Peace Accords, intimidation of academics with a contrary opinion is common. Another example of limited civil liberties can be found in the work place. Workers are routinely denied the right to organize and are subject to mass firings and blacklisting (Freedom House 2004).

Freedom of Press Index

The Freedom House organization also calculates the Freedom of Press Index, which it defines as "the degree to which a country permits the free flow of information" (World Resources Institute 2003, p. 3). The index is rated on a scale of 1 to 100, and is divided into three classifications. A country with a score of 1 to 30 is considered to have a free media; a 31 to 60 score indicates that the media is only partly free; and 61-100 indicates that the media is not considered to be free. Many components are analyzed and incorporated to calculate this index rating, these include: degree of state censorship and intimidation; media related legislation, access to information within a country; financial influences affecting the press due to corruption, government funding, quotas, and licensing bias (Freedom House 2004). Unfortunately, the freedom of the Guatemalan press appears to be deteriorating. In 2001, Guatemala received a 49 Freedom of the Press rating, however, two years later the rating had degraded to 62. There are many factors which caused this worsening of the country's rating. One primary cause was the intimidation of the press by government officials.

Jueves Negro

The rankings of the indices described above portray a country with severely limited freedoms, and are indicative of the weakened state of many Guatemalan governmental institutions. Perhaps most unnerving is the trending directions of these indices. As mentioned earlier, many of these indices have worsened since the signing of the Peace Accords. The signing of the Peace Accords in 1996 occurred when international concern was highest, and with it large amounts of international funding was dedicated to strengthen national institutions. However, this postwar period has not been a time of reconstruction in all areas of Guatemalan society. This is especially true concerning civic affairs. A recent event which personifies this degraded state has become known as *Jueves Negro*, or Black Thursday. A detailed examination of the events that occurred during *Jueves Negro* serves as a synopsis of these weakened institutions, and exemplifies the myriad of corruption, intimidation and abuse of power still prevalent in

Guatemala today.

Jueves Negro transpired on July 24, 2003, and the ramifications of this incident continue to emerge today. Leading up to the 2003 presidential election, the legality of the candidacy of General Efraín Ríos Montt was being deliberated due to his leading of a military coup d'état in 1982. Article 186 of the Guatemalan constitution prohibits participants in a coup to later serve as president. A complicated political and constitutional battle ensued between the Supreme Electoral Tribunal (TSE), the Supreme Court of Justice (CSJ), and the Constitutional Court (CC). The CSJ had first provisionally banned Ríos Montt's candidacy, a ruling contrary to the higher CC's initial verdict, however, the battles continued. Ríos Montt campaigned in spite of the CSJ's ruling. In fact, Ríos Montt indicated that the CSJ ruling was illegal, and on July 21 stated "when we are not in the law, violence can happen" (Amnistía Internacional 2003, *Derechos Humanos*). His words were foretelling of the events which would take place later that same week.

At the time Ríos Montt's political party, the Frente Republican Guatemalteco (FRG), wielded a great deal of power controlling the executive and legislative branches and the military. Fearing the government would prohibit Ríos Montt's candidacy, FRG political deputies organized a political rally in the capital. The goal of the rally was to show the courts that the Guatemalan people wanted Ríos Montt to run for president. The FRG's strategy was to have thousands of supporters march on the capital, demonstrating both their allegiance and their numbers. In order to rally support, the FRG organized the bussing of thousands to the capital, supplying the transportation, lunch, and a per diem. Among the participants were former members of the Civilian Patrol Units (PAC) from the civil war period, rural farmers, and governmental officials from the FRG party. Countless participants marched on the capital as *encapuchados*, or hooded figures, wearing black hoods to conceal their faces. Upon their arrival in the capital, rally leaders distributed wooden clubs, firearms, machetes, and gasoline. As may be expected when thousands march covering their faces and carrying clubs, the rally quickly became violent. The FRG-controlled military and civil authorities did nothing to squelch the unruly mob. The actions of this politically backed mob during *Jueves Negro* are summarized below:

1. Occupation of Governmental Offices. The mob swarmed the offices of the TSE, CSJ, and CC and continued on to the houses of judges who voted against the candidacy of Ríos Montt. Judge Rodolfo Rohrmoser of the CC was rescued from his house by helicopter. Many other judges received death threats. The mob took control of the Central Business Center, occupying the building for many hours and taking 400 people hostage.
2. Intimidation of Human Rights Organizations. Masked men amassed at leading human rights organizations, threatening to beat any human rights activists encountered on the streets. Many leaders sought refuge at the Myrna Mack Foundation. Security reinforcements were solicited by the foundation but none authorized by the governing agency.
3. Acts of Violence Toward the Press. The crowd congregated at the main office of *El Periódico*, a Guatemalan newspaper. Armed assailants destroyed the camera equipment of reporters Juan Carlos Torres of the *El Periódico*, and Edgar Valle of the *Notisiete*. The

> mob then doused Carlos Torres with gasoline and attempted to burn him alive, luckily he escaped. Reporter Héctor Ramírez of *Radio Sonora* was not as fortunate. Héctor Ramírez was chased by the angry mob, suffered severe head contusions and later died of a heart attack (Amnistía Internacional 2003).

The above description of the events from *Jueves Negro* serves to convey the manner in which political power and violence are used to manipulate and intimidate dissenting voices within Guatemalan society. *Jueves Negro* provides only a snapshot of the violence inherent to internal Guatemalan affairs. The story is a microcosm of events which occur in the more remote areas of the country. For instance, vigilantism is the prevailing justice system in the more rural areas of the country. Due to the citizenry's lack of confidence in the judicial system, locals often take the law into their own hands and lynchings are common. One occurrence alone may be fairly small and understandable in a developing country. However, the fact that these types of events occur with some regularity has led to a chronic weakening of governmental institutions throughout the country.

Jueves Negro was just one of many dark days throughout the nation's history. Although Ríos Montt was eventually permitted to run, he placed third gaining only 19% of the vote. Promisingly, many of the event's organizers have been brought to justice; a hopeful omen toward the rampant impunity entitled to political officials. More than six FRG party officials and political sympathizers were indicted for their involvement on *Jueves Negro*. In fact, in March of 2004, Ríos Montt was placed under house arrest for the "likely participation in three crimes: manslaughter, conspiracy and threatening bodily harm," according to a judge from the CSJ (Associated Press 2004, March 9, *Ríos Montt*). Additionally, his loss precludes his gaining a special type of criminal immunity afforded to Guatemalan presidents. As such, international and domestic efforts are underway to bring Ríos Montt to justice for crimes against humanity, having been charged with acts of genocide committed during the military campaigns of the early 1980s.

2.7. Economy

Guatemala possesses the largest economy of Central America, with a Gross Domestic Product (GDP) of $24.3 billion in 2003. From 1999 through 2003 economic growth rates averaged 2.8% (United Nations 2004). The economy consists of three primary sectors: agriculture at 23%, industry at 20%, and services at 57% (World Resource Institute 2003). Key components of the Guatemalan economy are discussed in greater detail below.

2.7.1. Labor Force

In 2003, the World Bank conducted a study that analyzed the trends of the Guatemalan labor market (Vakis 2003). The study found that approximately 4.5 million people participate in the Guatemalan labor force with more than two-thirds of the employed working in the informal sector. Participation within the informal labor market tends to be higher among the poor, uneducated, indigenous, and rural populations. Unemployment rates are fairly low and currently estimated at 1.8%. However, this unemployment rate is deceiving because approximately 30% of the entire labor force is considered underemployed. Underemployment is more endemic

among the rural indigenous because they tend to have lower reservation wages and are more likely to take any opportunity that becomes available. Particularly problematic is the high prevalence of child labor in Guatemala, with an estimated half a million children under the age of 14 working. Child labor often comes in place of the child attending school, this is a choice that can limit the child's professional and income earning opportunities later in life.

2.7.2. Agriculture

For more than a century, large multinational firms have driven the agricultural industry of Guatemala. Due to the country's favorable climate, fertile soils, cheap labor supply, and proximity to large markets the agricultural sector continues to drive a large portion of the country's economy. Sixty-five percent of all exports are related to the agricultural industry, and approximately 50% of the workforce finds employment in this sector as well (CIA 2004). Unfortunately, the vast majority of the export market remains concentrated in three traditional agricultural commodities: coffee, sugar and bananas. Together these three crops account for nearly 30% of the value of all exports. However, these commodities have been trading at historically low prices in recent years due to increased global competition and market saturation (US and Foreign Commercial Service 2004).

Increasingly, growth in the export market is largely attributable to the exportation of nontraditional products. Nontraditional products consist of everything that are not bananas, coffee, or sugar. Examples of nontraditional products include winter vegetables, cut flowers, specialty fruits and berries, shrimp, forest products, as well as manufactured items such as clothing and furniture. The yearly growth within this market is highly variable, as some of these items tend to be specialty goods with highly elastic demand curves that fluctuate with the economic conditions of Guatemala's trading partners. However, long-term steady growth in this market has been experienced for the last several years. For example, from 1997 to 2001 this nontraditional export market grew by 39% from $1.4 billion to more than $1.95 billion (International Finance Center 2004). More growth in this market is expected as the government seeks to liberalize trade via multilateral trade agreements, diversify its economy, and promote secondary manufacturing of raw products.

2.7.3. Remittances

Although Guatemala traditionally carries a negative trade balance, this economic blow is tempered by remittance monies sent home from Guatemalan workers earning wages in other countries. For many years Guatemala has been a source of unskilled labor for more developed countries, specifically the US. This trend seems to have accelerated during the large mass emigration which occurred during the civil war, particularly in the early 1980s. During this period many Guatemalans fled the country and settled in Mexico and the US. When the violence ended in Guatemala, some of these expatriate families returned while others remained in their new location. The individuals and families that remained in their location often received political amnesty and became legal residents of their new country. These networks of families served as initial entry points into a foreign landscape for future Guatemalan migration.

Initially, Guatemalan immigrants entered the US via the Mexican border, and went on to settle principally in Los Angeles, Chicago, New York, and Florida. Currently, due to more well-established networks of communication among immigrants and improved knowledge of the US, these newcomers have since expanded into many other areas of the country. Due to the vast majority of this immigration being illegal, reliable Guatemalan immigration data is difficult to obtain; with estimated numbers ranging widely depending on the political leanings of the publishing organization. However, Guatemala's ambassador to the US, Guillermo Castillo, estimates that approximately 1.5 million people from Guatemala are currently living in the US. Ambassador Castillo predicts that immigration rates will continue to grow as young men and women seek better opportunities for employment (González 2005, January 10). The Central Bank of Guatemala estimates that the total value of remittances for 2004 was approximately $2.5 billion, up 21% from 2003 (BN Valores 2004). In 2002, a study conducted by the International Organization for Migration (IOM) analyzed how the beneficiaries of these transfers used the funds and determined that 32% was allocated toward the purchase of consumables (e.g., food and medicine); 27% was used to acquire or improve housing, fund education, or put into savings; and 11% used toward canceling outstanding debts (Lozano 2005).

2.7.4. Economic Disparity

When analyzing Guatemalan economic indicators it is critical to ascertain the degree of socioeconomic disparity prevalent within the country's population. The Gini coefficient is one useful analytical tool in quantifying the degree of inequity among a population. This coefficient measures the degree to which the distribution of income within an economy deviates from a perfectly equal distribution (World Resource Institute 2003). A Gini index of zero indicates perfect equality among the population, and a score of one hundred indicates perfect inequality. In 2004, the United Nations Development Programme (UNDP) scored Guatemala as having a Gini index of 48.3, a rating which has improved in recent years. However, the UNDP estimates that 56% of Guatemalan families still live below the national poverty line, with 37% of Guatemalans living under $2 a day (UNDP 2004).

2.7.5. International Trade

Private enterprise in Guatemala has always focused on the export markets. This is largely because the vast majority of Guatemalans were, and remain, subsistence farmers with no practical means to purchase products, and thus were merely viewed as a cheap labor force by the multinational corporations. Table 2.2 summarizes the principal trading partners of Guatemala in 2003 (CIA 2004).

Table 2.2. Principal trading partners of Guatemala in 2003 (*Source:* CIA 2004).

Country	Percentage of export market	Country	Percentage of import market
United States	59	United States	33
El Salvador	9	Mexico	10
Nicaragua	3	South Korea	8
Costa Rica	3	El Salvador	6

Currently, there is great debate within the country over national policy affecting international trade as various multilateral trade pacts are vying for Guatemalan participation. Of particular debate is the Central American Free Trade Agreement (CAFTA), also know as the *Tratado de Libre Comercio* (TLC) or as a component of the larger hemispherical Free Trade Area of the Americas (FTAA). On May 28, 2004, Guatemala signed the CAFTA treaty along with Honduras, Nicaragua, El Salvador, Costa Rica, the Dominican Republic, and the US. However, by early 2005 only El Salvador and Honduras have officially ratified the treaty. The legislatures of the remaining countries are preparing to debate this tumultuous topic during the 2005 session. Widespread protesting has been prevalent in each of the countries involved. For example, immediately upon ratification in Honduras the convening legislators voted and quickly disbanded. They rapidly evacuated the congress for fear of the horde of protestors, many of whom were legislators from a dissenting political party, which entered the building breaking chairs and windows while delivering anti-CAFTA speeches from the pulpit (Cuevas 2005, March 3).

If ratified, the treaty would establish the parameters of free trade among all participating countries for the next 50 years. Proponents for the agreement argue that the removal of trade barriers will promote regional economic development. Dissidents of the trade pact, however, argue that the Guatemalan marketplace will become inundated with cheaper products from the US. Of particular concern among the rural population is the importation of corn from the US. Guatemalan farmers fear that the influx of subsidized corn, and other similar commodities from the US, will cause market prices to plummet forcing them further into poverty. Liberalization of trade tariffs for many of the more sensitive commodities, such as corn and sugar, are to be phased in gradually over the first 20 years of the accord to afford farmers the opportunity to increase production efficiencies and market competitiveness. However, there is great concern among the rural population that CAFTA will only serve to widen the disparity between the urban elite and the rural subsistence farmers, a fear that has manifested itself in the form of regional protests, highway blockades and murders.

2.8. Land Tenure Systems

"In every civilized society property rights must be carefully safeguarded; ordinarily, and in the great majority of cases, human rights and property rights are fundamentally and in the long run identical"—Teddy Roosevelt, "The Man in the Arena" April 23, 1910

Land tenure in Guatemala is a complicated and politically charged issue. As previously revealed by Guatemalan history, ownership of fertile land has been at the heart of nearly every bloody battle since the arrival of the first conquistadors and Lieutenant Don Pedro Alvarado in 1523.

Truth be told, even prior to the arrival of the conquistadors the Maya had a fairly inequitable land "ownership" system. Although, property ownership in modern terms did not exist among the Maya, a complex caste system determined how the communal land was cultivated and harvests allocated. Traditionally, the Mayan priests and nobles were able to own only small areas encircling a water source, while the large communal tracts were parceled out to the remainder of the population. Because of the extreme variability in land quality an Alcadecol, a powerful ruling member of the elite class, regulated the land distribution process (Donovan 2002). The ownership rights bestowed upon the patriarch of a family by the Alcadecol were usufructuary in nature, allowing only for the cultivation of crops and the transference of access to the land to the male heir of the family.

With the arrival of the Spanish in the 16th century, the complex communal land ownership system of the Maya crashed course with the "*encomienda*" system of the Spanish colonial system. In efforts to quickly convert, colonialize, and commercialize the resources of Guatemala the Spanish crown offered land as a reward for colonization. Large homesteads, or "*encomiendas*" were soon settled by Spanish Colonialists, and these vast tracts of land were cultivated using indigenous slave labor (Donovan 2002). This slave-based system evolved into a system of indentured servitude in 1542, where colonials awarded small parcels of land to indigenous workers, in exchange for their cultivation of the colonist's larger tract of land.

Unfortunately, land tenure remains much the same today as it was in the 16th century. In spite of Arbenz's attempted agrarian reforms of 1952, and the promises of the 1996 Peace Accords, Guatemala's land tenure system continues to deteriorate. According to a 1998 study conducted by the Ministry of Agriculture (MAGA), approximately 70% of the cultivated land is owned by 0.15% of Guatemalan farmers (MAGA 1998). A 2003 study conducted by the World Bank analyzed the landownership patterns in rural Guatemala. The study found that the probability of individuals having a title to their land decreased if they were poor, or if the parcel size was small. Table 2.3 illustrates the findings of this World Bank study (Vakis 2003, p.74).

Table 2.3. Rural households without land titles (*Source:* Vakis 2003).

Classification	**Percentage without land titles**
All	59
Extreme Poor	68
All Poor	62
Non Poor	52
Indigenous	60
Non-Indigenous	57
Parcel Size	
< 1 hectares	61
1-2 hectares	59
2-5 hectares	53
5-15 hectares	55
> 15 hectares	51

Various programs have existed over the years to assist landowners in securing titles to their land. The current program began in 1999 with the creation of the Inter Institutional Commission for

the Development and Strengthening of Land Property Rights (PROTIERRA). This agency has received financial support from the US Agency for International Development (USAID) and the World Bank, and seeks to "increase legal security of land tenure and reinforce the institutional and legal structure for land registry services" (Donovan 2002, p.12). One key goal of PROTIERRA is to register deeds within a national cadastral map using geographically referenced data to catalog parcel boundaries, locations of utilities and improvements, and registered owners into one national electronic database. Additionally, the program permits the registration of land titles to groups such as, cooperatives, municipalities, and other communal land owning arrangements (Donovan 2002).

The registration of land to communal or municipal entities is of particular significance in the more heavily populated indigenous areas of the country. For instance, in the indigenous municipality of Concepción Huista in the department of Huehuetenango approximately 80% of all land is registered as communal or municipal land (CODECH 2000). In these areas the legal title has been deeded to the governing municipality, with the current mayor acting as the legal representative. Thus, farmers cultivating crops on "private property" in fact merely possess usufructuary rights to cultivate the communal land. In effect, this is a modern version of the Alcadecol administered system of the ancient Maya. The decentralization of governmental authority in this manner was a main focus of the Peace Accords. The system's greatest failure is due to corruption, intimidation, and overall lack of transparency often prevalent in the smaller municipal governments. For instance, a farmer's usufructuary rights may be challenged should a new political party take office, in effect evicting the farmer from their land. It often is the case that these smaller rural farmers lack the financial means and legal knowledge to defend themselves from these abuses of power. This risk breeds instability in land tenure for farmers, and often serves as a hindrance to long-term resource management or investment in land improvements (i.e., soil conservation, irrigation, or agroforestry systems).

The current lack of a functioning national cadastral map causes many problems for all landowners. These problems become even more severe for rural indigenous farmers. Rural farmers often lack the institutional knowledge and financial means to resolve complex land title issues in a title office located ten hours away. These land titling problems produce secondary issues, which manifest themselves as boundary disputes with adjacent parcels, lack of credit from banking institutions, and hindrance of regional land use planning efforts (SEGEPLAN 2003).

2.9. Natural Resources of Guatemala

As may be expected by the contribution of agricultural commodities to GDP, Guatemala is a country richly blessed with natural resources. The three distinct climatic zones, the Highlands, the Petén, and the Pacific Coast, are each comprised of unique soil characteristics, moisture regimes, flora and fauna.

2.9.1. Hydrologic Resources

The three geographic zones of Guatemala form three macro watersheds that drain to the Pacific Ocean, Gulf of Mexico and the Caribbean Sea. Forty-seven percent of the country's area drains

into the Gulf of Mexico, 31% drains eastward into the Caribbean Sea, and 22% drains westward into the Pacific Ocean (Gálvez 2000). Guatemala receives approximately 2,034 millimeters of rainfall annually, however, this value varies from 500 to 6,000 millimeters across regions (Gálvez 2000). About 74% of surface withdrawals are used to irrigate crops and to maintain livestock, 17% are used in industry, and 9% used for household consumption (World Resources Institute 2003). Interestingly, although 74% of the water is used to irrigate crops only 7% of cropland is irrigated (World Resources Institute 2003). During the 1970s, Guatemala began to invest heavily in the construction of hydroelectric dams, and by 1990 roughly 92% of Guatemala's total electricity generation was from hydropower (Energy Information Administration 2001).

In 2002, the World Resources Institute calculated that the Internal Renewable Water Resources (IRWR) was approximately 9,277 cubic meters per capita (World Resources Institute 2003). The United Nations defines IRWR as the "average annual flow of rivers and recharge of groundwater generated from endogenous precipitation" (AQUASTAT 2000, On-line Glossary). The regional average for Central America and the Caribbean is 6,645 cubic meters per capita (World Resources Institute 2003). However, these values should be used only as a measure of the available hydrologic resource, not as an index of current water security. Even with seemingly abundant water resources many regions of the country lack reliable access to clean water, and are thus experiencing severe water security issues. Lack of water security in regions of the country, including the capital, are associated with lack of infrastructure (e.g., water distribution systems and treatment facilities) and municipal water management programs.

For example, in the municipality of Concepción Huista in the Western Highlands where rainfall averages exceed 2,000 millimeters annually, many areas within the main town and smaller villages lack regular access to potable water. Residents within the town center have access to a municipal water supply, however, the distribution system cannot maintain adequate water quality or quantity throughout the year. Water is distributed to the four cantons within the town on a sporadic and inconsistent schedule, with water being distributed to a particular canton at one moment, and to another area the next. During the rainy season, when the town's two distribution tanks are full, one particular canton may go 48 hours without water, while water is supplied to the other cantons. However, during the six-month dry season, a canton may go several days or even weeks without water. Compounding this problem is the fact that the distribution network is constructed of plastic piping which is buried shallowly in the center of the dirt roadway, over the years the weight from the heavy busses and trucks have cracked these pipes. When these distribution pipes are not filled with water, there is a negative pressure differential between the cracked pipe and the surrounding fill. Often, this fill dirt is contaminated with seepage from the raw sewage discharged from the surrounding households, as no sewage treatment system exists. When one canton is not receiving water, its distribution pipes frequently become contaminated as sewage infiltrates the cracked pipes, so when the water does come it is often contaminated.

Further exacerbating this problem is the lack of a distribution schedule. Because residents do not know exactly when the water will come, they leave the faucet open all of the time. When water is supplied, the open faucet quickly fills their sink, or *pila*, which soon overflows with the water

running into the nearest drain. In a mountainous country, this results in the distribution system lacking pressure to supply many residents that live slightly upslope; even if the mechanics of the gravity distribution system were engineered to otherwise permit adequate distribution. In many areas the only form of payment for municipal water is the initial application process for access to the main supply line. Once this connection is authorized by the local mayor, there is no metering system in place to regulate or measure consumption. In some areas, villagers are charged an annual fee for their municipal water connection, but this is often a flat fee and provides no real incentive for conservation.

2.9.2. Mineral Resources

Guatemala straddles three tectonic plates, which are moving in different directions and at differing rates. This complex and fragmented formation has resulted in a country that is seismically active, and richly endowed with a unique bounty of mineral resources. Minerals of commercial interest include: lignite, talc, rock salt, pumice, perlite, opal, mica, marble, jasper, jadeite, gypsum, feldspar, diatomite, kaolin, limestone, bentonite, barite, zinc, tungsten, titanium, silver, manganese, nickel, mercury, iron, lead, chromium, copper, cobalt, antimony, and gold. In addition to these minerals, the mining of gravel has accelerated in recent years to satisfy the rapid growth of the national cement industry (Doan 1999).

Guatemala is also the only oil producing country in Central America, and has been promoting the increased exploitation of its oil fields since 1996. In 1999, Guatemala produced 24,200 barrels per day of crude; the majority of these oil fields are located in the remote Xan fields of the Petén jungle. Development of these fields has been fraught with protests and sabotage from environmental groups, and their exploitation is further complicated due to their being located on or near the Maya Biosphere Reserve. This reserve was created by the Guatemalan government in 1990, with the objective of conserving the largest remaining tract of rainforest in Central America via a complex mix of conservation and sustainable development. However, some of the oil fields were in production prior to the reserve's creation and have thus been grandfathered into the reserve. The vast majority of the oil produced is exported to the US (Energy Information Administration 2001).

2.9.3. Forest Resources

The country's topography ranges from sea level to more than 4,200 meters in altitude, and this extreme range in topography provides for a wide variety of microclimates. This diversity forms 13 distinct life zones, according to the Holdridge life zone classification system (Gálvez 2000). The Holdridge system was created in 1967 and is based on two climatic indices: biotemperature and annual precipitation. Initially, this system was created as a classification tool to model ecosystem response as a function of climatic change. This system has become one of the more widely adopted ecosystem classification models, particularly in the tropical regions (Leemans et al. 1996). Of the 14 life zones in Guatemala, the following nine dominate the landscape: subtropical wet forest, subtropical moist forest, subtropical low montane wet forest, subtropical low montane moist forest, subtropical montane wet forest, subtropical montane moist forest, subtropical dry forest, subtropical rain forest, and subtropical low montane rain forest (FAO 2002).

The most recent national forest inventory was conducted in 2001, and the results indicate that approximately 40% of the country is forested (INAB, 2003). However, the Food and Agriculture Organization of the United Nations (FAO) estimates the actual forest coverage at 26% (FAO 2002). The discrepancy between these two forest coverage estimates is largely due to differing methodologies and inventory resolutions. The FAO study determined the annual deforestation rate from 1990 to 2000 at 1.7%. There are well over 700 forest species within the country, these various species are classified in three broad forest cover types: broadleaf, coniferous, and mixed forest. The national forest inventory conducted in 2003 estimates that approximately 82% of the forest area is classified as broadleaf, 10% coniferous, and 8% as mixed forest (INAB, 2003). An estimated 38% of this forest area is located on private land, 34% on federally controlled land, 15% on communally administered land, 8% is owned by municipal governments, and 5% of the forest area is owned by other groups (INAB 2003). Interestingly, about 55% of the total forest area is located within protected areas where management and conservation activities are administered by the Guatemalan Advisory Council of Protected Areas (CONAP) (INAB 2003). Due to limited institutional capacities and the often conflicting needs of local populations, the existence of many of these protected areas seems to occur more on paper than by any tangible activities on the ground.

The commercialization of forest products primarily focuses on the local and national markets. In 2003, of the harvested 735 thousand cubic meters authorized by the Guatemalan Forest Service (INAB), only 13% of this volume was exported (INAB 2003). Although forest resources are seemingly abundant, Guatemala is a net importer of forest products. In 2003, the country exported only $50.4 million in forest products while importing $493.6 million (INAB 2003). As such, the regionally high deforestation rates experienced during the 1990s have more to do with growing population pressures than overexploitation for foreign markets. This is true for the country as a whole, however, many exceptions do exist especially with regard to many of the high value tropical hardwood species grown along the border with Chiapas, Mexico. Thus, the majority of the deforestation is caused by land conversion via expansion of the agricultural frontier. As the rural population continues to grow, families are forced to clear and farm increasingly marginal land. Further accelerating this deforestation rate, is the country's heavy reliance on fuelwood for energy. It has been estimated that approximately 63% of the total energy consumed nationally is derived from fuelwood (Gálvez 2000).

Evidence of the expanding agricultural frontier is also revealed in Figure 2.12. This map illustrates the current land use compared with the desired land use for that site based on the soil characteristics and topography of the location (MAGA 2001). MAGA determines the desired land use for a site using the eight land capability classes defined by the US Department of Agriculture. Descriptions of each class are provided in Table 2.4. The map displays the relationship between an area's actual use in comparison to the desired land use class for that same area. The figure displays this relationship in one of the following five classes: **Correct Use** identified in pink, **Under Use** identified in green, **Depletive Use** identified in orange; **Urban Areas** are colored in red and **Bodies of Water** are identified in blue.

Table 2.4 Land use capability classes used by MAGA (*Source:* Helms 1992).

Class	Land description
I	Few limitations for cultivation
II	Some limitations for cultivation
III	Severe limitations for cultivation
IV	Very severe limitations for cultivation
V	Generally unsuited to cultivation without proper soil management
VI	Unsuited to cultivation, unless unusually intensive management is applied
VII	Unsuited to cultivation and having limitations which cannot be corrected
VIII	Presence of landforms that prohibit cultivation (i.e., protected areas)

The areas identified in orange are principally located in mountainous regions that are farmed with annual crops with no soil conservation systems in place. Due to the steep topography and the intensity, volume, and duration of precipitation, annual erosion rates exceeding 1,400 tons per square kilometer have been reported (Gálvez 2000). In total, 55% of the land area is classified as cultivated in a manner beyond its appropriate land use class. Approximately 36% of the land area is cultivated adequately, and about 9% of the land area should be cultivated more intensively to fully maximize the potential of the resource (Gálvez 2002).

2.9.4. Other Resources

In 2004, nearly 1.2 million tourists visited Guatemala to enjoy the diverse ethnic cultures, flora, and fauna species the country has to offer (PRONACOM 2005). The burgeoning tourism industry has continued to grow since the signing of the Peace Accords, in spite of continued problems with violence and abductions associated with increased organized criminal activity. The tourism trade includes ecotourism and cultural tourism. The former has become a mainstay of Guatemala, and consists of tourists traveling to view and enjoy specific sites or species within the country. The latter seems to be a particularly fast growing segment of the tourist industry, and consists of tourists coming to experience the diverse cultures of Guatemala. Of course, these two types of tourism may occur concurrently with one enhancing the other. However, it is worth mentioning that there seems to be a growing demand for the "real experience" by visiting tourists. Often, these immersion experiences consist of a tourist living with a rural family for a period of several days where they study the local language, participate in the normal work day chores of the family, and basically "try on" a new culture for a short period of time. Coincidentally, these groups may be viewed as cheap sources of labor for various forest management or tree nursery activities. Often, tourist groups will even pay for the experience and the locals tend to enjoy the activity more as the new strangers serve to break the monotony of the task at hand, as they pass the time explaining to the locals why it is that they paid for the opportunity to do this work.

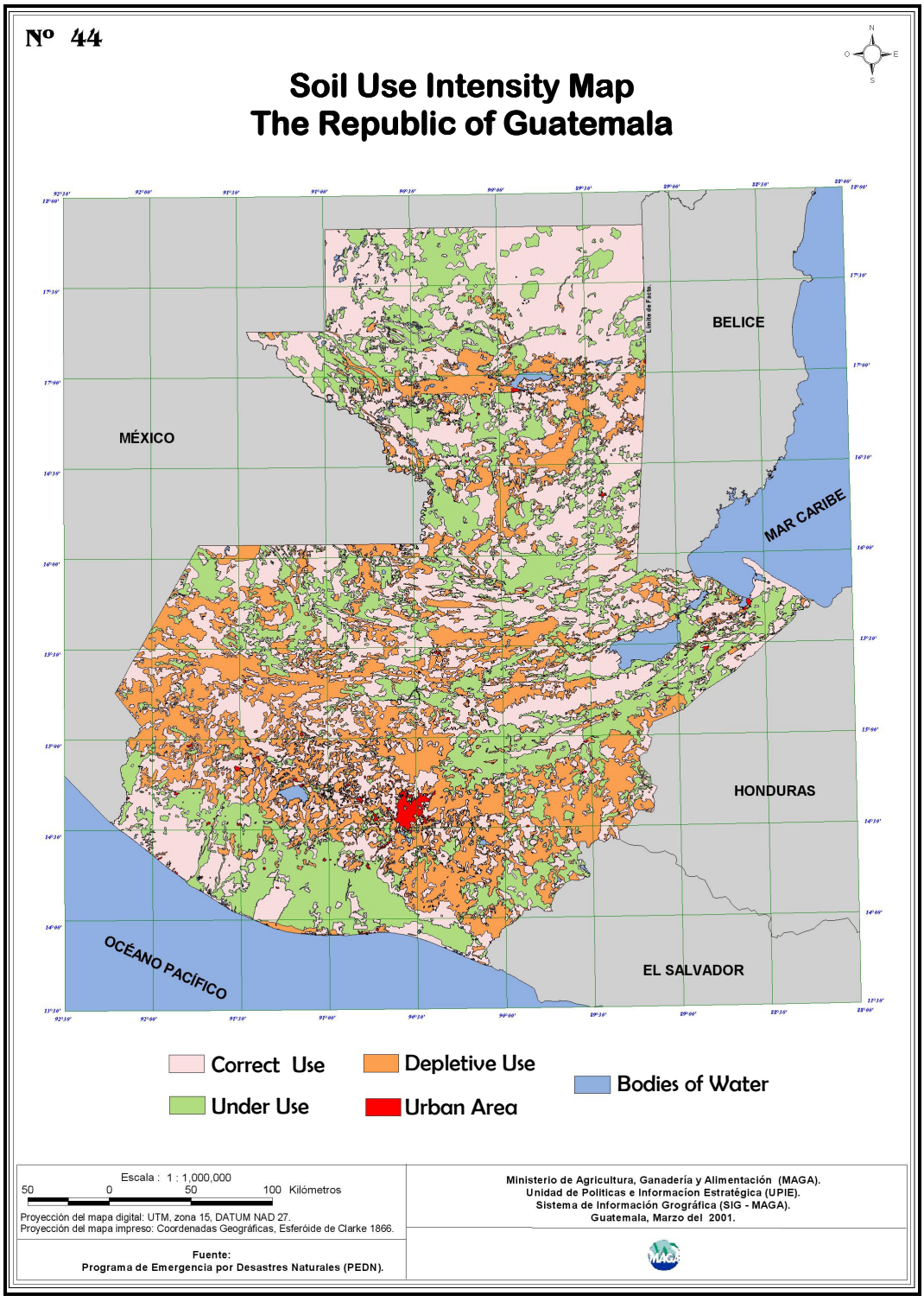

Figure 2.12 Land Use Intensity Map (*Source:* MAGA, 2001)

2.10. Summary of Guatemala Survey

As the previous sections have indicated, Guatemalan society is in the midst of radical change. The country largely remains a segregated dichotomy of modern urban ladinos and rural indigenous subsistence farmers. The disparate conditions between these two segments of society are much the same today as they were prior to the civil war, with little palpable change nine years after the signing of the Peace Accords. As the government contemplates ratification of the CAFTA agreement, civil unrest and opposition grow among the rural population. This unrest is of particular concern considering the fact that the majority of the population is indigenous, rural and lives below the poverty line.

Of particular concern is the rapid population growth rate being experienced in rural Guatemala. Considering the fact that the majority of this growth is occurring in regions with marginal farmland, further and more accelerated resource depletion can be expected if specific preventative efforts are not made. Well-intentioned conservation programs need to be tempered with practical income producing results, in order to have merit with the population and truly satisfy the needs of the people. First and foremost, programs need to focus on production systems which promote income generation for farmers with sustainable conservation of the resource base. Without such efforts it is argued that these rural areas will in fact enter a Malthusian state, where population pressure upon the resource base will surpass the resource's capacity to supply demand. This seemingly fatalistic scenario is perhaps all too real for rural Guatemala, given the region's topography, high rates of population growth, and inadequate soil management.

In situ interviews conducted with indigenous farmers in Concepción Huista, in the Western Highlands, give further credence to this scenario. In the remote villages of the municipality of Concepción Huista, many farmers continue to use fire to clear their lands for planting. Burning occurs during the months of April and May prior to the onset of the rainy season in early June. Once cleared, the burned fields are then planted with the first rains. Unfortunately, the preparation of these fields via fire results in nearly 100% exposure of mineral soil on slopes often greater than 25° resulting in severe soil erosion. The perpetual cultivation of these marginal lands under this cultural practice has resulted in vast areas with virtually no organic soil horizon. These fields now require more chemical fertilizers to produce a crop, however, in spite of these efforts crop yields continue to decline each year.

So, what does a rural farmer using slash and burn agriculture have to do with CAFTA and weakened national institutions? The key component toward sustainable development of Guatemala is recognizing that this rural farmer from Concepción Huista represents the majority of Guatemala. The farmer is indigenous, farms marginal land in rural Guatemala, and currently on an unsustainable path—as is the case with this farmer, so to is the majority of Guatemala.

Thus, when promoting sustainable development and attempting to strengthen national institutions, or considering the implementation of CAFTA, policy makers must consider how these actions will affect the majority of Guatemalans. If policy makers do not, the country will continue to move in two different directions: urban integration into the world market and rural

resource collapse. These differing paths seem to promote regional and institutional instability, rather than sustainable and equitable growth and development. In contrast, should policy makers focus on inclusion of the rural indigenous population and their integration into the national and international marketplace, a greater, more equitable, and sustainable growth may occur.

There are already many examples within Guatemala to disprove the notion that sustainable resource management, income generation, and inclusion of marginalized people are mutually exclusive alternatives. One such example is found in the growing demand for organic, fair trade, and shade-grown certified coffees. The global supply of coffee has far surpassed the increase in demand, and as within any mature industry market growth has been found through product specialization. Certified coffees have become that niche specialization for producers of high quality Guatemalan coffees. Through the certification process farmers can manage their land in accord with the demands mandated by the buyer. Some common certification requirements for coffee farmers are minimum levels of shade in the understory, impediments to prevent soil erosion, use of native tree species for shade, and limitations placed on the use of chemical inputs. Increasingly, buyers' demands include more than environmental factors alone and have grown to incorporate certain social aspects of coffee production, such as guaranteed prices paid to the farmer, fair labor conditions for all workers, freedom for workers to unionize, and improved access to credit for participating cooperatives.

The US consumes more coffee than any other nation at 2.3 billion pounds each year, with an overall market value of $5 billion per year. About 35% of this coffee market consists of the growing "specialty coffee" sector, which comprises $1.7 billion per year. Within the specialty coffee sector, the Fair Trade Certified™ coffee is the fastest growing segment. TransFair USA is the US only independent, third party certifier of Fair Trade Certified™ products and, since its inception in 1998, Fair Trade Certified™ coffee imports have grown at an annual rate of 75% (TransFair 2004). Examples of this nature are becoming increasingly common, and have gone on to include commodities such as chocolate, fruit, rice, and sugar. Perhaps these specialized markets have grown as a backlash to globalization, however, in one sense they embody the true theoretical goal of globalization being the very essence of a perfect market. The costs associated with the wise stewardship of the land, the social components of a fair wage, aspects which have been traditionally disregarded as externalities to production have now been internalized and reflected in the higher consumer price. Thus, if the positive environmental and social externalities produced by this system are in fact important to buyers, consumers are able to indicate this preference with their money.

The growing importance of nontraditional agricultural exports to national GDP, coupled with successful marketing of niche markets such as Fair Trade Certified™ products offers a unique opportunity for rural Guatemalan farmers. Increasingly, smaller scale farmers have better market access to domestic and international consumers. With the increased efficiencies associated with the liberalization of trade barriers (e.g., streamlining of the exportation process and lowering of tariffs) smaller producers are more able to competitively market their goods to wholesale buyers and consumers.

Additionally, the tragic socioeconomic disparity between the rich and poor does create a domestic marketing opportunity for rural farmers, as the newly affluent have increasingly refined tastes and consumption behaviors that parallel those of more developed nations. This last point is best illustrated by coffee consumption behavior of Guatemalans. In the poor rural areas, those farmers that do migrate to work on coffee plantations will often drink coffee that they have stored and crudely processed in their homes. However, the slightly more affluent will insist on purchasing instant coffee, paying an exuberant price for processed *Nescafe*, not so much because they can afford it but more out of the status associated with this refined product. However, the wealthy urban residents often no longer drink *Nescafe* insisting instead on organic coffee as consumed in the US or Europe. As in the US, Guatemalans place a great emphasis on "keeping up with the Jones" even if slightly beyond one's financial means. As such, the growth in organic markets and other niche markets experienced in more developed countries will continue to be mirrored by the more affluent consumers of the developing world.

The growing financial success of nontraditional and organic crops serve as strong examples of the opportunities that exist for small-scale farming in Guatemala. For continued growth in these markets, Guatemalans will need to continually seek new niches to fill in both domestic and international markets. With the rich resources of Guatemala, the variety of crops and cultivation systems available is seemingly infinite. However, because of the current levels of social instability, attention must be focused on areas with not only marginal farm land, but also marginalized people. Specifically, efforts must be focused within the Highland regions of the country, where the indigenous populations suffer in some of the worst standards of living in the hemisphere. The high population growth, low living standards, marginal and degraded land, and high concentrations of indigenous people characterized by this region should make this zone a high priority for future development projects. No longer can organizations naively propose vast areas to be set aside exclusively for conservation purposes. Research must focus on agricultural production systems for these zones that conserve the resource base and produce income for the farmer. Development programs designed which do not satisfy both of these conditions, do not provide a solution and are a deterrent to sustainable development.

Guatemala's climate permits the cultivation of a wide variety of species. However, the high altitudes and colder climates experienced in some zones of the Highland region limit the cultivation options available to farmers. On the other hand, of the species which will grow in this region, some could produce a financially lucrative crop for the farmer. One such species is *pinabete*, or Guatemalan fir (*Abies guatemalensis*). The remaining portion of this paper will focus on the commercialization and conservation of *pinabete*. The following sections will provide a general species overview, marketing information, and policy factors affecting its management. The section will culminate in a financial analysis of three cultivation systems, and provide suggestions for future management directions.

CHAPTER 3. PINABETE

3.1. Species Overview

Pinabete is the common name for *Abies guatemalensis* Rehder, or Guatemalan fir. This species has the southern most range for the *Abies* genus. The core distribution of this species extends from Mexico, through Guatemala, and into parts of Honduras and El Salvador; however, the majority of its distribution is concentrated in the Western Highlands of Guatemala (CONAP/INAB 1999). Pinabete grows in pure stands, and in association with *Cupressus lusitanica, Pinus sp*., *Alnus sp*., and *Quercus sp*. This forest type exists within the subtropical montane wet forest of the Holdridge life zone classification system. Mean annual rainfall in this zone exceeds 1,000 mm, with altitudes ranging from 2,400 to 3,400 meters (CONAP/INAB, 1999). Pinabete grows well in both the volcanic soils which comprise its western range and in the more calciferous soils found further north in the Sierra de Los Cuchumatanes. As typical for the *Abies* genus, seed germination rates of pinabete are quite low and generally do not exceed 12% depending on the seed source (ECODESA 2003). It has been estimated that the original extent of pinabete forests in Guatemala encompassed 558,858 hectares. However, in 1999 it was estimated that only 25,255 hectares of this original forested area remained (CONAP/INAB, 1999). This species is considered endangered, and appears on the World Conservation Union's (IUCN) Red List of Threatened Species. In 1997, the IUCN classified the status of this species as vulnerable and facing a high risk of extinction in the wild in the medium term future (IUCN, 2003).

3.2. Cultural Uses

Traditionally, the indigenous people have harvested pinabete for the fabrication of roofing shingles and furniture, or as an energy source directly as fuelwood or processed as charcoal (Macvean 2003). For millennia, the indigenous have used the trees' foliage to decorate their homes and ceremonial areas during traditional festivals owing to its desirable and long-lasting fragrance (Aguilar 2003). These uses continue today, and have grown to include using the foliage to decorate churches and cemeteries, particularly during All Saints Day and Holy Week. Apart from these more traditional uses, since the 1950s a strong demand has developed for pinabete Christmas trees. The Guatemalan Christmas tree market appears to have started in 1958 and was initially geared toward the selling of trees to the expatriate population residing in Guatemala. However, because of Guatemala's predominantly Catholic population this custom was soon adopted by the nationals and demand for Christmas trees quickly grew over the following years (CONAP/INAB 1999). These pinabete Christmas trees come from one of three sources: harvested young trees, a portion of a harvested crown from a larger tree, or constructed of pinabete branches assembled on a wooden post.

3.3. Threats to Species

In 1999, the Guatemalan Forest Service (INAB) and the Guatemalan Advisory Council of Protected Areas (CONAP) conducted a national study focusing on the conservation of the remaining natural stands of pinabete. The study determined that there are five leading factors threatening these natural stands, listed in descending importance these factors are: overgrazing,

cutting of branches for Christmas trees, land conversion, timber harvesting, and forest fires (CONAP/INAB 1999). The results of the CONAP/INAB study are described in detail below.

3.3.1. Overgrazing

Residents of the Guatemalan Highlands have traditionally maintained herds of sheep and goats for meat and wool production. This cultural practice dates back to the 17th century, with the introduction of these domesticated animals by the Spaniards. To date the cultural practice has been for a member of the family, typically a child or a woman, to tend to the herd as the animals grazed on communal land during the day. As the population has grown, so to has the population of these herds and their pressure on this open resource as no real rangeland management exists. The sheep and goats browse upon the new vegetative growth and naturally regenerated seedlings of pinabete. This pressure results in deformed growth patterns of pinabete as the new leaders are eaten by the livestock, and severely decreased rates of successful natural regeneration. Additionally, overtime the overgrazing leads to soil compaction, erosion, and the formation of gullies further compounding the problem.

3.3.2. Cutting of Branches

As mentioned before, the Maya have long used the branches of pinabete for decorative purposes. However, the rate of the cutting of these live branches has increased over the years in response to the demands created by the burgeoning market for Christmas trees in urban areas. These assembled Christmas trees provide a large source of revenue for many rural farmers during the holiday season. However, the removal of these branches creates several problems which threaten the survival of this species. First, the removal of a large percentage of the living crown can kill or severely injure the tree, rendering it prone to secondary damage caused by various forest pathogens and insects. Second, these branches are harvested during the first weeks of December, a period when seeds are still maturing inside the cones. The cutting of these branches stops the seed maturation process, further limiting the chance for natural regeneration of the species.

3.3.3. Land Conversion

The conversion of forested areas to agricultural land has accelerated over the years, and these conversion rates have in effect grown proportionally to the rural Guatemalan population. The expansion of the agricultural frontier into these marginal zones has been mentioned previously in this paper, and is of particular concern for this tree species. Land conversion tends to be not only a change in land use, but also serves as a de facto change in land ownership. For instance, a forest is traditionally viewed as a communal asset, however, as the borders of the forest are converted to farmland the tilled soil serves as a pseudo delimitation of private property. Long-term forest management quickly becomes rapid resource consumption by these colonizing farmers. Forest depletion is fairly understandable given the small land parcel sizes, growing population, and the farmers' subsistence nature. The larger effect of this change in ownership is the loss of the traditional Maya stewardship of the communal land. This communal stewardship is a cultural tradition that appears to be succumbing to the immense population pressure and the pressure to modernize their rural society.

3.3.4. Timber Harvesting

For centuries, pinabete timber has been highly valued for the multitude of uses mentioned before. Harvesting patterns have traditionally been selective in nature. When the human population was small relative to the large forested area, the occasional removal of the largest, straightest, and healthiest specimens created no real forest health problem. Conversely, today the pressure is much higher than before and the forested area is smaller and more fragmented. The reduced area of pinabete forests has created genetic islands of this tree species. Each day that a large, straight, healthy pinabete is harvested from the forest, that set of alleles for this desirable phenotype are also removed from the available genetic pool. This genetic bottleneck further accelerates species degradation, as the most viable and vigorous genes are culled from the gene pool. The continual high grading of these forests, coupled with the forests' reduction in size, results in pinabete stands characterized by ill-formed, slow growing, and unhealthy trees. Additionally, there is concern that the reduction in stand density associated with timber extraction may disturb the microclimate required for the natural regeneration of pinabete seedlings in small gaps in the forest understory.

3.3.5. Forest Fires

Due to the mountainous topography of the Guatemalan Highlands, forest fires present a serious forest management problem. For instance, a continuous unbroken slope may extend from 1,500 meters to well over 3,000 meters above sea level. The cultivation of corn occurs up to about 2,500 meters above sea level. Farmers will often use fire to clear their corn fields at the end of the dry season in preparation for the next year's planting. Often the case is that a fire created at the bottom of one slope will grow and quickly becomes out of control. These frequent occurrences are due to the lack of an adequate fire line, dry seasonal winds, low moisture content of the fuels, and the convective preheating associated with wildfires in steep mountainous topography. The end result is that by the time this fire climbs upslope to the forest boundary, it is a raging inferno that can quickly become a crown fire and destroy an entire forest in minutes. Forest fires are a problem throughout Guatemala, and present a particular problem for pinabete as the majority of the remaining forests occur in regions with steep topography and seasonal dry periods.

3.4. Policy

A variety of national and international institutions have established policies and programs which affect the conservation, cultivation, and commercialization of pinabete. Many of these programs are regional in nature, only existing in one specific portion of the country. The aim of this section is to provide an overview of the programs and institutions operating throughout the entire pinabete region of Guatemala. Descriptions of these institutions and their specific programs related to pinabete are provided below.

3.4.1. Guatemalan Forest Service

The National Forest Service (INAB) was created in December of 1996 with the passage of Legislative Decree 101-96 by the Guatemalan Congress. The act created a new national forestry law that formed and charged INAB with the chief administration of the public forestry sector in the country. The agency's mission is to promote technical assistance and dissemination of

information, and to facilitate the general cooperation among investors, municipalities, universities, foresters, and other actors within the forestry sector in order to generate greater economic, ecological, and social development within Guatemala. The agency's larger vision is to create a country that has protected natural areas, a sustainable forest products sector that creates employment in rural areas, productive agroforestry systems, and a Guatemalan society that benefits from the goods and services created by the forest sector (INAB 1996).

There are three specific articles within Forestry Law 101-96 that stipulate policy affecting the management of pinabete. Articles 34 and 99 prohibit the harvest of protected species, such as pinabete, and legally authorize INAB to sanction fines and imprisonment of the violator. Article 71 created a national forest incentive program aimed to increase the forest resource base, this incentive program is known as PINFOR (INAB 2004).

3.4.2. National Forest Incentive Program (PINFOR)

The objective of the PINFOR program is to maintain and improve sustainable forest production and increase the contribution from the forest sector to the national economy. The program seeks to increase the overall forest mass to a point at which forest volumes can sustainably supply a growing forest products industry. The program provides a cash payment incentive for the reforestation of currently open lands with a forestry vocation. PINFOR is funded by 1% of the country's annual budget. The program is scheduled to terminate 20 years after its inception ending in 2017.

PINFOR also has an incentive structure for the ongoing management of naturally forested areas. Within the broader goals of forest management and reforestation, a variety of incentive formats are available varying with species and the management objectives of the landowner. There are three specific incentive options related to the cultivation and management of pinabete under the PINFOR program: reforestation for long-term forest management, establishment of plantations with short rotations, and the establishment of forested areas for environmental services. These incentives follow the pay schedule described in Table 3.1, except that the incentives for establishment of plantations with short rotations are limited to just the first three payments. As the table indicates, both INAB and the local technical agency receive a percent of these incentives to cover administrative costs. INAB charges 9% of the total incentive and the local agency will typically charge an additional 9% to 12%. Public technical agencies (i.e., municipal forest offices) will tend to charge less than private agencies (i.e., local cooperatives). Table 3.1 is the administrative cost structure charged by the Municipal Forest Office of Concepción Huista in Huehuetenango. The income generated by PINFOR for these local agencies can become quite significant depending on the total area enrolled in PINFOR through that office and the age of their plantations. Typically, PINFOR is limited to projects no smaller than two hectares. However, this is total project size and a local agency may administer these two hectares as one project across some quantity of smaller parcels. These smaller parcels must be larger than five *cuerdas* in size, or approximately 1/5 of one hectare—which is about half the size of a football field.

Table 3.1. PINFOR payment schedule (*Source:* INAB 2005).

Year	Incentives per hectare	Administrative costs		Farmer receives
		INAB (9%)	Local agency (10%)	
0	645	58	64	522
1	271	24	27	219
2	232	21	23	188
3	181	16	18	146
4	168	15	17	136
5	103	9	10	84
Total	**1,599**	**144**	**160**	**1,295**

Pinabete plantations must be registered with INAB prior to any management activities. Any silvicultural treatments are considered illegal acts unless the plantation is registered with the forest agency, and upon registration these treatments must follow a formal forest management plan. Any discrepancies between on the ground activities and the management plan are also considered to be a violation of the law, possibly leading to fines and imprisonment of the violator. In addition to the required management plan, there are two specific requirements by INAB concerning the harvesting of pinabete from these plantations for Christmas trees. First, each tree to be harvested needs to receive a white plastic band, or *marchamo*. This band is placed on each individual tree by an INAB forest technician. Each band is coded with a unique serial number and contains the CONAP and INAB logos. The plantation owner must purchase the band from INAB and they cost roughly $0.85 each. The *marchamo* serves as a final branding mark for other authorities, middlemen, and the final consumer that this tree has been legally harvested from a registered pinabete plantation. Additionally, when transporting one or hundreds of these harvested trees, commercial shippers are required to have a shipping note, or *Nota de Envio*. This document serves as an indication to various authorities that the current shipment of the pinabete cargo has been authorized by INAB. This note costs approximately $0.65 per shipment regardless of the quantity of trees shipped.

3.4.3. Advisory Council of Protected Areas

The Guatemalan Advisory Council of Protected Areas (CONAP) was created in 1989 with the passage of Legislative Decree 04-89 by the Guatemalan Congress. This law created a National System of Protected Areas (SIGAP) and created and charged CONAP with the legal authority to manage these protected areas. Specifically, CONAP is responsible for defining national policy regarding conservation of national biodiversity. In addition to establishing national policy, CONAP is responsible for the administration of 88 protected areas within the SIGAP system. Because pinabete is considered an endangered species, CONAP is also responsible for the overall formulation and coordination of policies affecting the conservation and management of this species. In 1999, CONAP formed a Strategic Institutional Plan (*Plan Estratégico Institucional 1999-2001*) which outlined its various initiatives concerning the conservation of pinabete. This plan is comprised of and focuses on the following four key areas: the creation of new and strengthening of existing protected areas, increased policing, education and extension programs, and the promotion of authorized pinabete plantations (CONAP 1999).

First, CONAP seeks to strengthen management efforts within already declared SIGAP zones that contain pinabete forests, and create new SIGAP areas containing pinabete forests. The agency seeks to form technical groups which serve as extension agents that are to coordinate with local communities and authorities in effort to form a management plan for a community's pinabete forest. Second, the plan attempts to reduce the amount of branches illegally harvested during the Christmas season via the coordination with local agencies, the national police, and the Public Ministry. In concert, these authorities are to form a network to report and persecute illegal harvesting activities, and form a network of road inspection stations along the main highways between the pinabete regions and urban areas. These inspection points begin in late November and last through the Christmas season, consisting of both the national police and military. Buses and trucks are stopped at random posts along the highways during this period, and officials examine the cargo for illicit pinabete contraband. Third, CONAP focuses on information dissemination programs geared to educate the general public on the endangered status of pinabete and promote its conservation. This education effort largely consists of brochures, advertisements, and announcements using the printed news, television and radio mediums. Finally, the CONAP strategy aims to reduce the overall pressure on the remaining natural pinabete forests via the promotion of authorized and certified pinabete plantations (CONAP 1999).

3.4.4. Natural Resource Protection Service

As previously mentioned, the CONAP strategy entails the interinstitutional coordination with various state, municipal, and communal authorities. One such institution is the National Civilian Police (PNC) agency, and more specifically the Natural Resource Protection Service (SEPRONA) division within the PNC. The chief mission of the SEPRONA division is to enforce the various environmental laws established by CONAP and INAB. Typically the sanctions levied by CONAP and INAB via SEPRONA for violations concerning the illegal harvesting of pinabete range from 5 to 10 years imprisonment and fines of $3,700 for first time offenders (INAB 1996). Due to the organization's size, enforcement in rural areas is inconsistent. However, enforcement is much higher along the national highways where these products are transported. In effect, the enforcement activities target the larger traffickers rather than the poorer rural pinabete poachers. There is good reason for this approach as the more affluent traffickers are able to pay a higher fine than a rural subsistence farmer.

3.4.5. International Institutions

The Guatemalan Congress ratified the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1979 with the passage of Legislative Decree 63-79. Upon the initial ratification of this treaty, pinabete immediately became listed as a protected species in threat of extinction and international commercialization was banned. The CITES convention was initially formed on March 3, 1973, and "works by subjecting international trade in specimens of selected species to certain controls" (CITES 2004, Discover CITES). Pinabete is currently listed in Appendix I of the CITES convention, this appendix affords the greatest protection offered by this convention. CONAP is the national administrative authority for Guatemalan trade policy affected by the CITES Convention. Interestingly, the CITES convention only pertains to and prohibits the international trade of this species and does nothing

to prohibit, regulate or otherwise control intrastate commerce and there is no evidence that an international market for products derived from pinabete has ever existed.

3.5. The Pinabete Market

Although CITES prohibits international trade, an all too thriving domestic market exists for this species. In 1998, INAB conducted a study of the Christmas tree market in Guatemala City (INAB 1998). Although, this study is now outdated and of limited scope it is still the most recent study conducted analyzing the national Christmas tree market. The study found that pinabete dominates the Christmas tree market with 65% of consumers preferring this species to *Cupressus lusitanica* with only 15%, *Pinus sp*. at 12%, and other varieties at 8%. Survey respondents indicated they preferred this species due to the following desirable attributes, listed in decreasing order of importance: color, size, fragrance, form, and price. Fifty percent of respondents preferred a tree 1½ meters tall, 22% favored a tree 2 meters in height, with the remaining 28% divided between even taller trees (>2 meters) or very short trees (< 1 meter). In 1998, the capital area required 136,000 Christmas trees annually, 93% of this demand was satisfied domestically with 7% being satisfied via the importation of Christmas trees from the US and Canada.

The most disheartening statistic gleaned from the survey data is that only 26% of the pinabete trees sold are from plantations and labeled with the *marchamo*, the remaining 74% of the trees sold neither contained this label nor came from registered plantations. In fact, the market study revealed that 70% of the pinabete Christmas trees sold were not trees, but were actually constructed of a wooden post with pinabete branches wired together to resemble a Christmas tree. The branches used to construct the assembled trees were poached from the natural forest, smuggled into the capital, and then assembled and sold. Leading up to the Christmas season these illicit pinabete branches are in high demand, with each branch worth about $0.65 (Aguilar 2003). During the holiday period hundreds of trucks, each filled with approximately 30,000 branches each, race to the capital eluding authorities with each illicit load earning $2,600 in revenue (Aguilar 2003). This is particularly problematic as illegal activities in general increase in frequency leading up to Christmas Day as people look for ways to earn quick cash to purchase, or otherwise acquire, holiday gifts for their family. In 1996, Guatemalan authorities confiscated nearly 2.5 million pinabete branches. This contraband had an estimated street value of more than $112,000 (Aguilar 2003). This, of course, is only what authorities were able to stop in 1996, as the INAB market study revealed three years later in 1999, 70% of the Christmas trees sold were still constructed from these branches. The high prices paid for pinabete coupled with its strong illicit market have earned it the nickname *coca verde*, or green cocaine among producers.

3.6. Pinabete Regions

As discussed previously, the remaining forested pinabete regions of Guatemala have decreased significantly in size over the past one hundred years (CONAP/INAB 1999). The remaining forests tend to be in more remote areas with extreme topography. Of the original area covered by pinabete forests, much of the area is now cultivated by indigenous farmers. The marginalization of the indigenous population over the centuries coupled with exploding

population growth has forced them to clear the forest and cultivate these Highland areas. As pinabete often grows on the deepest and most fertile soils in these regions, these forests in particular were soon cleared to begin cultivation. It is in these zones where cultivation systems need to promote soil conservation, income generation, and crop diversification for these farmers and therein lies one opportunity for pinabete.

In addition to grazing, land use in these mountainous regions primarily consists of the cultivation of potatoes, fava beans, and wheat. The majority of the fava bean and potato production serves as a source of revenue for the farmer and are considered the main cash crops of the area. In previous years this was also true for wheat cultivation. However, more recently the national market has collapsed due to competition from international producers. Thus, the percent of farmers cultivating wheat have also diminished.

Potatoes are more extensively cultivated than fava, and are exported throughout Central America. Farmers often refer to the potato harvest as the *lotería*, or lottery, because of the extremely high variability of market prices at harvest time. In fact, there are many years that potato farmers do not harvest their crop because the market price is so low. Based on *in situ* interviews conducted in the village of Onlaj in Hueheutenango, during the 2003 potato harvest, farmers in this village were only able to sell their crop at $1.50 per 100 pound sack. However, one year later the same farmers were receiving approximately $13.00 per 100 pound sack. MAGA estimates the production cost of cultivating one hectare of potatoes at approximately $3,398 per year (Rivera 2002). The actual costs will vary greatly among different producers, as costs of various inputs (i.e., fertilizers, labor, seed) vary regionally. One hectare of land can produce approximately 452 100 pound sacks, depending on site quality, seasonal factors, and seed source. Table 3.2 reveals how the financial returns of potato cultivation can vary from boom to bust from one year to the next.

Table 3.2. Cultivation of potatoes: Costs and revenues of one hectare.

Year	Production costs	Harvest (100 lb. sacks)	Market price (100 lb. sacks)	Net yearly balance	Internal rate of return
2003	3,398	452	1.50	(2,720)	- 80 %
2004	3,398	452	13.00	2,478	73 %

It should be noted that farmers within cooperatives tend to be more buffered from this high market volatility, as the larger cooperatives have more established access to regional buyers and to the export market. Independent farmers are exposed to the lower market prices experienced during years of over production, and they are dependent exclusively on the prices offered by middlemen who will transport their crop to the markets in the larger cities. Interestingly, a specific farmer's willingness to participate within the structure of a cooperative differs dramatically across regions and among different indigenous cultures.

CHAPTER 4. METHODOLOGY

4.1. Pinabete Options Available to Farmers

A variety of management options exist for farmers that wish to cultivate pinabete on their land. These management objectives range from the establishment of pure Christmas tree plantations, to agroforestry systems, and go on to include the establishment of pinabete stands for the creation of old growth forest for conservation purposes. Due to the creativity of farmers, many more options exist and each adopted method should portray the farmers' willingness to accept risk and management objectives. For comparison purposes the analysis will be performed on the following three cultivation systems: Christmas tree plantation, agroforestry system and reforestation. The management details for each of the three systems are described later in this chapter.

4.2. Scope of Analysis

It is worth clarifying that this analysis is purely a financial analysis. As such, the cash flow schedules only reflect the costs and benefits of the project from the investor's perspective, namely the farmer. Thus, only goods that the farmer can directly bring to a market are assigned a cash value. This paper attempts to illustrate some of the nonmarket values generated by the cultivation of pinabete (i.e., species conservation, watershed protection, carbon sequestration). However, the financial analysis itself does not incorporate the value generated by any of these ecosystem services as would an economic analysis. Additionally, this analysis makes no effort to analyze the economic impact within a given community due to the generation of employment, value-added processing, or other sources of revenue generated offsite as a result of the project. Simply, this analysis only examines the cash flows between the market, farmer, and field.

4.3. Data Collection

The data used to conduct these series of financial analyses were gathered from a wide variety of sources. Data collection initially began in October of 2003, and consisted of informal interviews with INAB foresters and technicians, field visits with pinabete farmers, and the scouring of various agency and organizational libraries for copies of written reports and research documents that have been conducted regarding pinabete. These actions occurred in coordination with visits to the Pinabete Group (PROFOR) of INAB located in Totonicapan; interviews with members of the Pinabete Growers Association of Guatemala in the departments of San Marcos and Quetzaltenango; and visits to offices of various NGOs and cooperatives involved with pinabete in the departments of Quetzaltenango and Huehuetenango. Interviews were videotaped to accurately record the information collected. Subsequently, these interviews have been edited and an informational video produced which currently serves as an educational tool in many municipal forestry offices.

More often than not many differing values were obtained during the data acquisition and interview process. These occurrences can be expected due to the wide geographic area that the data was collected from, and the high socioeconomic and market variability across these geographic regions. As mentioned below, the bias of the data used in this financial analysis is toward an overestimate of costs and an underestimate of revenues. As with any *ex-ante* financial

analysis, this analysis is merely an estimation of future market conditions and surely will not be exact. However, the underlying goal is that when the information in this document is applied in the real world these calculated estimates tend to err on the conservative side. Table 4.1 provides a description of the various project inputs and outputs used in each cultivation system. Table 4.2 compliments the previous table as it provides information regarding the specific source of the information along with the unitary price used in the financial calculations.

4.4. General Assumptions

Assumptions are a necessary part of any *ex-ante* financial analysis because this requires the analyst to estimate specific events and market conditions of some future date. This financial analysis will assume the following conditions:

Land and Taxes

The analysis will assume that the farmer currently holds a clear title to the land and that the parcel is farm land currently in fallow with no forest cover. The tax system in Guatemala is quite complex and its very structure and function have evolved considerably since the 1996 Peace Accords. Currently, a 10% tax is paid when the land is initially purchased with no annual property taxation effectively levied thereafter on parcels without structures. As such, property taxes will be ignored for this analysis as the farmer already owns this parcel of land and there are no physical structures on the property. Additionally, all unit values used in this analysis are real market prices that include the national sales tax when appropriate.

Inflation and Prices

The analysis is performed using real interest rates, but these rates do not take into account the anticipated rates of inflation. Also, the analysis assumes there are no real changes in prices as it is anticipated that prices will keep pace with inflation. Furthermore, the basis of this analysis is conducted on one hectare of land and will ignore the various economies of scale that may exist for larger producers. Additionally, all monetary values are expressed in US dollars and have been converted using an exchange rate of 7.75 Quetzales to 1.00 US dollars.

Site Index

Rotation lengths have been determined from information gained from interviews conducted with various pinabete growers. The range of site indices, soil types, qualities of seed stock, and management intensities found among the interviewed farmers is quite disparate. The rotation lengths and yield information described in the analyzed scenarios are generic versions of the empirical information that was acquired in the field.

Table 4.1: Description of Project Inputs & Outputs

Item	Unit	Description
INPUTS		
Seedlings	1 seedling	Material cost of 2-0 seedling stock purchased from local nursery
Transportation	1 seedling	Transportation cost of one seedling from a local tree nursery to the plantation site
Establishment	1 seedling	Labor costs associated with: •Offloading of seedling from the truck •Conducting plantation layout •Removal of competing vegetation •Distribution of seedling in the plantation •Planting of seedling
Management	1 tree	Cost of labor associated with manual removal of competing vegetation
Shearing	1 tree	Cost of labor associated with annual shearing and pruning of Christmas trees
Fireline Construction	1 hectare	Cost of labor to clear a three meter fireline along the perimeter of the plantation
Maintenance of Fireline	1 hectare	Annual cost of labor to maintain fireline denude of vegetation and other fuel sources
Seed Collection	1 tree	Labor cost associated with collecting seed from one mature tree
Marchamo	1 plastic band	Cost associated with the banding of harvested Christmas trees by INAB technician
Nota de Envío	1 shipping note	Cost associated with purchasing required INAB authorization to ship harvested tree
OUTPUTS		
Christmas Tree	1 tree	Value of one harvested Christmas tree sold to a wholesaler
Harvested Seed	0.375 kg	Average amount of seed harvested from one pinabete tree

Table 4.2: Prices Used to Determine Project Cash Flows & Source of Information

Item	Unit	Value	Primary Information Source	
			Name	Description of Source
INPUTS				
Seedlings	1 seedling	1.94	G.E. Jimenez, 2002	Thesis Study, ESTEFFOR
Transportation	1 seedling	0.02	Ing. Juan Mendoza, 2003	Forester, Asociación de Organizaciones de Los Cuchumatanes (ASOCUCH)
Establishment	1 seedling	0.20	Ing. Juan Mendoza, 2003	Forester, Asociación de Organizaciones de Los Cuchumatanes (ASOCUCH)
			Castillo et al., 1997	Thesis Study, Universidad Rural de Guatemala
Management	1 tree	0.15	Ing. Juan Mendoza, 2003	Forester, Asociación de Organizaciones de Los Cuchumatanes (ASOCUCH)
			Castillo et al., 1997	Thesis Study, Universidad Rural de Guatemala
Shearing Years 3, 4 & 5	1 tree	0.03	Leuschner & Sellers, 1975	Division of Forestry, Virginia Polytechnic Institute
			Castillo et al., 1997	Thesis Study, Universidad Rural de Guatemala
Shearing Years 6 & 7	1 tree	0.04	Leuschner & Sellers, 1975	Division of Forestry, Virginia Polytechnic Institute
			Castillo et al., 1997	Thesis Study, Universidad Rural de Guatemala
Fireline Construction	1 hectare	19.35	Ing. Juan Mendoza, 2003	Forester, Asociación de Organizaciones de Los Cuchumatanes (ASOCUCH)
Maintenance of Fireline	1 hectare	16.12		
Seed Collection	1 tree	12.90	Don Belizario Ixlaj	Entrepreneur and Private Cultivator of Pinabete
Marchamo	1 plastic band	0.84	Ing. Mario Velásquez Ing. Armindo Tomas	Chief Foresters of the Pinabete Group, PROFOR-INAB
Nota de Envío	1 shipping note	0.65		
OUTPUTS				
Christmas Tree Harvested Year 6	1 tree	22.57	Don Belizario Ixlaj	Entrepreneur and Private Cultivator of Pinabete
Christmas Tree Harvested Year 7	1 tree	29.02	Don Urbano López	Entrepreneur and Private Cultivator of Pinabete
Christmas Tree Harvested Year 8	1 tree	34.47	Don Carlos Rudi	Entrepreneur and Private Cultivator of Pinabete
Processed Seed Harvested from 1 Tree	0.375 kg	35.51	ECODESA	Natural Resource Management NGO and Commercial Seed Bank
			BANSEFOR	Public Seed Bank Administered by INAB
			INAB, 2001	Conducted study analyzing the characteristics of a principle forest used as a seed source for pinabete.
PINFOR INCENTIVES				
Establishment	1 hectare	522.32	INAB, 2005	Public Agency Responsible for Overseeing the Pay Schedule of PINFOR
Year 1	1 hectare	219.37		
Year 2	1 hectare	188.04		
Year 3	1 hectare	146.25		
Year 4	1 hectare	135.80		
Year 5	1 hectare	83.57		

4.5. Cost of Capital

Farmers interested in pinabete cultivation come from a wide variety of socioeconomic backgrounds. Nowhere is this variety more revealed than in the membership of the National Pinabete Growers Association. The membership of this association consists of business owners with large tracts of land comprising hundreds of hectares, or *fincas*, to smaller near subsistence farmers with parcels of less than one hectare. As can be imagined, these farmers have differing expectations as to what they consider a financially lucrative investment. Basically, this translates to each farmer having their own alternative rate of return (ARR), or second-best investment option. For any of the pinabete management systems analyzed in this paper to be a suitable choice for any given farmer, the financial return needs to surpass that farmer's ARR. Varying capital constraints, investment horizons, market knowledge, and tolerances of risk are factors which determine the ARR available to any specific investor.

However, in the context of this analysis one key constraint for subsistence farmers is their limited access to capital. In 2003, a World Bank study concluded that the majority of the loans received by rural Guatemalans were from informal lenders (Vakis 2003). These informal lenders tend to be extended family members or local businessmen and the interest rates on these loans vary widely depending on the relationship with the borrower and the form of collateral offered. As illustrated in Table 2.3, the majority of rural Guatemalans lack a title to their land and with it adequate collateral to negotiate favorable terms for a loan.

The three cultivation options analyzed in this paper have been calculated using a 25% discount rate. However, due to the high variance of the cost of capital available to different borrowers and the risks associated with pinabete production, a wider range of discount rates are included in the sensitivity analysis. These rates were selected based on the ranges of discount rates used in similar natural resource and agricultural projects within Guatemala (Current et al. 1995). A lower rate of 15% was incorporated to reflect possible financing by various nongovernmental organizations that offer subsidized loans for natural resource projects managed by marginalized groups.

4.6. Descriptions of Cultivation Systems Analyzed

4.6.1. Christmas Tree plantation

The rough topography and lack of mechanization in these regions enables a wide range of planting patterns. A hexagonal planting pattern is ideal as it both optimizes land area and promotes a more symmetrical foliage growth pattern. However, this scheme tends to be more difficult for farmers to implement in their field during the initial planting, as undulations in the terrain can make it difficult for the farmer to maintain uniform spacing and cause the entire layout to become askew. Thus, a more simplified planting layout using staggered rows is recommended. This arrangement tends to be easier to manage in the field with inexperienced planters and also promotes symmetrical growth of the foliage. However, this method does not as efficiently optimize the total land area.

Seedlings will be planted in parallel rows with each seedling opposite the middle of the gaps between the seedlings from the neighboring row. Seedlings will be spaced at two meters along each row, and the distance between each row will also be two meters (Barnes et al. 1998). The staggering of rows in this manner also serves to prevent the formation of gullies in steep terrain. Using this spatial arrangement the planting of one hectare will require 2,500 seedlings.

The prolonged droughts, severe frosts, and frequent fires experienced in these regions complicate the estimation of one year survival rates. Two factors that greatly influence survival rates are slightly more manageable. These are the technical skill of the planter and the quality of the seedling stock used. Experienced planters claim 90% one-year survival rates, however, we will assume an 85% first year survival rate (*In situ* interviews, 2003). Thus, the second year will require the replanting of 375 seedlings, or 15% of the plantation. Management activities largely consist of site preparation, planting, shearing, and fire prevention activities. Additionally, it is assumed that 10% of the trees in the plantation will not posses the required form and symmetry desired by the market and will be calculated as a loss at harvest end. The plantation will be planted using 2-0 seedling stock purchased from local tree nurseries.

The assumptions indicated above will be used to conduct a financial analysis of the costs and returns produced over one rotation. One third of the plantation will be harvested when the plantation reaches five years of age, another at six years, and the final harvest will occur at seven years.

Beginning in year five, the landowner must decide whether to replace the harvested trees. To incorporate this reinvestment option into the financial analysis, three different scenarios will be examined. The first two scenarios will examine the returns without reinvestment, or without replacement of the harvested trees. These two scenarios will examine this management system with and without the use of the PINFOR incentives. The third scenario will use both the PINFOR incentives and replace the harvested trees in years five, six, and seven. The establishment costs from these replaced trees are included in the analysis, however, the revenues that they will generate are not included. Also, PINFOR will only be included in the first rotation as no parcel may receive these incentives more than once. This last scenario portrays the potential permanent nature of this management option as its budget incorporates the costs for reestablishment of the plantation for the subsequent harvest.

Interestingly, many pinabete farmers use a silvicultural treatment termed *manejo por tocones*, or management by trunks. Users of this technique harvest the tree above the first whorl of branches, intentionally leaving the bottom branches intact. The harvested top is sold, and the branches atop the residual stump are staked upward. This treatment captures the inherent trait of lateral branches of the *Abies* genus to reestablish apical dominance. Gradually, a second tree crop is formed from the first planting. Often two stems are cultivated atop a common stump, and can be formed to be "flat sided" or to become fairly symmetrical depending on the staking technique used and the objectives of the farmer.

Surprisingly, the harvested flat sided Christmas trees seem to be finding a niche market for city dwellers living in small houses or apartments. The use of this technique greatly maximizes revenue as more than one rotation is harvested by one plant.

Additionally, the growth rates experienced between the first harvest and the following harvests are dramatically higher as the rooting system is already well established, and all growth is then concentrated in the canopy. Plants managed under this modified coppice treatment usually are replaced after three or four harvests due to the aging plants' decline in vigor. Typically farmers will selectively apply this treatment, and not manage an entire plantation in this form. Rather, farmers select individual trees based on the aptitude of a specific tree to be manipulated using this treatment. As such, this analysis assumes that each plant yields one harvested Christmas tree and is then replanted by traditional means.

Figure 4.1 illustrates the timeline for the Christmas tree plantation scenario. Appendices A through C include the cash flow tables for the scenarios analyzed in this cultivation option.

4.6.2. Agroforestry System

The agroforestry system will enable the integrated cultivation of annual crops and Christmas tree cultivation. As with most agroforestry systems a wide range of spatial arrangements and crop combinations are available to the farmer. For this analysis we will once again use the staggered row planting pattern, however, the distance between rows will be increased to facilitate the cultivation of the annual crops. As such, seedlings will be spaced at two meters along each row, and the distance between each row will measure three meters. Using this spatial arrangement the initial planting of one hectare will require 1,666 seedlings. Management of the pinabete trees will parallel that of the previous scenario, the only differences being the planting pattern and density.

As previously mentioned, the crop options in these regions are fairly limited due to climatic conditions. However, the analysis will only incorporate the stream of revenue associated with pinabete production, and will disregard any income or costs associated with the annual crops. This myopic analysis will be done for the following reasons:

1. Remove the high volatility of harvest prices from the analysis
2. Enable the application of the results to purely subsistence farmers
3. Convey a more conservative estimate of the generated revenues

As in the Christmas tree plantation option described above, beginning in year five the landowner must decide whether replace the harvested trees. This reinvestment option, along with the use of the PINFOR incentives, is analyzed across the same three scenarios outlined above, which are:

1. Agroforestry System
2. Agroforestry System with PINFOR
3. Agroforestry System with PINFOR and reinvestment

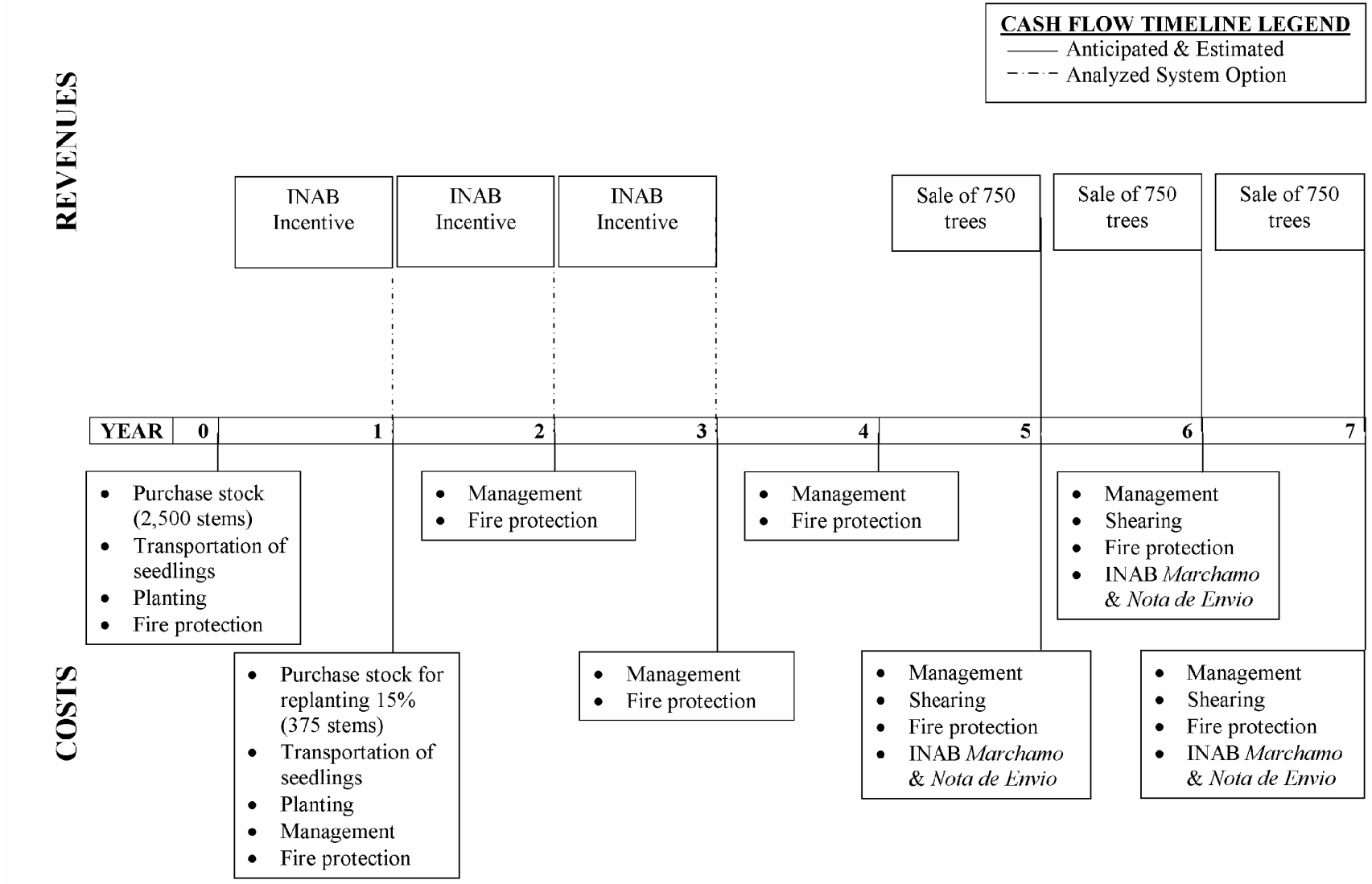

Figure 4.1 Timeline for the Christmas Tree Plantation

Although the financial aspects associated with the annual crops have been disregarded in the analysis, a brief discussion of the opportunity costs associated with this system is merited. First, space allocated to the cultivation of pinabete reduces the land area which can be cultivated on an annual basis. For example, if the farmer is planning to market Christmas trees that are an average of 2¼ meters in height, the width of the row will be approximately 1½ meters allowing for the desired taper of the Christmas tree. Using this management objective with the two-by-three-meter staggered spacing arrangement, will result in the formation of 33 strips 1½ meters wide by 100 meters long. In total 5,000 square meters of the hectare will be allocated to the production of pinabete, half of the annual cultivable land area will be lost. However, this allocation of area is a condition that is grown into as it occurs gradually. During the years immediately following the establishment of the plantation the percentage of the area used by the pinabete trees is actually much lower because the trees are smaller at this stage and occupy less area. Additionally, these calculated areas assume that no crops are planted within each of these strips. This last point may be an unnecessary condition because even when the trees achieve their desired heights, approximately ¾ of a square meter of cultivable land remains available between each tree along each strip. Certain types of annual crops may be suitable for planting in the areas along the strips and in between the pinabete trees.

In addition to the spatial opportunity cost of this agroforestry system, there is also an opportunity cost associated with the cropping options available to the farmer. This is the case with respect to wheat and potato cultivation. Intercropping with wheat is problematic because burning is the cultural practice of choice for land site preparation and is performed on a yearly basis. As such, it is not recommended that wheat be used in conjunction with pinabete cultivation as great losses due to fires can be expected. Intercropping with potatoes can be done, however, damage to the roots of the pinabete trees can occur if great care is not exercised. Potato cultivation is possible within the alleys of the agroforestry system if a buffer is maintained between the plowed soil and the rooting zone of the pinabetes. Immediately following establishment of the plantation potatoes can be cultivated with minimal risk to the pinabete roots, however, as the trees develop and their roots grow this becomes increasingly difficult.

In spite of these limitations some crop combinations yield a mutually beneficial relationship to the agroforestry system, and tend to maximize overall production of the system. One such example is the cultivation of the fava bean (*Vicia fava*), within the plantation. Fava beans have a long history of cultivation in the Highlands of Guatemala, and there has historically been a strong regional and national market for this crop. The incorporation of fava beans within the agroforestry system serves two distinct purposes. First, the incorporation of this cash crop presumably strengthens the financial returns to the system. Second, the *Vicia* genus forms a symbiotic association with the nitrogen fixing bacteria *Rhizobium leguminosarum*. The *Rhizobium* bacteria is able to convert nitrogen gas from the atmosphere into a biologically available oxidized form of nitrogen, in this now reduced form it becomes readily available to the plant and stimulates growth (Kimmins 1997). Silim and Saxena (1992) estimate the rates of nitrogen fixation via this association between *Vicia* and *Rhizobium* to be greater than 120 kg per hectare (Bellow 2004). Thus, the fava bean can be managed as both an annual cash crop and as a green manure to promote more rapid growth of the pinabete trees. However, research should be

done to determine if the incorporation of fava could serve as a secondary host for aphids within the pinabete plantation.

Additionally, many farmers encircle their parcels of land with trees. Often this is initially done to delimit the boundaries of their land. However, a more productive agroforestry system can be achieved through the incorporation and adaptation of this cultural practice. For instance, the boundaries of an agroforestry system with pinabete, fava and potato can be encircled with *Alnus sp.* and *Pinus sp.* along the perimeter of the parcel. The *Alnus sp.* is a quick growing tree which is used extensively for fuelwood production. Additionally, this genus is a prolific stump-sprouter and can be coppiced for the rapid production of fuelwood. As a secondary benefit this genus also forms a symbiotic nitrogen fixing association with bacteria of the *Frankia* genus, an association which promotes more rapid growth for the *Alnus sp.* tree and increases local availability of biologically available nitrogen within the entire agroforestry system. Trees of the *Pinus* genus can also be planted along the perimeter of the parcel. Ideally, the *Alnus sp.* is planted at one or two meters distance as a curtain running along the perimeter, and the *Pinus* sp. is planted every 15 or 20 meters along this same perimeter. Managing the *Alnus sp.* as a coppice crop will aim to keep the overall height of the trees fairly short and limit the amount of shade cast upon the encircled pinabete agroforestry system. However, the pines can be managed for lumber and needle production, and grown to much taller heights. Interestingly, there is a strong year- round market for green pine needles, which are used for a variety of celebrations. As such, the live crown ratio of these pines can be expected to be very low and with it very little shading of the crops below will occur as a result of the planting of these pines. In addition to the production of fuelwood, lumber, increased nitrogen availability, and pine needles, this system will serve as a windbreak and frost break for the encircled crops. Last, the fallen leaves of *Alnus sp.* and *Pinus sp.* produce an excellent type of organic matter called *broza*, which is highly sought after and is used extensively in the cultivation of potatoes.

Figure 4.2 illustrates the timeline for the agroforestry system scenario. Appendices D through F include the cash flow tables for the scenarios analyzed in this cultivation option.

4.6.3. Reforestation

Due to the endangered status of pinabete many organizations are promoting the reforestation of areas with this species. These programs have generated a great deal of interest among farmers. Many planting options exist for farmers interested in reforesting areas for long-term forest management. In this scenario, the plantation will be established by planting the seedlings 2½ meters apart with 2½ meters distance between each staggered row requiring 1,600 seedlings per hectare. In order to maximize revenue, the majority of the trees will be cultivated as Christmas trees with the final harvest occurring in the seventh year of the plantation. The residual trees will be managed to form a permanent forest cover for long-term species conservation. Between establishment and the seventh year the management activities will parallel those of the Christmas tree plantation, as previously described. In plantation years five through seven, the harvested Christmas trees will occur uniformly and systematically throughout the plantation. These

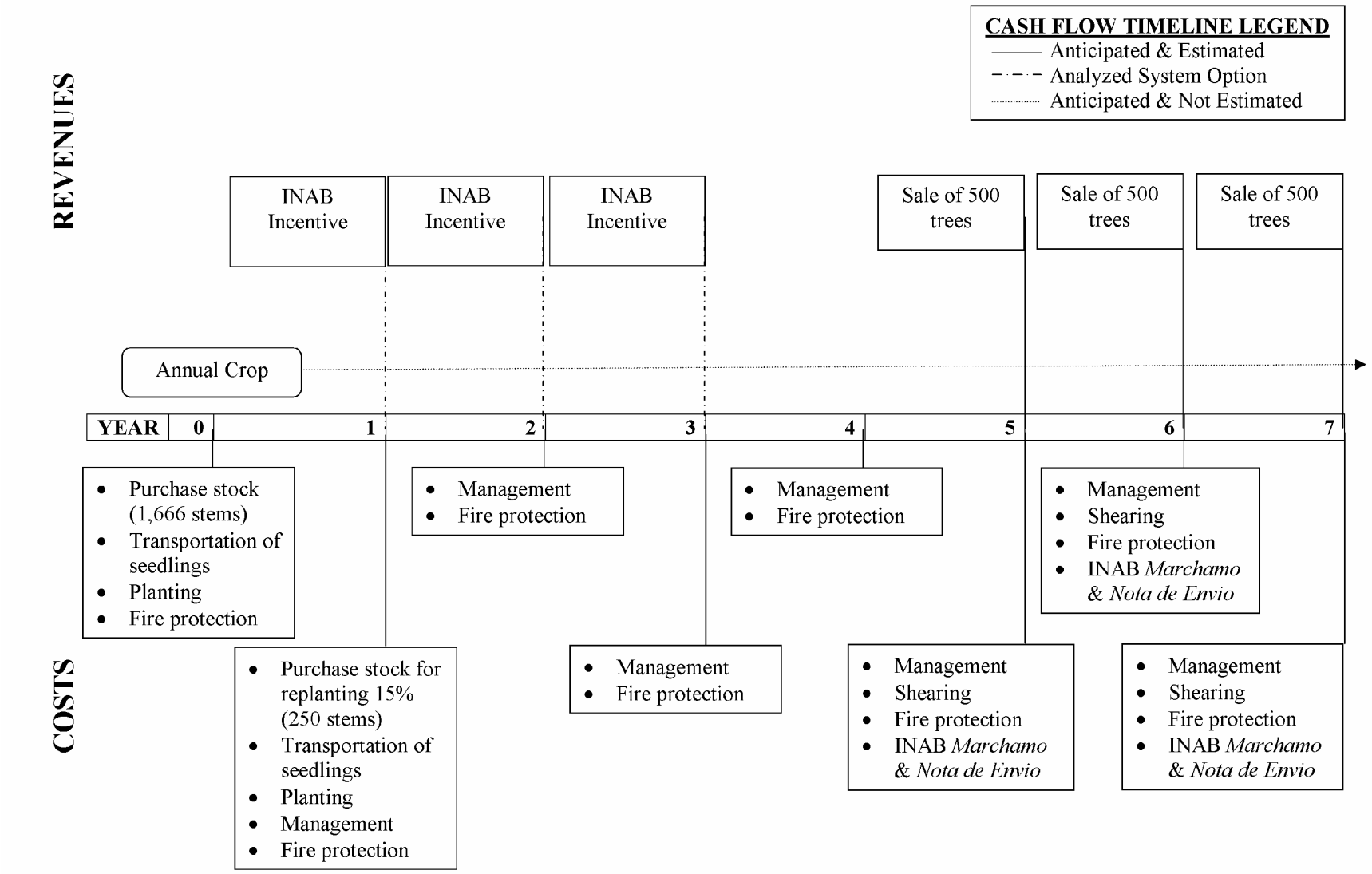

Figure 4.2 Timeline for the Agroforestry System

harvests will collectively serve as a thinning for the residual stand resulting in an interim stocking density of approximately 355 stems per hectare at year eight. Although, the primary goal is species conservation, good forest management will entail subsequent thinnings as needed throughout the life of the plantation. These treatments will vary dramatically from one site to another, however, the analysis will assume that there are approximately 150 stems per hectare by year 50. The forest will be certified for seed production by INAB. The primary goal of the silvicultural treatments will be to maintain the genetic integrity of the seed being produced within the plantation by removing diseased, suppressed, or poorly formed trees from the stand. Seed collection will begin in year 30 and will occur on a biennial basis. The collected certified seed will be sold to the various forest seed banks, forestry organizations, and private citizens throughout the country. The management of the residual stand will primarily consist of fire and disease protection. Management activities related to species conservation and seed production will begin in year 12, and will be performed every six years coinciding with every third seed collection year. As with the other two systems, this reforestation option will be analyzed with and without the PINFOR incentives. Figures 4.3 and 4.4 illustrate the timeline for the Reforestation scenario. Appendices G through L include the cash flow tables for the scenarios analyzed in this cultivation option.

4.7. Measures of Financial Efficiency

For a given project to be considered financially efficient the project needs to generate the maximum value possible with the resources available. Furthermore, a project must satisfy three criteria in order to be deemed an efficient use of the available resources. These criteria are:

1. The discounted value of aggregate benefits must be greater than the discounted value of the aggregate costs (Gregersen and Contreras 1992)
2. The project must generate a rate of return greater than similar alternative investment options available to the investor
3. The project must produce the maximum amount of benefit per unit of cost

To determine the financial efficiency for each of the three cultivation systems previously described in this paper, this analysis will use the following financial criteria: Net Present Value, Soil Expectation Value, Equal Annual Equivalent, Internal Rate of Return, Benefit Cost Ratio, and Payback Period. While no one criterion alone can adequately serve as an indicator of overall efficiency, in concert these criteria enable an investor to compare and quantitatively rank the financial efficiency of each alternative. The formula, benefits and limitations of each financial criterion are presented below.

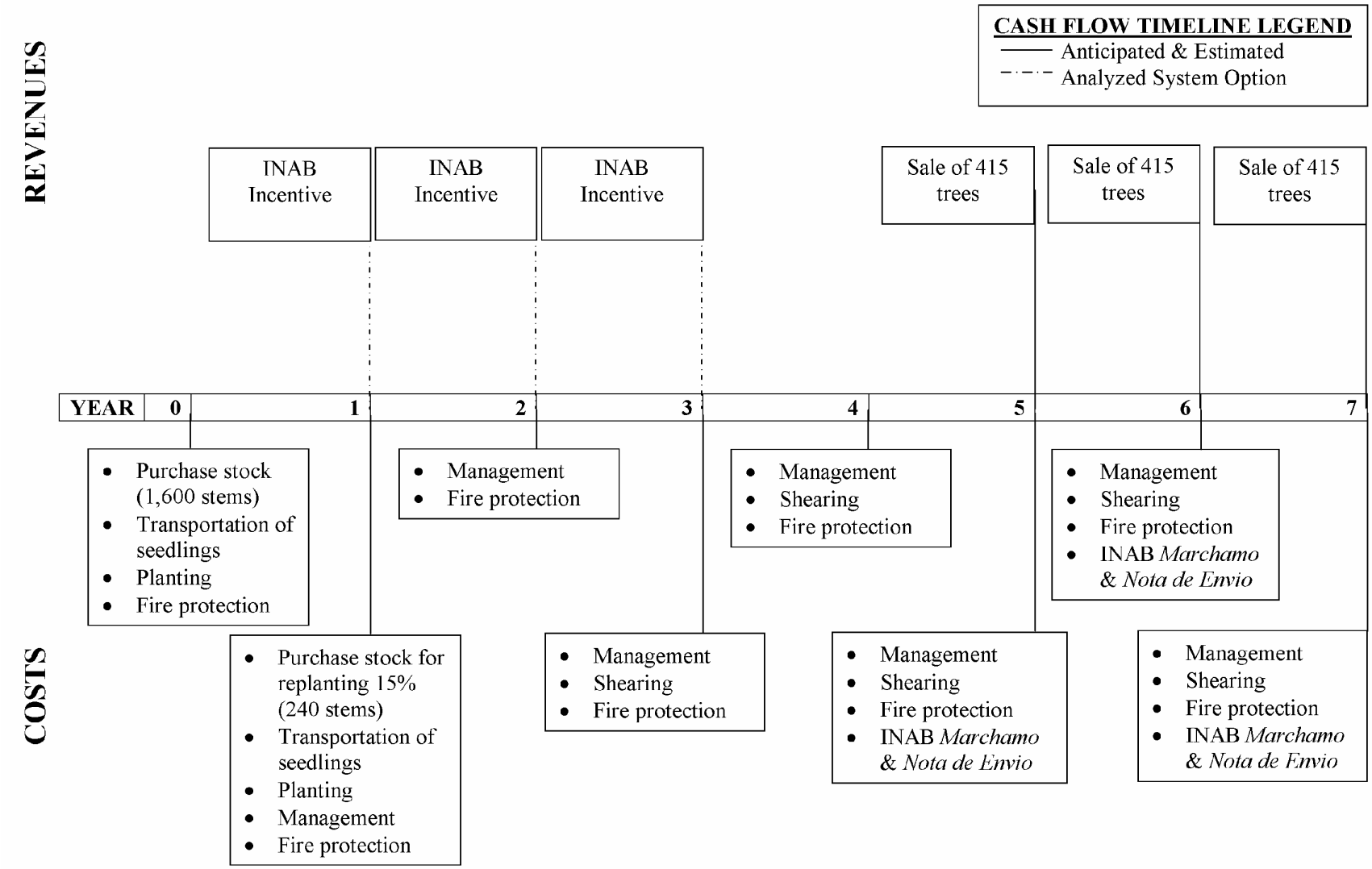

Figure 4.3 Timeline for the Reforestation Project – *Establishment through Year Seven (Part I of II)*

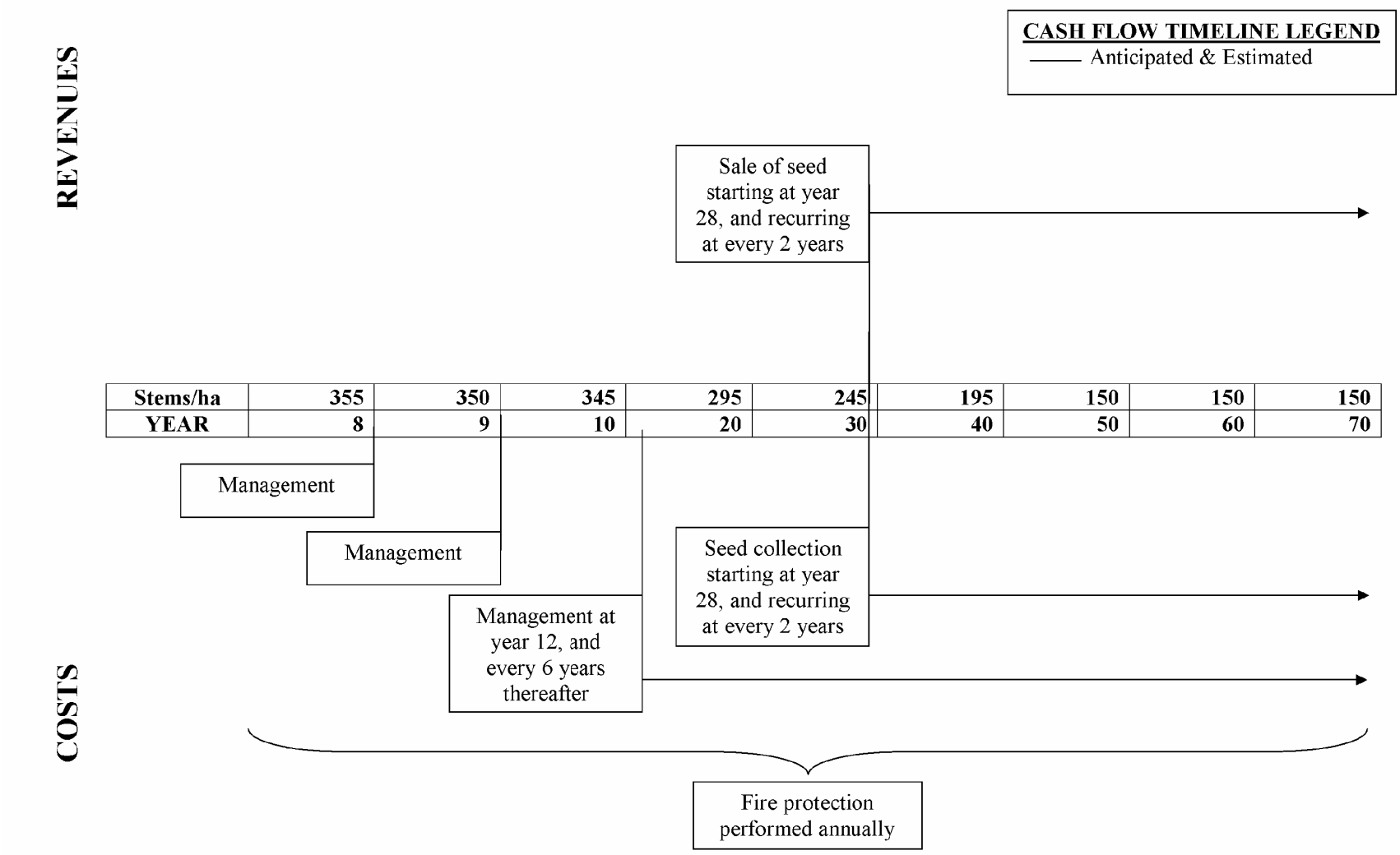

Figure 4.4. Timeline for the Reforestation Project – *Years Seven through Seventy (Part II of II)*

4.7.1. Net Present Value

$$NPV = \sum_{t=0}^{n} NR_t \; / \; (1 + i)^t$$

Definition
Net Present Value (NPV) is defined as the sum of the discounted net revenues over the planning periods, where (Davis et al. 2001):

Rt = revenue in period *t*
Ct = cost in period *t*
NRt = *Rt – Ct*
i = discount rate
n = number of planning periods
t = year of transaction

Benefits of Net Present Value
There are four main benefits to using NPV as a measure of financial efficiency. First, this technique incorporates the expected cash flow for the entire lifecycle of the project. Second, this cash flow is adequately discounted to the present in order to reflect the time value of money (Ross et al. 2002). Third, variables such as risk and opportunity cost can be incorporated into the selected discount rate and the impacts of these factors reflected in the NPV calculated for the project (Odellion Research 2005). Finally, because NPV is a measure of the overall value of an investment, it is an effective criterion for investors to use when comparing among different investment alternatives.

Limitations of Net Present Value
Of course NPV has certain limitations as well, most problematic of which is the selection of the discount rate. Also, NPV itself reveals nothing of the specific timing of the cash flows nor of the total investment period required to achieve the calculated value. Finally, a project with the highest NPV is not always a feasible investment option due to capital constraints (Odellion Research 2005).

4.7.2. Soil Expectation Value

$$SEV = NPV ((1 + i)^t / (1 + i)^t - 1)$$

Definition
The Soil Expectation Value (SEV) is the present value of the discounted net revenues generated from perpetually cultivating a parcel of currently bare land under a specific management prescription (Davis et al. 2001).

Benefits of Soil Expectation Value
The SEV is similar in nature to the NPV and shares many of the same benefits. However, there are two benefits that are unique to the SEV. First, the SEV is an effective way of normalizing projects of different project lengths as SEV determines a given project's present value for an infinite series of rotations. Thus, SEV can be used as a common denominator when analyzing mutually exclusive projects with different time lengths because all projects share the common project horizon of infinity. Second, SEV is an effective means of determining the maximum price a buyer should be willing to pay for a parcel of land with no forest inventory.

Limitations of Soil Expectation Value
Owing to the similarity of SEV with NPV, many of its limitations parallel those of NPV. There are two unique disadvantages which are inherent to the SEV approach. First, SEV assumes that all rotations on a parcel of land will be managed identically to the first rotation. This assumption facilitates the calculation of SEV but will seldom jibe with real world events. Second, SEV assumes that the same investment options that are available today will be available indefinitely. Again, this assumption will not always be true especially when considering how market prices and preferences change overlong periods of time.

4.7.3. Equal Annual Equivalent

$$EAE = NPA\ (i\ (1 + i)^t / (1 + i)^t$$

Definition
The Equal Annual Equivalent (EAE) is the discounted present value of a particular project expressed as the annual value paid each year throughout the life of the project. In effect, the EAE is a manipulation of the project's NPV expressed as an annuity (University of Florida 2005).

Benefits of Equal Annual Equivalent
There is one main benefit to incorporating the EAE in a financial analysis and this occurs when the schedule of benefits varies among the different investment alternatives. For example, suppose a farmer was considering converting production from an annual crop to a forest plantation. This farmer could use the EAE as an annualized measure of these two investment alternatives that each have an otherwise distinct series of cash flows and rotation lengths.

Limitations of Equal Annual Equivalent
There of course is also one drawback to the EAE approach. The limitation of the EAE is the fact that it does not accurately reflect the reality of the investment's timeline. The actual payout of benefits are unique to each project and occur at distinct intervals. The timing of an investor's returns are determined by the project's cash flow schedule not the EAE. Thus, the real downside to EAE is that it risks not being interpreted correctly.

4.7.4. Internal Rate of Return

$$\sum_{t=1}^{n} R_t / (1+i)^t = \sum_{t=1}^{n} C_t / (1+i)^t$$

Definition

The Internal Rate of Return (IRR) is defined as that rate of interest which discounts the flow over time of net revenue generated by an investment such that the present value of the net revenue flow is equal to the capital sum invested, or break even point. IRR is the discount rate at which the NPV is equal to zero (Bannock et al. 2003).

Benefits of Internal Rate of Return

There are three main benefits to using IRR as a measure of a project's financial efficiency. First, calculation of the IRR does not require an analyst to select a discount rate for the project. Second, IRR serves as a "relative measure of project worth, which gives information on the returns per unit of cost and thus provides more relevant information for comparing the benefits which can be expected from alternative uses of a limited budget" (Gregersen and Contreras 1992, p. 110). Thus, an analyst can simply compare the IRR to the ARR, and if the former is greater than the latter the analyst can assume that this particular investment is a wise use of capital. Finally, the IRR is often used for purposes of convenience as this intuitive unitless measurement can easily be understood by decision makers outside of the financial arena.

Limitations of Internal Rate of Return

There are four main limitations to the IRR method. First, a project with the highest IRR will not necessarily be the project that produces the highest NPV. Thus, analysts must use careful consideration with their treatment of IRR when ranking mutually exclusive projects as IRR alone is not indicative of the magnitude of the return. Second, multiple rates of return will be calculated for projects that require investments beyond the first cash outflow. In cases of multiple cash flows use of the IRR is often difficult as there often is no way to effectively discern which rate is the true measure of the total project's IRR. Third, the IRR alone has no real meaning unless compared with some other guiding rate. In effect, a discount rate is needed when using IRR, not for calculating the rate itself but rather for correctly interpreting and measuring the result (Ross et al. 2002). Finally, the IRR must be normalized for its proper comparison between projects of different size.

4.7.5. Benefit to Cost Ratio

$$\frac{B}{C} = \frac{\sum_{t=1}^{n} C_t / (1+i)^t}{\sum_{t=1}^{n} R_t / (1+i)^t}$$

Definition
The Benefit to Cost Ratio (BCR) is calculated by dividing the sum of the discounted revenue by the sum of the discounted costs. This ratio serves to denote the total discounted revenue per unit of discounted cost (Rideout and Hesseln 2001).

Benefits of Benefit-Cost Ratio
There are three main benefits to the BCR approach. First, interpretation of the BCR is very intuitive as only projects with a ratio of greater than one need be considered. Second, the ratio itself is appealing as it, in effect, provides a multiplier for an investor to speculate on how much benefit (i.e., revenue) would be produced per dollar invested in a given project (Rideout and Hesseln 2001). Finally, BCR is a useful means of ranking different independent projects based on their relative efficiencies (Davis et al. 2001).

Limitations of Benefit-Cost Ratio
Because BCR is a construct of NPV, the BCR approach shares many of the same disadvantages of NPV. Specifically, there are two main limitations to the BCR. First, this approach requires the analyst to select a discount rate in order to calculate the BCR. Second, the BCR must also be normalized for proper comparison between projects of different size.

4.7.6. Payback Period

$$PP = T + (| \sum D_t | / B_t)$$

Definition
The Payback Period (PP) is the total length of time necessary to recuperate the initial cost of an investment through cash flows generated from that same investment where (Engineering Reference 2005; Odellion Research 2005):

PP = total payback period
T = last year with negative cash flow $\sum$
$\boldsymbol{D_t}$ = absolute value of total accrued debt
$\boldsymbol{B_t}$ = net balance of final payback year

Benefits of Payback Period
There are three distinct advantages to the PP method, both of which help to explain its wide spread use. First, the PP method provides a quick snapshot as to the level of profitability of a certain investment in relation to time. Second, the PP is easily used as an initial screening tool for analysts. For example, an investor may only be interested in projects with a PP of three years, an analyst can then use PP to weed out investment options that do not satisfy this initial criteria. The analyst can then perform a more robust analysis for those options that satisfy the required PP. The third and final virtue of PP is the fact that it is a simple, straightforward approach that requires relatively little information by the analyst and provides results that are easily understood by the broader population.

Limitations of Payback Period

However, there are three main drawbacks concerning the quick and easy PP approach. First, the standard PP approach pays no respect to the time value of money. Second, this method only analyzes the project up to the payback period and cash flows beyond this point are ignored (Odellion Research 2005). Finally, the decimal portion of the PP can be misleading if a project's cash flows occur at discrete points in time, because no payouts occur before these points regardless of what the decimal may otherwise suggest.

4.8. Sensitivity Analysis

The cultivation of pinabete is a land use option that is inherently fraught with risk and uncertainty. In the three cropping scenarios analyzed in this study, the first cash inflow is not scheduled to occur until the fifth year—and a lot can change in five years. For instance, how do we know that the current market prices being used in this analysis will still be valid five years from now? How would the financial returns be affected by an aphid infestation in year six that reduced the marketability of the trees? How would the project's value be affected if a new factory were constructed in the wake of the CAFTA treaty that caused local labor prices to double?

Lacking a crystal ball, the overall robustness of a project must be tested under a range of different scenarios. The range of these different scenarios should reflect both the specific areas of uncertainty regarding the project, and the components of the project which have the most impact in the overall value of the project. As such, a sensitivity analysis is performed in the following chapter displaying response of NPV to the manipulation of key project variables. Two distinct components of project uncertainty are included in the sensitivity analysis. These are Market Variables and Stand Event Variables. Market Variables include project inputs and outputs that would be most affected by changes in current market prices and discount rates. The Stand Event Variables attempt to capture the degree of biological uncertainty that the future holds for a forest plantation (i.e., effects of fire, severe frost, and plagues) and their potential impact on the total project worth.

CHAPTER 5. RESULTS

5.1. Financial Efficiency

Each of the three cultivation systems satisfied the three criteria of financial efficiency at a guiding rate of 25%. In other words, the financial analysis performed on each system option resulted in a NPV > 0, B:C > 1 and produced an IRR greater than the guiding rate. Soil Expectation Values were calculated for each system option that did not include the PINFOR incentives. SEV was not calculated for these scenarios because current INAB policy only permits payment of the PINFOR incentives for the first rotation of a plantation. In effect, this policy constitutes a change in the management prescription between the first rotation and the second, and the use of the SEV in this situation would be misleading. However, the three calculated SEV values serve as a normalized basis for comparison between these mutually exclusive land use options. Conversely, it should be explicitly stated that SEV is the only truly

comparable method for ranking the present value of these three projects, because they differ in length and cost. Comparisons may accurately be made between cultivation systems using SEV, and within cultivation systems using the other financial criteria. Table 5.1 contains the results of the financial analysis. The main findings for each cultivation system are presented below.

5.1.1. Christmas Tree Plantation

The Christmas tree plantation produced the highest SEV of the three systems analyzed at $11,381. Within this cultivation system, the option that incorporated the PINFOR incentives generated the highest NPV at $9,649; the highest B:C at 2.23 and the highest IRR at 47%. The option that did not incorporate the incentives was the most expensive system analyzed and accrued a total negative balance of $7,927 during the first five years of the project.

5.1.2. Agroforestry System

The agroforestry system produced the second highest SEV of the three systems analyzed at $7,560. Within this cultivation system, the option that incorporated the forestry incentives generated the highest NPV at $6,629; the highest B:C at 2.26 and the highest IRR at 48%. Additionally, this option had the shortest Payback Period at 4.42 years.

5.1.3 Reforestation

The reforestation option produced the lowest SEV for all of the systems analyzed at $4,313. Within this cultivation system, the option that incorporated the forestry incentives generated the highest NPV at $5,094; the highest B:C at 2.01 and the highest IRR at 45%. Due to the multiple cash flows associated with this option, the IRR was graphed against NPV to ensure that there were no multiple rates of return. This option produced the lowest total negative balance for all of the cultivation systems at only $4,027. Additionally, this system achieves these financial returns in 70 years making it the longest rotation of all of the projects analyzed.

5.2. Sensitivity and Risk Analysis

Table 5.2 contains the results of the sensitivity and risk analysis which measured the percent response in NPV to various potential market and biological phenomena. The guiding rate of 25% was selected as the baseline for comparison purposes. Overall, this part of the analysis revealed that the three cultivation systems are sensitive to changes in the discount rate, decreases in Christmas tree prices, increases in seedling costs, and decreases in the number of marketable Christmas trees. The cultivation options do not appear to be sensitive to increases in labor costs or decreases in the price of processed pinabete seed, and are only moderately sensitive to changes in the first year seedling survival rate. Details of the response of NPV to each manipulated variable are provided below.

Table 5.1 Indicators of Financial Efficiency

Cultivation System	System Option	SEV[a]	NPV	EAE	B:C	IRR	Total Balance Before First Profit	Payback Period (yrs.)	Period Analyzed (yrs.)
Christmas Tree Plantation	Without PINFOR	11,381	8,995	2,845	2.15	45 %	(7,927)	4.50	7
	With PINFOR	-	9,649	3,052	2.23	47 %	(6,997)	4.44	7
	With PINFOR and Reinvestment	-	8,262	2,614	1.90	45 %	(6,997)	4.49	7
Agroforestry System	Without PINFOR	7,560	5,975	1,890	2.14	45 %	(5,310)	4.50	7
	With PINFOR	-	6,629	2,097	2.26	48 %	(4,381)	4.42	7
	With PINFOR and Reinvestment	-	5,705	1,805	1.92	46 %	(4,381)	4.46	7
Reforestation	Without PINFOR	4,313	4,313	1,078	1.85	41 %	(5,103)	4.59	70
	With PINFOR	-	5,094	1,273	2.01	45 %	(4,027)	4.45	70

Note. Calculations performed using real interest rates with a guiding rate of 25%.

[a]SEV calculations are only applicable in scenarios not incorporating the reforestation incentives as current national policy only permits the single application of these incentives to any given parcel.

Table 5.2 Sensitivity & Risk Analysis: Percent Response in NPV to Manipulation of Selected Variables

Type of Analysis	Cultivation System							
	Christmas Tree Plantation			Agroforestry System			Reforestation	
	Without PINFOR	With PINFOR	With PINFOR and Reinvestment	Without PINFOR	With PINFOR	With PINFOR and Reinvestment	Without PINFOR	With PINFOR
Market Variables								
Change in Discount Rate								
15 %	114%	107%	114%	114%	104%	111%	138%	120%
25 %	0%	0%	0%	0%	0%	0%	0%	0%
35 %	-64%	-60%	-64%	-64%	-59%	-62%	-73%	-64%
45 %	-101%	-105%	-101%	-101%	-93%	-99%	-115%	-101%
Cost of Seedling Increases								
50 %	-30%	-28%	-40%	-30%	-27%	-39%	-40%	-34%
100 %	-60%	-56%	-81%	-60%	-54%	-78%	-80%	-68%
175 %	-105%	-98%	-141%	-106%	-95%	-137%	-141%	-119%
Cost of Labor Increases								
50 %	-11%	-10%	-12%	-11%	-10%	-12%	-15%	-13%
100 %	-21%	-20%	-25%	-22%	-20%	-24%	-30%	-26%
475 %	-101%	-94%	-117%	-103%	-93%	-115%	-143%	-121%
Price of Christmas Tree Decreases								
-20 %	-37%	-35%	-41%	-38%	-34%	-39%	-43%	-37%
-40 %	-75%	-70%	-81%	-75%	-68%	-79%	-86%	-73%
-50 %	-94%	-87%	-102%	-94%	-85%	-98%	-108%	-91%
-60 %	-112%	-105%	-122%	-113%	-102%	-118%	-130%	-110%
Price of Pinabete Seed Decreases								
-50 %	-	-	-	-	-	-	-1%	0%
-90 %	-	-	-	-	-	-	-1%	-1%
Plantation Event Variables								
Decline in First Year Survival Rate								
-50 %	-15%	-16%	-21%	-15%	-16%	-21%	-20%	-20%
-75 %	-26%	-26%	-35%	-26%	-26%	-35%	-35%	-33%
-100 %	-38%	-36%	-50%	-38%	-36%	-49%	-50%	-46%
Decline in Number of Marketable Christmas Trees								
-25 %	-46%	-42%	-45%	-46%	-41%	-44%	-53%	-45%
-50 %	-91%	-85%	-91%	-92%	-83%	-88%	-105%	-89%
-75 %	-137%	-128%	-136%	-137%	-124%	-132%	-158%	-133%

Note. Calculations performed using real interest rates with a guiding rate of 25% except where otherwise indicated.

Prices of Christmas Tree Decreases

A decrease in the market price for the harvested trees significantly affected the overall value of each project. If prices were to decline by 20%, the overall NPV for each project would decrease by approximately 35%. However, prices could drop by 50% and the majority of the systems would still produce a positive NPV.

Price of Pinabete Seed Decreases

The reforestation scenario was not sensitive to a significant decline in the market price for processed pinabete seed. High discount rates coupled with the fact that seed collection does not begin to occur until year 28, result in the revenues derived from seed collection contributing very little to NPV. In fact, the current market price for processed seed could fall by 90% and have virtually no impact on the project's overall NPV.

Decline in First Year Survival Rate

Generally, all systems were fairly tolerant to decreases in the first year survival rate. Again, the reinvestment and reforestation options were most sensitive to this scenario. If half of the plantation did not survive the first year each option would still maintain approximately 80% of the original NPV. In fact, even if the entire plantation needed to be replanted no cultivation option would lose more than 50% of the original NPV.

Decline in Number of Marketable Christmas Trees

The response of NPV to a decline in the number of marketable Christmas trees paralleled the response to a decrease in the price of harvested Christmas trees. Again, if the number of marketable trees were to be reduced by 25%, the overall NPV for each project would decrease by approximately 45%. However, the inventory of marketable stock could drop by 50% and the majority of the systems would still produce a positive NPV.

CHAPTER 6. CONCLUSION

6.1. Interpretation of Analysis

The results of the financial analysis indicate that the cultivation of pinabete can be a financially efficient investment. Furthermore, the sensitivity analysis reveals the overall robustness of pinabete cultivation under a wide variety of likely contingencies. The results of this analysis will be most utile when they are compared with all of the alternative investment options available to the investor. Through the comparison of these financial efficiency criteria and the capital costs from one project to another, investors can more judiciously select the project that best matches their financial objectives.

The scenario in the analysis assumed that a farmer was planning on cultivating one hectare of fallow land and was considering pinabete. So, should the farmer plant pinabete? Well, of course, the answer depends. However, the results of the analysis suggest that pinabete can be a viable alternative to potato farming. For instance, each of the Christmas tree plantation options

returned an EAE larger than the $2,478 earned from potato farming during a good year. Of course, all pinabete options earned an EAE better than potato farming during a bad year.

Throughout the analysis, the scenario has been presented as a mutually exclusive option for the farmer—selecting one option or the other. However, in reality this scenario will seldom reflect the decision making process of the Guatemalan farmer. Although, many farmers may cultivate vast tracts of land with pinabete, subsistence farmers with smaller parcels are more apt to adaptively manage portions of their land with pinabete. It seems these subsistence farmers are more likely to mentally divide their parcel into different areas of production—with imaginary lines delimiting wet areas from dry, frost pockets from areas of higher yields, and so on. In this same manner, the farmer is most likely to adopt and integrate pinabete cultivation into the land. This adoption will most likely not be an exclusive choice between an agroforestry system, a Christmas tree plantation, or reforestation, instead a mixture tailored to suit the farmer's land.

In spite of these observations, the treatment of these cultivation options as mutually exclusive one hectare alternatives facilitates their comparison among different project alternatives using this common project scale. Table 6.1 provides a ranked listing of the project alternatives based on project worth. Intuitively, within each cultivation system the option that incorporates the forestry incentives produces a markedly higher NPV, B:C, and IRR than the option without the incentive.

Table 6.1. Listing of project alternatives ranked by present value.

Ranked system	Cultivation system	SEV	Ranked option	Option	NPV	Cost of investment
1	Christmas Tree Plantation	11,381	1	With PINFOR	9,649	(6,997)
			2	Without PINFOR	8,995	(7,927)
			3	With PINFOR and Reinvestment	8,262	(6,997)
2	Agroforestry System	7,560	1	With PINFOR	6,629	(4,381)
			2	Without PINFOR	5,975	(5,310)
			3	With PINFOR and Reinvestment	5,705	(4,381)
3	Reforestation	4,313	1	With PINFOR	5,094	(4,027)
			2	Without PINFOR	4,313	(5,103)

Money is always a limiting factor and to reflect this a capital constraint can easily be incorporated into the interpretation of Tables 5.1 and 6.1. For instance, assume the farmer in the scenario has now been approved for an agricultural loan of $5,500; with a rate of interest below the guiding rate used in this analysis. The farmer can now refer to Table 6.1 and select the projects that have an investment of less than $5,500. The farmer must now decide between the agroforestry system and reforestation alternatives, because the Christmas tree plantation is too expensive. Assuming the farmer's financial objective is to maximize value the farmer would select the agroforestry system, because this alternative produces the highest SEV. The farmer would then select the option with the forestry incentives as this generates the highest NPV within this alternative. In year five, the farmer would need to decide whether or not to reinvest in this cultivation system by replacing the harvested Christmas trees.

6.2. Policy Insights

The results of this financial analysis serve to illustrate the market realities created by the PINFOR incentive program and the pinabete forest products market. These financial realities can then be compared to the various national policies influencing the management of pinabete and the long-term goals of these programs. For instance, from a purely financial view point, the most profitable system is the Christmas tree plantation with the incorporation of the PINFOR incentives as it produces the greatest NPV.

However, from a macro perspective, the large scale implementation of this option would not diversify the sources of revenue but rather shift production from one monoculture to another. Additionally, the mass production of pinabete may result in market saturation, and cause the market price to plummet. Also, from a species conservation perspective, large scale implementation of this system would theoretically reduce the pressure on the remaining natural forests, but this system does little to enhance the genetic health of the species as the trees are harvested before they will reach sexual maturity. The policy goal should create a balanced mix of the three systems described in this financial analysis. This balance needs to be in accord with the landowner's objectives and its summation across the landscape should parallel the institutional goals for long-term species conservation and increased contribution from the forest sector to the national economy.

6.3. Benefits Produced

The cultivation of pinabete will produce both direct and indirect benefits. Results from the financial analysis indicate that one direct benefit provided to the farmer will be income generation. The generation of revenue is one of the main hurdles rural development programs first encounter, as income generation is of utmost concern and of high priority for poor farmers. The establishment of a pinabete plantation enables the farmer to diversify their source of revenue in the form of an appreciating asset. For example, farmers cultivating exclusively potatoes are forced to sell their crop annually and are thus highly subject to the volatility of the market price at harvest. However, farmers incorporating pinabete into their cultivation system can defer harvesting a pinabete tree from one year to the next, and during that time their investment will presumably accrue in value. This deferment option enables the farmers greater flexibility in cashing in on their investment and serves as a mechanism to help mitigate risk.

These plantation systems produce a multitude of secondary and indirect benefits to the farmer, region, country and world. Although these values are beyond the scope of this initial financial analysis, their mentioning is well merited and begs for future study in the broader context of an economic analysis. First, these systems can be designed and incorporated into larger soil conservation systems. For instance, a farmer may opt to plant strips of pinabete along the contours of the terrain in the steepest parts of the parcel. These strips, along with the planting of forage grasses, will serve to prevent soil erosion and overtime form natural terraces for the planting of annual crops. Soil conservation provides a direct benefit to the farmer, and overtime provides secondary benefits to the landowners of down slope parcels. Additionally, the degree of rainwater that would otherwise be lost as surface runoff tends to be reduced by these soil conservation systems. Reducing the velocity of this water promotes greater rates of infiltration

and groundwater recharge enabling springs to run longer into the dry season. Access to water in the dry season is a key concern for the growing villages in the Highlands and increasing its supply provides an important benefit for local residents.

These plantation systems also serve to reduce the total pressure on the remaining natural pinabete forests, both by increasing the total forested area of pinabete and by directly providing Christmas trees to satisfy the national demand. On a global scale the establishment of these plantations assists in the long-term survival of this endangered tree, enabling the genetic conservation of one of earth's species. Additionally, due to the rapid growth rates of pinabete, vast quantities of carbon dioxide are sequestered within a young plantation. Perhaps these final two benefits may one day become incorporated into the framework of a larger payment system for environmental services.

6.4. Limitations

Many limitations exist to the successful establishment of pinabete plantations, particularly with respect to development programs targeting the rural poor. As with most development projects, the project's execution is equally as important as the initial program idea. The following three concerns are perceived to be the main hurdles that may limit the effective execution and establishment of pinabete plantations. Although these limitations are geared toward rural development programs, the same points are applicable to any investor considering establishing a pinabete plantation.

1. Perhaps the greatest limitation to the cultivation of pinabete is the large capital cost associated with the establishment of the plantation. As previously mentioned, all three cultivation systems analyzed carried a negative balance through the fifth year even with the use of governmental incentives. A five-year period is an especially long period of time for subsistence farmers. By the same token, those five years reflect the opportunity cost of not planting annual crops. This opportunity cost may be quite high or very low depending on the harvest prices of the alternative crop over those same five years.

2. The management of these cultivation systems is technical in nature, this is particularly true regarding the Christmas tree production component of the plantations. For the harvested products to receive a good price, the trees will need to possess the characteristics mandated by the market. Shearing, pruning, and controlling diseases are all minimum requirements for the production of high quality Christmas trees. Currently, it is estimated that less than 5% of these plantations are being sheared and pruned (PROFOR 2004). The technical nature of these aspects can soon overwhelm a rural farmer if an effective extension system is not in place.

3. Potato cultivation has provided a great source of income for many Highland farmers, and the overall market is expanding. However, in spite of increasing demand Highland farmers cannot always afford to harvest their crop due to low market prices at harvest time. Rural farmers tend to be intimidated by the urban areas and larger market places, and have no means to transport the harvest themselves. Thus, many individual farmers

rely exclusively on middlemen, or *coyotes*, to purchase and transport their crop. In effect, this pits one farmer against the others, as there is no organized mechanism for the producers to use as leverage against these middlemen. This same unfortunate scenario is also a real possibility for individual pinabete producers, especially as supply begins to reach demand.

6.5. Recommendations

The cultivation of pinabete is often touted as a panacea for the development of the Highland area, clearly this is not the case. Pinabete simply happens to be one cash crop that there currently is a strong market for, and that happens to grow in these Highland regions. The species should be viewed as one small piece of the sustainable development puzzle for projects in these mountainous areas. Each investor can determine the financial merits of pinabete cultivation and establish whether it provides an efficient manner toward achieving their specific goals. However, listed below are general recommendations for rural development projects, cooperatives, and other institutions considering their options with this species:

1. For each cultivation system, 89% of the first year costs for each system are attributed to the purchasing of the plants, and at least 70% of the five-year negative balance occurs during this first year due to the initial establishment of the plantation. Areas that have an adequate year round water supply have two distinct advantages, if they are able to care for a tree nursery. In 2002, a study was conducted that analyzed the production costs of pinabete seedling in a tree nursery. This study found that it costs only $0.50 to care for a pinabete seedling in a tree nursery, as opposed to its $1.93 market price (Jiménez 2002). Thus, if a group or family is able to tend to a tree nursery this can significantly reduce the first year costs associated with the plantation's establishment. This reduction in cost not only improves financial returns, but also serves to minimize risk for the farmer. Additionally, if resources and interest are sufficient, the tree nursery can produce trees to sell on the open market to generate revenue more quickly and offset other costs.

2. Continued efforts must be made on the part of INAB, CONAP, and SEPRONA to control the poaching and illegal trafficking of pinabete. Although the efforts to control poaching of pinabete are costly, they serve to bring public notice to the situation. This awareness, in turn, will inspire the general public to buy only those trees harvested legally from plantations and displaying the white *marchamo*, which should create an even larger demand for plantation grown pinabete Christmas trees.

3. Finally, due to the technical nature of these plantations, it is necessary that great care be given to form an adequate extension system. These extension systems should seek to efficiently disseminate information regarding the technical aspects of cultivation. Additionally, these systems should promote the formation of communal growers associations which can leverage more favorable contracts with wholesale buyers. Some of these networks already exist in the Highlands in the form of potato cooperatives. The inclusion of these cooperatives and municipal forestry offices will greatly maximize the efficiency and effectiveness of any pinabete program. The incorporation of the services

provided by these entities (i.e., knowledge of local languages, extend agricultural loans, legal documents and access to PINFOR) can greatly improve the chances for farmer adoption and long-term success of these plantations.

6.6. Future Research

To date, there has been very little formal research focusing on the management of pinabete plantations. Many details affecting the cultivation of pinabete currently remain unknown, or exist in fragmented undocumented sources. More specifically, the greatest wealth of information that does exist regarding the management of this species lies in the form of the personal experiences gained by pioneering pinabete producers. This format inhibits the large scale dissemination of information, forcing many new producers and programs to reinvent the wheel. In addition to the compilation of the experiential information from seasoned growers, it is recommended that future research focus on the following areas:

1. A new national market study must be conducted to better ascertain both the volume and characteristics of the demand for the national Christmas tree market. As the underpinnings of nearly all management activities are conducted with this final product in mind, it is necessary that the market be well understood in order to assure a commercially viable product.

2. Unfortunately, legal pinabete producers are currently unable to sell the clippings generated by the annual pruning and shearing activities. National authorities are concerned that there is no efficient manner of determining which clippings are legal and which have been poached from the natural forests. By prohibiting the sale of this valuable commodity, pinabete producers are prevented from taking advantage of an additional source of revenue. This law serves as a disincentive to producing high quality sheared Christmas trees, as there is no way for producers to offset the management costs associated with shearing. This being the case, research should be conducted by the governing institutions that seeks to enable legal sale of these secondary products.

3. This ex-ante financial analysis was of fairly low resolution and its findings should be interpreted as broad generalities only. The results of this initial study indicate that pinabete cultivation can be a financially lucrative option for farmers; however, a higher resolution (i.e., regional) study should be performed prior to any project implementation to better estimate the impact of local market prices on the analysis. To facilitate a more refined analysis, a copy of the program used to conduct the financial analysis performed in this study is available at <http.www.yul-ha.com>. This program enables users to enter local market information and view its impact on the financial efficiency criteria for each cultivation system, and enables the manipulation of key variables while performing the sensitivity and risk analyses.

   Due to the mounting population pressure and limited land area, the role of productive agroforestry systems in the sustainable development of the Highlands cannot be stressed enough. As such, future research must focus on various intercropping associations in

order to maximize the productivity of pinabete agroforestry systems. Specifically, research should examine the symbiotic relationships that not only promote increased system productivity, but serve to further diversify sources of revenue.

4. Further research must be conducted to identify pinabete seed sources of the highest quality. Specifically, seed sources should be identified which possess the genetic traits that produce the desired phenotypes for Christmas trees. For example, seeds must be selected for desirable traits such as high rates of germination, fast growth, resistance to disease and pests, dense foliage, and desirable fragrance and color.

5. Finally, following the examples provided by the growing demand in the nontraditional agricultural export sector and with specialized coffees, research regarding similar opportunities for the exportation of pinabete is well merited. It is strongly believed that there are certain aspects of a pinabete Christmas tree that, if marketed appropriately, could find a niche market in more developed countries. A Guatemalan-grown pinabete tree may share the same allure as does organically grown coffee. Furthermore, a successful marketing strategy which incorporates the cultural components of the species and its production, may be key in capitalizing on the good will of the Christmas season. Currently, there are two obstacles that prevent the exportation of pinabete in this manner. First, the species is listed in CITES Appendix I, which virtually prohibits all exportation of the tree. Second, there are no uniform standards for the green certification of Christmas tree plantations. Consequently, it is recommended that a market study be conducted which focuses on the export market. Upon the results of this initial study, further research may be conducted to explore the possibilities of green certification and amendments to the CITES convention.

6.7. Closing Comment

The true merits of pinabete cultivation lie in the fact that it promotes development through commerce, targets regions inhabited by marginalized people, enables the diversification of revenue sources for farmers, and promotes the stewardship of a threatened species. Collectively, these characteristics of pinabete create one opportunity toward the sustainable development of the Guatemalan Highlands.

REFERENCES

Aguilar, F. 2003. Comercio Ilegal. *Primer Taller Nacional del Pinabete, 2003*. Quetzaltenango, Guatemala: Instituto Nacional de Bosques.

Amnistía Internacional. 2003. *La legitimidad política, electoral y judicial en peligro Derechos Humanos y Elecciones 2003 en Guatemala.* Retrieved November 11, 2004, from http://web.amnesty.org/library/print/ESLAMR340512003

Associated Press. 2004 (March 9). Guatemala: Ríos Montt indemne pese a arresto domiciliario. *Guatemala, Associated Press.* Retrieved October 18, 2004 from www.prensalibre.com.gt

AQUASTAT. 2000. *Contabilización de Recursos Hídricos Renovables por País.* Food and Agricultural Organization. Rome, Italy: FAO. Retrieved February 2, 2005, from http://www.fao.org/ag/agl/aglw/aquastat/countries/guatemala/indexesp.stm

BANSEFOR. 2003. *Semillas Forestales.* Banco de Semillas Forestales, Instituto Nacional de Bosques. Guatemala City, Guatemala.

Barnes, B.V., D. R. Zak, S. R. Denton, and S. H. Spurr. 1998. *Forest Ecology. 4th ed.* New York, NY: John Wiley & Sons, Inc.

Beletsky, L. 1999. *The Ecotravellers' Wildlife Guide: Belize and Northern Guatemala*. San Diego, CA: Academic Press.

Bellow, J. 2004. Fruit-tree-Based agroforestry in the Western Highlands of Guatemala: An Evaluation of tree-Crop Interactions and Socioeconomic Characteristics. Unpublished doctoral dissertation. Gainesville, FL: University of Florida.

BN Valores. 2004. *Guatemala 2004. BN Valores Comunica.* Banco Nacional Valores de Costa Rica. Retrieved November 11, 2004, from https://www.bnvalores.com/download/Guatemala%202004.pdf

Bannock, G., R. E. Baxter, and E. Davis. 2003. *Dictionary of Economics. 4th ed*. Princeton, NJ: Bloomberg Press.

Castillo, H. M., P. P. Juárez, A. B. Enríquez, A. F. Herrera, and J. Hesen. 1997. Producción de pinabete (*Abies guatemalensis*) en la Aldea de San Antonio Serchil, Departamento de San Marcos. Asociación Desarrollo Para Todos. Thesis Study. Sand Marcos, Guatemala: Universidad Rural de Guatemala.

CIA. 2004. *The World Fact Book: Guatemala.* Washington, D.C.: Central Intelligence Agency (CIA). Retrieved November 18, 2004, from http://www.cia.gov/cia/publications/factbook/geos/gt.html

CITES. 2004. *Discover CITES.* Convention on International Trade in Endangered Species of Wild Fauna and Flora. Geneva, Switzerland. Retrieved October 25, 2004, from http://www.cites.org/eng/disc/how.shtml

CODECH. 2000. *Diagnostico Municipal 2002*. Concepción Huista, Huehuetenango, Guatemala: Consejo de Desarrollo Concepción Huista.

CONAP. 1999. *Resumen de la Estrategia del Pinabete.* Consejo Nacional de Áreas Protegidas. Guatemala City, Guatemala. Retrieved November 17, 2005, from http://www.conap.gob.gt:85/index.html

CONAP/INAB. 1999. *Diagnóstico de las poblaciones naturales de pinabete (Abies guatemalensis R.) en Guatemala y Estrategia para su Conservación.* Consejo Nacional de Áreas Protegidas. Guatemala City, Guatemala.

Cuevas, F. 2005 (March 3). Honduras ratifies CAFTA: Honduras becomes second Latin American country to ratify CAFTA. *Associated Press.* Retrieved March, 6 2005 from http://www.mx.us.biz.yahoo.com/ap/050303/honduras_us_cafta_4.htm

Currais, L. 2000. From the Malthusian Regime to the Demographic Transition: Contemporary Research and Beyond. *Económica* 3:75-101.

Current, D., E. Lutz, and S. Scherr. 1995. *Costs, Benefits, and Farmer Adoption of agroforestry: Project Experience in Central America and the Caribbean*. Environment Paper no. 14. Washington, D.C.: The World Bank.

Daniel, F. J. 2004 (November 15). U.N. closes shop in Guatemala, says work remains. *AlertNet Organization, Reuters Foundation.* Retrieved November 28, 2004, from http://www.americasnet.net/news/UN_closes_shop.pdf

Davis, L. C., K. N. Johnson, P. S. Bettinger, and T. E. Howard. 2001. *Forest Management: To Sustain Ecological, Economic, and Social Values. 4th ed*. New York, NY: McGraw-Hill.

De la Rocha, M. G. 2001. *Guatemala and Uruguay*. In *Choices for the Poor: Lessons from National Poverty Strategies* (Ch. 13), ed., Grinspun, A. New York, NY: United Nations Development Programme. Retrieved November 28, 2004 from http://www.undp.org/dpa/publications/choicesforpoor

Doan, D. B. 1999. The Mineral Industry of Guatemala. *U.S. Geological Survey Minerals Yearbook–1999.* Reston, VA: United States Geological Survey.

Donovan, D. K. 2002. *Land Tenure and Land Administration Issues in Guatemala*. Department of Spatial Information Science and Engineering, University of Maine. Retrieved November 1, 2004, from http://www.spatial.maine.edu/~onsrud

ECODESA. 2003. *Inventario de Semillas Forestales y Agroforestales Enero de 2003.* Equipo de Consultores en Proyectos de Desarrollo Ecológico Sostenible. Quetzaltenango, Guatemala.

Encarta. 2003. *World Atlas.* Microsoft MapPoint Web Service. Retrieved September 15, 2004, from http://encarta.msn.com/encnet/features/MapCenter/Map.aspx

Energy Information Administration. 2001. *Country Analysis Briefs –Central and South America: Guatemala.* Washington, D.C.: United States Department of Energy. Retrieved March 12, 2005 from http://www.eia.doe.gov/emeu/cabs/guatemal.html

Engineering Reference. 2005. *Project Financial Analysis.* Eagan, MN. Retrieved June 15, 2005, from http://www.engineeringreference.com

FAOSTAT. 2004. *FAO Statistical Databases.* Rome, Italy: Food and Agriculture Organization of the United Nations. Retrieved May 5, 2005, from http://faostat.fao.org/

Feiring, B. 2001. *Pueblos Indígenas y Pobreza: Los Casos de Bolivia, Guatemala, Honduras y Nicaragua*. London, UK: Minority Rights Group Internacional.

Food and Agriculture Organization. 2002. *Global Forest Resources Assessment 2000*. Rome, Italy: Food and Agriculture Organization (FAO).

Freedom House. 2004. *Freedom in the world: Guatemala.* Washington, D.C. Retrieved November 19, 2004, from http://www.freedomhouse.org/research/freeworld.htm

Gálvez, J. 2000. *Perfil ambiental de la Republica de Guatemala.* Ciudad de Guatemala, Guatemala: Sociedad de Cooperación para el Desarrollo Internacional.

Gálvez, J. 2002. *Agricultora Sostenible, Recursos Naturales y Ambiente: Marco Conceptual*. Guatemala City, Gautemala: Instituto de Agricultura, Recursos Naturales y Ambiente, Universidad Landivar.

Genne, M. 1981. The theory of the demographic transition as a reference for demo economic models. *Tiers Monde* 22(87):557-572.

González, D. 2005 (January 10). Guatemala consulate planned for Phoenix: Arizona is now main entry point. *The Arizona Republic.* Retrieved February 4, 2005 from http://www.azcentral.com/arizonarepublic

Gregersen, H. M., and A. H. Contreras. 1992. *Economic Assessment of Forestry Project Impacts.* FAO Forestry Paper 106. Rome, Italy: Food and Agricultural Organization of the United Nations (FAO).

GTZ. n.d. *Indigenous Peoples in Latin America & the Caribbean.* Deutsche Gessellschaft für Technische Zusammenarbeit (GTZ). Eschborn, Germany. Retrieved November 28, 2004, from http://www.gtz.de/indigenas/

Gulden, T. R. 2002. *Spatial and Temporal Patterns in Civil Violence: Guatemala 19771986.* Washington, D.C.: The Brookings Institution, Center on Social and Economic Dynamics. (Working Paper No. 26).

Helms, D. 1992. *The Development of the Land Capability Classification. Readings in the History of the Soil Conservation Service.* NRCS History Articles. Washington, D.C.: Natural Resources Conservation Service, USDA. Retrieved July 10, 2005 from http://www.nrcs.usda.gov/about/history/articles

INAB. 1996. *Ley Forestal: Decreto Legislativo Número 101-96*. Ciudad de Guatemala, Guatemala: Instituto Nacional de Bosques.

INAB. 1998. *Estudio de Mercado Nacional del Pinabete*, *Primer Taller Nacional del Pinabete, 2003*. Quetzaltenango, Guatemala: Instituto Nacional de Bosques.

INAB. 2001. *Estudio de un Rodal Semillero de Pinabete: Palestina de Los Altos, Totonicapán.* PROFOR-INAB. Quetzaltenango, Guatemala: Instituto Nacional de Bosques.

INAB. 2003. *Boletín de Estadística Forestal 2003*, *Administración del INAB*. Ciudad de Guatemala, Guatemala: Instituto Nacional de Bosques. Retrieved November, 15, 2004, from http://www.inab.gob.gt/espanol/inab/estadisticas/2003

INAB. 2004. *La Junta Directiva del Instituto Nacional de Bosques – Reglamento del Programa de Incentivos Forestales* (Resolución 02.12.2004). Ciudad de Guatemala, Guatemala: Instituto Nacional de Bosques. Retrieved November 15, 2004, from http://www.inab.gob.gt

INAB. 2005. *Programa de Incentivos Forestales PINFOR*. Ciudad de Guatemala, Guatemala: Instituto Nacional de Bosques. Retrieved January 23, 2005, from http://www.inab.gob.gt/

Instituto Nacional de Estadística de Guatemala. 2004. *Evolución de la Población Total, Censo Nacional De Población.* Guatemala City, Guatemala. Retrieved November 15, 2004, from http://www.ine.gob.gt/index.htm

IUCN. 2003. *2003 IUCN Red List of Threatened Species.* Gland, Switzerland: International Union for Conservation and Natural Resources (IUCN). Retrieved November 15, 2004, from http://www.iucnredlist.org/

International Finance Center. 2004. *International Finance: Guatemala Country Fact Sheet.* Yahoo Finance–International Finance Center. Retrieved October 23, 2004, from http://biz.yahoo.com/ifc/gt.html

Jiménez, G. E. 2002. Costos de Producción de Cinco Viveros Forestales de las Sierras de Los Cuchumatanes. Thesis Perito Forestal, Escuela Técnica de la Formación Forestal. Jacaltenango, Huehuetenango, Guatemala: ESTEFFOR.

Kimmins, J. P. 1997. Biogeochemistry: Cycling of Nutrients in Ecosystems. In *Forest Ecology: A Foundation for Sustainable Management,* 2d ed. Upper Saddle River, NJ: Simon & Schuster.

Leemans, R., W. Cramer, and J. G. Van Minnen. 1996. Prediction of Global Biome Distribution Using Bioclimatic Equilibrium Models. In *Global Change: Effects on Coniferous Forests and Grasslands* (Ch. 16), eds., Breymer, A. I., D. O. Hall, J. M. Melillo, and G. I. Agren. Scientific Committee on Problems of the Environment (SCOPE). John Wiley & Sons. Retrieved March 12, 2005 from http://www.icsu-scope.org/downloadpubs/scope56

Leuschner, W. A., and W. A. Sellers. 1975. *The economics of producing and marketing Christmas trees.* Virginia Polytechnic Institute and State University, Division of Forestry, Retrieved October 12, 2004, from http://ohioline.osu.edu/b670

Lozano, V. 2005. *Encuesta Nacional Sobre Emigración Internacional de Guatemaltecos 2002 - 2003. Población y Salud en Mesoamérica, 2* (2, articulo 4). Centro Centroamericano de Población. Universidad de Costa Rica. San José, Costa Rica. Retrieved January 20, 2005, from http://ccp.ucr.ac.cr/revista/

Macvean, A. L. 2003. *Abies Guatemalensis* Rehder. Herbario del Instituto de Investigaciones, Universidad del Valle de Guatemala. Retrieved November 5, 2004, from http://www.evergreen.edu/library/govdocs/pdf/usda/aghandbooks/721 /species /abies-guatemalensis.pdf

MAGA. 1998. *Actores Rurales y Marco de Políticas de Funcionamiento.* Plan de Acción Forestal Guatemala. Boletín Informativo 7. Ministerio de Agricultura, Ganadería y Alimentación. Guatemala City, Guatemala.

MAGA. 2001. *Mapa de Intensidad de Uso de la Tierra, Republica de Guatemala. Numero 44.* Programa de Emergencia por Desastres Naturales (PEDN), Sistema de Información Geográfica. Ministerio de Agricultura, Ganadería y Alimentación. Guatemala City, Guatemala. Retrieved November 22, 2004 from http://www.maga.gob.gt/sig/indice_tematico.htm

Mahler, R. 1999. *Guatemala: Adventures in Nature*. 2d ed. Santa Fe, NM: John Muir Publications.

McFarland, M. 2003. *Sowing Seeds of Peace.* The Norman Borlaug Heritage Foundation. Retrieved November 11, 2004, from http://macserverr.independence.k12.ia.us/~jlang/Education/BorlaugEssay.htm

Meadows, D. H., D. I. Meadows, J. Randers, and W. W. Behrens, III. 1972. *The Limits to Growth: A Report to the Club of Rome.* Hamburg, Germany. Retrieved October 25, 2004, from http://www.clubofrome.org/docs/limits.rtf

Mendoza, J. F. 2003. *Costos de Reforestación por Año. Proyecto Vivero Forestal y Reforestación ADIPY. Etapa II: Reforestación Área Base: 1 Ha*. Asociación Desarrollo Integral Proyecto Yamanonh (ADIPY). Concepción Huista, Huehuetenango, Guatemala. Unpublished raw data.

MINUGUA. 2004. MINUGUA's 9th and Final Report on Fulfillment of the Peace Accords in Guatemala. United Nations Verification Mission in Guatemala. Retrieved January 20, 2005, from http://www.nisgua.org/articles/minugua_Final_Report_Aug2004.htm

Montgomery, K. n.d. *The Demographic Transition.* Department of Geography and Geology, University of Wisconsin. Retrieved November 11, 2004, from http://www.uwmc.uwc.edu/geography/Demotrans/demtran.htm

Odellion Research. 2005. *Online Community – Financial Models.* Austin, TX. Retrieved, June 15 2005, from http://odellion.com/pages/research/models

O'Kane, T. 2000. *In Focus: Guatemala - A Guide to the People, Politics and Culture.* Brooklyn, NY: Interlink Publishing Group, Inc.

Organisation for Economic Cooperation and Development. 2003. *Fighting Corruption: What role for civil society? The experience of the OECD.* Paris, France: Organisation for Economic Cooperation and Development OECD. Retrieved November 24, 2004 from www.oecd.org/dataoecd/8/2/19567549.pdf

Overpopulation.com. n.d. *Paul Ehrlich.* Retrieved, November 24, 2004, from http://www.overpopulation.com/faq/people/paul_ehrlich.html

Population Reference Bureau. 2004. *Glossary*. Washington, D.C. Retrieved, November 20, 2004, from http://www.prb.org/Content/NavigationMenu/PRB/PRB_Library

PROFOR. 2004. *Análisis del Manejo de las Plantaciones Navideños de Pinabete.* Manejo y Conservación de Pinabete, Protección Forestal, Instituto Nacional de Bosques. Quetzaltenango, Guatemala: Instituto Nacional de Bosques. Unpublished Raw Data.

PRONACOM. 2005. *Mejorando para Competir: Turismo.* Programa Nacional de Competitividad. Guatemala City, Guatemala. Retrieved March 13, 2005 from http://www.pronacom.org

Rideout, D. B., and H. Hesseln. 2001. *Principles of Forest & Environmental Economics.* 2d ed. Fort Collins, CO: Resource & Environmental Management, LLC.

Rivera, J. 2002. *El Cultivo de la Papa en Guatemala - Solanum tuberosum L. Primera Edición.* Instituto de Ciencia y Tecnología Agrícolas, Ministerio de Agricultura. Guatemala City, Guatemala.

Roosevelt, T. 1910. *Citizenship in a Republic: The Man in the Arena.* Speech at the Sorbonne on April 23, 1910. Paris, France. Retrieved June 1, 2005, from http://www.theodore-roosevelt.com

Ross, S. A., R. W. Westerfield, and J. Jaffe. 2002. *Corporate Finance.* 6th ed. New York, NY: The McGraw-Hill Companies.

SEGEPLAN. 2003. *Estrategia de Reducción de la Pobreza Departamental: Huehuetenango.* Secretaria de Planificación y Programación de la Presidencia (SEGEPLAN). Guatemala City, Guatemala. Retrieved March 12, 2005, from http://www.segeplan.gob.gt/docs/ERP/ERP_REG_DEPTOS/estrategias.htm

Silim, S., and M. Saxena. 1992. Comparative performance of Some faba bean (*Vicia faba)* cultivars of contrasting plant types: 1. Yield, yield components and nitrogen fixation. *Journal of Agricultural Science* 118:325-332.

Southgate, D., D. H. Gram., and L. Tweeten. 2005. *The Global Food Economy.* Oxford, UK: Blackwell Publishing Limited.

TransFair. 2004. *Fair Trade Market Achieves Record Growth in 2003.* Oakland, CA: TransFair USA, Fairtrade Labelling Organizations International. Retrieved October 20, 2005 from http://www.transfairusa.org/content/about/pr_040329.php

Transparency International. 2003. *Transparency International Corruption Perceptions Index 2003: Nine out of ten developing countries urgently need practical support to fight corruption, highlights new index* (Press Release). Berlin, Germany: Transparency International.

United Nations. 2002. *World Population Prospects: The 2002 Revision and World Urbanization Prospects.* New York, NY: Population Division, Department of Economic and Social Affairs of the United Nations Secretariat. Retrieved November 15, 2004, from http://esa.un.org/unpp

United Nations. 2004. *National Accounts Main Aggregates Database.* New York, NY: Economic Statistics Branch, United Nations Statistics Division. Retrieved November 13, 2004, from http://unstats.un.org/unsd/snaama

United Nations Development Programme. 2004. *Human Development Reports 2003: Guatemala.* New York, NY: United Nations Development Program (UNDP). Retrieved November 15, 2004, from http://hdr.undp.org/statistics/data/cty/cty_f_GTM.html

University of Florida. 2005. *Investing in Forestry.* Florida Forestry Information: Institute of Food and Agricultural Sciences, School of Forest Resources and Conservation, University of Florida. Retrieved June 12, 2005, from http://www.sfrc.ufl.edu/Extension/ffws

USAID. 2000. *Guatemala Overview.* Latin America and the Caribbean Overview. Washington, D.C.: United States Agency for International Development (USAID). Retrieved October 17, 2004, from http://www.usaid.gov/pubs/bj2001/lac/gt/

US & Foreign Commercial Service. 2004. *Guatemala Country Commercial Guide 2004 Update - Entire Guide.* Washington, D.C. Retrieved October 25, 2004, from http://strategis.ic.gc.ca/epic/internet/inimr-ri.nsf/en/gr127311e.html

US State Department. 2004. *Background Note: Guatemala.* Washington, D.C.: Bureau of Western Hemisphere Affairs, US State Department. Retrieved September 20, 2004, from http://www.state.gov/r/pa/ei/bgn/2045.htm

Vakis, R. 2003. *Guatemala: Livelihoods, Labor Markets, and Rural Poverty*. Technical Paper no. 1. Washington, DC: The World Bank, Guatemala Poverty Assessment Program. Retrieved November 10, 2004, from http://www.worldbank.org/guatemalapoverty

World Resources Institute. 2003. *Earth Trends, 2003. The Environmental Information Portal Country Profiles.* Washington, D.C. Retrieved October 10, 2004, from http://www.earthtrends.wri.org

Appendix A: Christmas Tree Plantation Without Governmental PINFOR Incentives

CASH FLOW TABLE								
Investment Year	**Establishment**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Stems per Hectare	2500	2500	2500	2500	2500	2500	1750	1000
Christmas Trees Harvested	0	0	0	0	0	750	750	750
Costs								
Transportation	60.45	9.07	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	4836.28	725.44	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	506.49	75.98	0.00	0.00	0.00	0.00	0.00	0.00
Management	0.00	369.26	369.26	369.26	369.26	369.26	258.48	147.70
Shearing	0.00	0.00	0.00	76.15	76.15	76.15	61.60	35.20
Fireline Construction	19.35	16.12	16.12	16.12	16.12	16.12	16.12	16.12
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	628.72	628.72	628.72
INAB - *Nota de Envío*	0.00	0.00	0.00	0.00	0.00	0.64	0.64	0.64
Subtotal Costs	5422.57	1195.86	385.38	461.53	461.53	1090.89	965.56	828.38
Revenue								
Christmas Trees	0.00	0.00	0.00	0.00	0.00	16926.98	21763.26	26599.54
Subtotal Revenue	0.00	0.00	0.00	0.00	0.00	16926.98	21763.26	26599.54
Annual Balance $ (USD)	(5,422.57)	(1,195.86)	(385.38)	(461.53)	(461.53)	15,836.09	20,797.70	25,771.16

Appendix B: Christmas Tree Plantation With Governmental PINFOR Incentives

CASH FLOW TABLE								
Investment Year	**Establishment**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Stems per Hectare	2500	2500	2500	2500	2500	2500	1750	1000
Christmas Trees Harvested	0	0	0	0	0	750	750	750
Costs								
Transportation	60.45	9.07	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	4836.28	725.44	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	506.49	75.98	0.00	0.00	0.00	0.00	0.00	0.00
Management	0.00	369.26	369.26	369.26	369.26	369.26	258.48	147.70
Shearing	0.00	0.00	0.00	76.15	76.15	76.15	61.60	35.20
Fireline Construction	19.35	16.12	16.12	16.12	16.12	16.12	16.12	16.12
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	628.72	628.72	628.72
INAB - *Nota de Envío*	0.00	0.00	0.00	0.00	0.00	0.64	0.64	0.64
Subtotal Costs	5422.57	1195.86	385.38	461.53	461.53	1090.89	965.56	828.38
Revenue								
Christmas Trees	0.00	0.00	0.00	0.00	0.00	16926.98	21763.26	26599.54
PINFOR Incentives	0.00	522.32	219.37	188.03	0.00	0.00	0.00	0.00
Subtotal Revenue	0.00	522.32	219.37	188.03	0.00	16926.98	21763.26	26599.54
Annual Balance $ (USD)	(5,422.57)	(673.54)	(166.00)	(273.50)	(461.53)	15,836.09	20,797.70	25,771.16

Appendix C: Christmas Tree Plantation With Governmental PINFOR Incentives and Reinvestment

CASH FLOW TABLE								
Investment Year	**Establishment**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Stems per Hectare	2500	2500	2500	2500	2500	2500	2500	2500
Christmas Trees Harvested	0	0	0	0	0	750	750	750
Costs								
Transportation	60.45	9.07	0.00	0.00	0.00	18.14	20.86	20.86
Seedlings	4836.28	725.44	0.00	0.00	0.00	1450.88	1668.52	1668.52
Establishment	506.49	75.98	0.00	0.00	0.00	151.95	151.95	151.95
Management	0.00	369.26	369.26	369.26	369.26	258.48	258.48	258.48
Shearing	0.00	0.00	0.00	76.15	76.15	76.15	61.60	35.20
Fireline Construction	19.35	16.12	16.12	16.12	16.12	16.12	16.12	16.12
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	628.72	628.72	628.72
INAB - *Nota de Envío*	0.00	0.00	0.00	0.00	0.00	0.64	0.64	0.64
Subtotal Costs	5422.57	1195.86	385.38	461.53	461.53	2601.08	2806.88	2780.48
Revenue								
Christmas Trees	0.00	0.00	0.00	0.00	0.00	16926.98	21763.26	26599.54
PINFOR Incentives	0.00	522.32	219.37	188.03	0.00	0.00	0.00	0.00
Subtotal Revenue	0.00	522.32	219.37	188.03	0.00	16926.98	21763.26	26599.54
Annual Balance $ (USD)	(5,422.57)	(673.54)	(166.00)	(273.50)	(461.53)	14,325.90	18,956.38	23,819.06

Appendix D: Agroforestry System Without Governmental PINFOR Incentives

CASH FLOW TABLE								
Investment Year	**Establishment**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Stems per Hectare	1666	1666	1666	1666	1666	1666	1166	666
Christmas Trees Harvested	0	0	0	0	0	500	500	500
Costs								
Transportation	40.29	6.04	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	3222.90	483.43	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	337.53	50.65	0.00	0.00	0.00	0.00	0.00	0.00
Management	0.00	246.50	246.07	246.07	246.07	246.07	172.22	98.37
Shearing	0.00	0.00	0.00	50.75	50.75	50.75	41.04	23.44
Fireline Construction	19.35	16.12	16.12	16.12	16.12	16.12	16.12	16.12
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	419.14	419.14	419.14
INAB - *Nota de Envío*	0.00	0.00	0.00	0.00	0.00	0.64	0.64	0.64
Subtotal Costs	3620.05	802.30	262.19	312.94	312.94	732.73	649.17	557.72
Revenue								
Christmas Trees	0.00	0.00	0.00	0.00	0.00	11284.65	14508.84	17733.03
Subtotal Revenue	0.00	0.00	0.00	0.00	0.00	11284.65	14508.84	17733.03
Annual Balance $ (USD)	(3,620.05)	(802.30)	(262.19)	(312.94)	(312.94)	10,551.92	13,859.67	17,175.31

Appendix E: Agroforestry System With Governmental PINFOR Incentives

CASH FLOW TABLE								
Investment Year	**Establishment**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Stems per Hectare	1666	1666	1666	1666	1666	1666	1166	666
Christmas Trees Harvested	0	0	0	0	0	500	500	500
Costs								
Transportation	40.29	6.04	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	3222.90	483.43	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	337.53	50.65	0.00	0.00	0.00	0.00	0.00	0.00
Management	0.00	246.50	246.07	246.07	246.07	246.07	172.22	98.37
Shearing	0.00	0.00	0.00	50.75	50.75	50.75	41.04	23.44
Fireline Construction	19.35	16.12	16.12	16.12	16.12	16.12	16.12	16.12
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	419.14	419.14	419.14
INAB - *Nota de Envío*	0.00	0.00	0.00	0.00	0.00	0.64	0.64	0.64
Subtotal Costs	3620.05	802.30	262.19	312.94	312.94	732.73	649.17	557.72
Revenue								
Christmas Trees	0.00	0.00	0.00	0.00	0.00	11284.65	14508.84	17733.03
PINFOR Incentives	0.00	522.32	219.37	188.03	0.00	0.00	0.00	0.00
Subtotal Revenue	0.00	522.32	219.37	188.03	0.00	11284.65	14508.84	17733.03
Annual Balance $ (USD)	(3,620.05)	(279.98)	(42.82)	(124.91)	(312.94)	10,551.92	13,859.67	17,175.31

Appendix F: Agroforestry System With Governmental PINFOR Incentives and Reinvestment

CASH FLOW TABLE								
Investment Year	**Establishment**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Stems per Hectare	1666	1666	1666	1666	1666	1666	1666	1666
Christmas Trees Harvested	0	0	0	0	0	500	500	500
Costs								
Transportation	40.29	6.04	0.00	0.00	0.00	12.09	13.90	13.90
Seedlings	3222.90	483.43	0.00	0.00	0.00	967.26	1112.34	1112.34
Establishment	337.53	50.65	0.00	0.00	0.00	101.30	101.30	101.30
Management	0.00	246.50	246.07	246.07	246.07	172.22	172.22	172.22
Shearing	0.00	0.00	0.00	50.75	50.75	50.75	41.04	23.44
Fireline Construction	19.35	16.12	16.12	16.12	16.12	16.12	16.12	16.12
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	419.14	419.14	419.14
INAB - *Nota de Envío*	0.00	0.00	0.00	0.00	0.00	0.64	0.64	0.64
Subtotal Costs	3620.05	802.30	262.19	312.94	312.94	1739.52	1876.72	1859.12
Revenue								
Christmas Trees	0.00	0.00	0.00	0.00	0.00	11284.65	14508.84	17733.03
PINFOR Incentives	0.00	522.32	219.37	188.03	0.00	0.00	0.00	0.00
Subtotal Revenue	0.00	522.32	219.37	188.03	0.00	11284.65	14508.84	17733.03
Annual Balance $ (USD)	(3,620.05)	(279.98)	(42.82)	(124.91)	(312.94)	9,545.13	12,632.12	15,873.91

Appendix G: Reforestation Without Governmental PINFOR Incentives (*Establishment through Year 7*)

CASH FLOW TABLE								
Investment Year	**Establishment**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Stems per Hectare	1600	1600	1600	1600	1600	1600	1185	770
Christmas Trees Harvested	0	0	0	0	0	415	415	415
Costs								
Transportation	38.69	5.80	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	3095.22	464.28	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	324.15	48.62	0.00	0.00	0.00	0.00	0.00	0.00
Management	0.00	236.32	236.32	236.32	236.32	236.32	175.03	113.73
Shearing	0.00	0.00	0.00	48.74	48.74	48.74	14.61	14.61
Fireline Construction	19.35	16.12	16.12	16.12	16.12	16.12	16.12	16.12
Seed Collection	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	347.89	347.89	347.89
INAB - *Nota de Envío*	0.00	0.00	0.00	0.00	0.00	0.64	0.64	0.64
Subtotal Costs	3477.41	771.15	252.44	301.18	301.18	649.72	554.29	492.99
Revenue								
Christmas Trees	0.00	0.00	0.00	0.00	0.00	9366.26	12042.34	14718.41
Subtotal Revenue	0.00	0.00	0.00	0.00	0.00	9366.26	12042.34	14718.41
Annual Balance $ (USD)	(3,477.41)	(771.15)	(252.44)	(301.18)	(301.18)	8,716.55	11,488.05	14,225.42

Appendix H: Reforestation With Governmental PINFOR Incentives (*Establishment through Year 7*)

CASH FLOW TABLE								
Investment Year	**Establishment**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Stems per Hectare	1600	1600	1600	1600	1600	1600	1185	770
Christmas Trees Harvested	0	0	0	0	0	415	415	415
Costs								
Transportation	38.69	5.80	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	3095.22	464.28	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	324.15	48.62	0.00	0.00	0.00	0.00	0.00	0.00
Management	0.00	236.32	236.32	236.32	236.32	236.32	175.03	113.73
Shearing	0.00	0.00	0.00	48.74	48.74	48.74	14.61	14.61
Fireline Construction	19.35	16.12	16.12	16.12	16.12	16.12	16.12	16.12
Seed Collection	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	347.89	347.89	347.89
INAB - *Nota de Envío*	0.00	0.00	0.00	0.00	0.00	0.64	0.64	0.64
Subtotal Costs	3477.41	771.15	252.44	301.18	301.18	649.72	554.29	492.99
Revenue								
Christmas Trees	0.00	0.00	0.00	0.00	0.00	9366.26	12042.34	14718.41
PINFOR Incentives	0.00	522.32	219.37	188.03	146.25	135.80	83.57	0.00
Subtotal Revenue	0.00	522.32	219.37	188.03	146.25	9502.07	12125.91	14718.41
Annual Balance $ (USD)	(3,477.41)	(248.84)	(33.07)	(113.15)	(154.93)	8,852.35	11,571.62	14,225.42

Appendix I: Reforestation (*Year 8 through Year 24*)

CASH FLOW TABLE																	
Investment Year	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Stems per Hectare	355	350	345	340	335	330	325	320	315	310	305	300	295	290	285	280	275
Christmas Trees Harvested	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs																	
Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Management	52.43	51.70	0.00	0.00	49.48	0.00	0.00	0.00	0.00	0.00	45.05	0.00	0.00	0.00	0.00	0.00	40.62
Shearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fireline Construction	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12
Seed Collection	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INAB - *Nota de Envío*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Subtotal Costs	68.56	67.82	16.12	16.12	65.60	16.12	16.12	16.12	16.12	16.12	61.17	16.12	16.12	16.12	16.12	16.12	56.74
Revenue																	
Christmas Trees	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Processed Seed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Subtotal Revenue	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Annual Balance	(68.56)	(67.82)	(16.12)	(16.12)	(65.60)	(16.12)	(16.12)	(16.12)	(16.12)	(16.12)	(61.17)	(16.12)	(16.12)	(16.12)	(16.12)	(16.12)	(56.74)

Appendix J: Reforestation (*Year 25 through Year 39*)

CASH FLOW TABLE															
Investment Year	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
Stems per Hectare	270	265	260	255	250	245	240	235	230	225	220	215	210	205	200
Christmas Trees Harvested	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs															
Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Management	0.00	0.00	0.00	0.00	0.00	36.19	0.00	0.00	0.00	0.00	0.00	31.76	0.00	0.00	0.00
Shearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fireline Construction	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12
Seed Collection	0.00	0.00	0.00	3288.67	0.00	3159.70	0.00	3030.74	0.00	2901.77	0.00	2772.80	0.00	2643.83	0.00
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INAB - *Nota de Envío*	0.00	0.00	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00
Subtotal Costs	16.12	16.12	16.12	3305.44	16.12	3212.66	16.12	3047.50	16.12	2918.53	16.12	2821.32	16.12	2660.60	16.12
Revenue															
Christmas Trees	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Processed Seed	0.00	0.00	0.00	9053.71	0.00	8698.66	0.00	8343.62	0.00	7988.57	0.00	7633.52	0.00	7278.47	0.00
Subtotal Revenue	0.00	0.00	0.00	9053.71	0.00	8698.66	0.00	8343.62	0.00	7988.57	0.00	7633.52	0.00	7278.47	0.00
Annual Balance	(16.12)	(16.12)	(16.12)	5,748.27	(16.12)	5,486.01	(16.12)	5,296.11	(16.12)	5,070.03	(16.12)	4,812.20	(16.12)	4,617.87	(16.12)

Appendix K: Reforestation (*Year 40 through Year 54*)

CASH FLOW TABLE															
Investment Year	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**
Stems per Hectare	195	190	185	180	175	170	165	160	155	150	150	150	150	150	150
Christmas Trees Harvested	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs															
Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Management	0.00	0.00	27.32	0.00	0.00	0.00	0.00	0.00	22.89	0.00	0.00	0.00	0.00	0.00	22.16
Shearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fireline Construction	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12
Seed Collection	2514.87	0.00	2385.90	0.00	2256.93	0.00	2127.96	0.00	1999.00	0.00	1934.51	0.00	1934.51	0.00	1934.51
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INAB - *Nota de Envío*	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64
Subtotal Costs	2531.63	16.12	2429.99	16.12	2273.70	16.12	2144.73	16.12	2038.66	16.12	1951.28	16.12	1951.28	16.12	1973.43
Revenue															
Christmas Trees	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Processed Seed	6923.43	0.00	6568.38	0.00	6213.33	0.00	5858.28	0.00	5503.24	0.00	5325.71	0.00	5325.71	0.00	5325.71
Subtotal Revenue	6923.43	0.00	6568.38	0.00	6213.33	0.00	5858.28	0.00	5503.24	0.00	5325.71	0.00	5325.71	0.00	5325.71
Annual Balance	4,391.79	(16.12)	4,138.39	(16.12)	3,939.63	(16.12)	3,713.55	(16.12)	3,464.58	(16.12)	3,374.43	(16.12)	3,374.43	(16.12)	3,352.28

Appendix L: Reforestation (*Year 55 through Year 70*)

CASH FLOW TABLE																
Investment Year	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
Stems per Hectare	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Christmas Trees Harvested	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Costs																
Transportation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seedlings	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Establishment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Management	0.00	0.00	0.00	0.00	0.00	22.16	0.00	0.00	0.00	0.00	0.00	22.16	0.00	0.00	0.00	0.00
Shearing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fireline Construction	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12	16.12
Seed Collection	0.00	1934.51	0.00	1934.51	0.00	1934.51	0.00	1934.51	0.00	1934.51	0.00	1934.51	0.00	1934.51	0.00	1934.51
INAB - *Marchamo*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INAB - *Nota de Envío*	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64	0.00	0.64
Subtotal Costs	16.12	1951.28	16.12	1951.28	16.12	1973.43	16.12	1951.28	16.12	1951.28	16.12	1973.43	16.12	1951.28	16.12	1951.28
Revenue																
Christmas Trees	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Processed Seed	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71
Subtotal Revenue	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71	0.00	5325.71
Annual Balance	(16.12)	3,374.43	(16.12)	3,374.43	(16.12)	3,352.28	(16.12)	3,374.43	(16.12)	3,374.43	(16.12)	3,352.28	(16.12)	3,374.43	(16.12)	3,374.43