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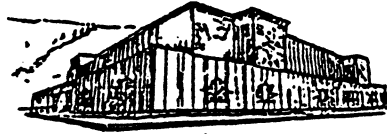
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Fire in the Mountains:

Campesino and natural resource manager perspectives on agro-pastoral burning and forest fires in Honduras

by

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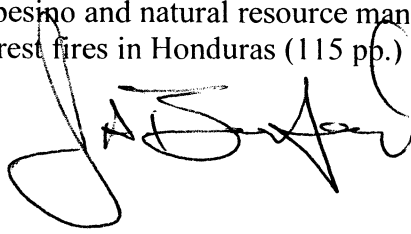
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Fire in the Mountains: *Campesino* and natural resource manager perspectives on agro-pastoral burning and forest fires in Honduras (115 pp.)

Director: James Burchfield



ABSTRACT:

In Honduras fire has been used as a traditional agro-pastoral tool since pre-Columbian times. Today fire remains the primary tool for clearing land, disposing of agricultural residues, and improving forage conditions for cattle. There has been a long tradition of natural resource managers condemning agro-pastoral burning. Forest fires are commonly reported to be due to farmers burning their fields, ranchers burning to improve forage, and incendiaries (arsonists and pyromaniacs).

This study investigated the relationship between the practice of agro-pastoral burning and forest fire ignitions in Honduras. The perceptions of twenty Honduran *campesinos* (farmers and ranchers) and natural resource managers was explored through the use of a standardized open-ended interview. The validity of their responses was determined by triangulating with available literature on the topic and my personal observations and experiences from two years of fieldwork in Honduras.

More than 95 percent of fire ignitions in Honduras are intentionally lit incendiary fires. Due to the criminal nature of incendiaries very little is known about this cause and almost nothing has been done to address it. The majority of the blame and actions taken to reduce fire ignitions have been focused on *campesinos* and their practice of agro-pastoral burning. Alternative land preparation methods to burning do not offer the same benefits and the practice is unlikely to cease. The use of agro-pastoral burning and its link to forest fire ignitions is affected by a number of interrelated factors. These include the traditional culture of burning, current land access and distribution patterns, widespread poverty, the lack of feasible alternative land preparation methods, local fire behavior, and poor fire suppression capabilities.

The ban on burning is counterproductive. Rather than the current opposition between groups, a collaborative alliance should be built. Efforts to reduce forest fires due to agro-pastoral burning must focus on community based forest and fire management strategies. Incentives for forest protection must be implemented in order to make real gains in forest fire reduction. The major factors of poverty, and land distribution and tenure must be addressed as well. There is a pressing need for meaningful economic and agrarian reform.

KEYWORDS: Honduras, fire, forest fire, agro-pastoral burning, agricultural burning, pastoral burning, fire management, natural resource management, farming, ranching

Dedication

Este tesis está dedicado a toda la gente de Nueva Armenia, Francisco Morazán,

Honduras.

Por su hospitalidad y generosidad durante mi tiempo allá tienen mi gratitud y amor.

Siempre estarán en mi corazón

Honduras de noche

yo miro al día cambiar la noche

los grillos comienzan a cantar canciones de amor y paz

las luciérnagas vuelan aún más alto

desde el cerro a la montaña ellas cambian en estrellas

el cielo de noche es infinito

mi mente está viva

las honduras son sin límites

- Dale 'Gregorio' Woitas

10 June 1999

Acknowledgements

I would like to express my gratitude to Dr. Ronald Wakimoto and Dr. Paul Haber for serving on my committee and providing me with expert advice and editorial guidance. I am especially grateful to my major adviser, Dr. James Burchfield, for his encouragement and guidance over the course of almost four years, whether during chats in his office in Missoula or through e-mails received by myself in Tegucigalpa. I am especially thankful for the generous gift of his time, as well as for the use of his office and resources.

Of course this study would not have been possible without the participation of the twenty Honduran farmers, ranchers, and natural resource managers whom I interviewed. I extend my most sincere thanks to all persons involved for generously sharing their time and perspectives with me, and for their patience during the interview process. This study would not have been possible without their help. I am especially grateful for the guidance and help of the always busy Jorge Betancourt.

I would also like to express my deepest gratitude to the people of Nueva Armenia, F.M., Honduras. They gave me much more than I was able to give in return. I am especially indebted to the Nuñez-Rodríguez family. They opened their house and hearts to me and welcomed me as another son. I will never forget their love and hospitality. I would also like to thank my friends and family who supported me throughout my Peace Corps service with their guidance and encouragement.

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Introduction

On a hot March afternoon I sat in a crowded old school bus, traveling from the Honduran capital of Tegucigalpa to my Peace Corps site of Nueva Armenia, Francisco Morazán. The stereo speaker crackled as it blasted out the chorus to a popular song, “*Suave, suavecito papi, suave.*” My shirt clung to me as sweat ran down my neck and back. I wanted to open a window but knew that the dust would come pouring in and I’d be even more uncomfortable. The bus labored to climb the steep dirt road and I looked out over the dry, brown and gray landscape. It was the height of the dry season and most of the country hadn’t seen a trace of rain since the previous October. The only green visible was on the pine trees, but even these had a brown tinge to them from the dust.

Alongside the road I noticed a hillside *milpa*¹ (cornfield) that had recently been burned. It was a mosaic of soil covered by black ash, large rocks, and small patches of unburned corn stubble. Scattered over the *milpa* were the short, bright red stumps of *carbón* trees (*Acacia pennatula*) that had been cut before the burn. It all looked very desolate to me but I knew that when the rains returned in late May the scene would quickly change. New corn plants would sprout golden-green on every space not occupied by trees or rocks. The stumps of *carbón*, despite a complete lack of leaves, would shoot up again, providing the fuel to cook more delicious meals of rice and beans, corn tortillas, and sugary coffee.

As we reached the crest of one of the many hills along the route I strained to see

¹ The most relevant *italicized* words can be found in the Glossary beginning on page 106. It explains local Spanish terms, abbreviations and acronyms.

the Gulf of Fonseca, 50 miles to the south. But today there was no chance of that. As far as I could see there were plumes of thick smoke rising from the land. A pall of smoke hung in the valleys and over the mountains. I could see no flames, only smoke. On a parcel near a small stream I could see a few *campesinos* burning a pasture. Hillside *milpas* were scattered across the landscape among open stands of *ocote* pine (*Pinus oocarpa*), making it difficult for a distant observer to determine whether a particular column of smoke was due to an *incendio forestal* (forest fire) or to a *quema agrícola* (agricultural burn). This got me thinking. Since *campesinos* (farmers, ranchers) sometimes retain trees within their fields, and have fields surrounded by forest, pasture, and fallow lands, how can one differentiate an agro-pastoral burn from a forest fire? Do these burns sometimes go into the forest and become forest fires? Is this a common occurrence? What are the factors that allow this to happen? When ranchers burn forest understory to renew forage is it classified as a *quema* or as an *incendio*?

Overview of the situation in Honduras

Each year in Honduras columns of smoke fill the sky as hundreds of thousands of hectares of forest, agricultural land, and pastoral land burn. One, or sometimes both, of the international airports are forced to suspend all flights for days at a time due to poor visibility (Dixmude 2001). Children, the elderly, and those with respiratory problems are affected by the increased air pollution. Respiratory-related visits to hospitals tend to increase during the months of April and May (Dixmude 2001).

Honduras experiences one of the highest rates of deforestation in the world. Loss of forest cover is estimated to be as high as 2.3 percent annually (estimated loss from 1990 to 1996; Encarta 2001). An increasing population has led to the clearing of land for

farming (generally using the slash and burn method), the farming of marginal soils on hillsides, unregulated logging, and uncontrolled development on the edges of urban areas (CIA 2001, Encarta 2001). These vectors of deforestation as well as unchecked forest fires and agro-pastoral burns are factors that may contribute to increased soil erosion and loss of diversity. Severe soil erosion has led to increased pollution and sedimentation of freshwater sources. More than 75 percent of the country's land area is considered mountainous terrain (Faber 1993). Small-scale farmers and ranchers have been relegated to working hillside parcels. These parcels form a mosaic with forested land.

Agro-pastoral burning is a common tool used by subsistence farmers and ranchers in Honduras. Agricultural burning is a land preparation method used by farmers where a parcel is burned periodically, then allowed to go fallow for a few years before being slashed and burned again. This method, known as swidden agriculture or shifting slash and burn agriculture, is an ancient method used in the tropics and semi-tropics. It is distinct from slashing and burning as a land clearing method, where a parcel is being cut for the first time. It is an acceptable agricultural practice in large areas with low population densities. Modern Honduran farmers cultivating basic grains such as corn and beans commonly use fire as a tool to clear fields and prepare them for cultivation, and to dispose of agricultural residues (Jansen 1998, Dixmude 2001). This can be done at any time during the dry season, which runs from November until mid-May, but is most common in March, April and May. Pastoral burning is also quite common in Honduras. Ranchers use fire as a tool to improve the growth of forage for their cattle, and to eliminate ticks and other parasites from their grazing lands. In this case they burn

savanna or forest understory for use as pastureland, without cutting any vegetation before burning.

Forest fires in Honduras are a seasonal event and generally only occur during the dry season. Like agro-pastoral burns, forest fires are most common later in the dry season, in the months of March and April. Nearly all forest fires are due to human, rather than natural, causes. Lightning fires are extremely rare. Most electrical storms occur during the rainy season when the vegetation is verdant and there is low fire danger. Even when storms occur during the dry season they are accompanied by rainfall that inhibits fire ignitions. Forest fires are commonly reported to be due to farmers burning their fields, ranchers burning to improve forage, and incendiaries (arsonists and pyromaniacs).

While an organized fire management program has existed in Honduras since at least 1974 there has been little institutional capacity to compile statistical data or to even manage wildfires. The Honduran government lacks the necessary resources to successfully implement a fire management program. Specific information on fire occurrence, causes, and area burned would be useful in order to determine target audiences for fire prevention campaigns, and for the monitoring and evaluation of fire management program performance. At present this information is based upon unreliable estimates and does not exist in a systematized format.

Existing literature on the topics of agriculture and forest management in Central America tend to make unfounded generalizations. Much of the literature cites data taken from secondary sources such as policy documents. In turn, this data has been taken from tertiary sources (Jansen 1998). The lack of resources to do good quantitative research in the field promotes an uncritical use of rough estimates, or 'guesstimates' (Biot et al 1995,

Jansen 1998). The lack of accurate quantitative data has hindered a realistic understanding of these topics.²

There has also been increasing realization that natural resource management must be based upon more than just quantitative scientific data but must also take into account qualitative data, such as public perception, in order for management decisions to be successfully implemented (Stine 1987, Ketterings et al 1999, Winter et al 2002). While these studies have become increasingly common the majority have been conducted on research problems in the United States. One response to conventional research has been a push for various ‘agro-ecology’ approaches (Conway 1985, Altieri 1987). These approaches have shifted the research focus by employing traditional ‘indigenous’ knowledge. This works to give a voice to the peasant in an intellectual system not accustomed to dealing with the ‘uneducated.’ Some studies in Honduras have focused on local farmer knowledge of the issues of organic farming and sustainability (Bunch 1982, Bentley 1989, Smith 1994, Bunch and López 1995). Few studies have attempted to achieve an in-depth understanding of the link between agro-pastoral burning and forest fires, or of local knowledge of agro-pastoral burning in Honduras (Jansen 1998). A few policy papers from the FAO briefly touch upon these subjects (Allard and Mutch 2000, Soihet 2001).

Guiding Questions

Small-scale farmers and ranchers have diverse experiences and a wealth of ‘in the field’ knowledge that is extremely valuable and must be considered when developing and implementing resource management policies that will both affect them and be effected by

² This lack of quantitative data applies to this research as well. Much of the quantitative data cited has been based on estimates. When possible I have tracked down original sources rather than secondary citations.

them. Natural resource managers (NRM's) should recognize the importance of this local knowledge and stress participatory approaches in order to formulate effective policies.

This study is a qualitative process designed to explore the connection between the practice of agro-pastoral burning and forest fire ignitions. It will provide natural resource managers insights into this connection and allow them to better address the problem of unregulated forest fires in Honduras.

The major questions that guided research of this topic included:

- How is fire used as a tool by farmers and ranchers in Honduras?
- What is the relationship between agro-pastoral burning and forest fires in Honduras?
- What are the major factors that influence this relationship?
- How is fire (both forest fires and agro-pastoral burning) perceived by Honduran farmers, ranchers, and natural resource managers?
- Do the perspectives of farmers, ranchers, and natural resource managers vary greatly regarding agro-pastoral burning and forest fires?

These questions were explored through the use of a standardized open-ended interview conducted with twenty Hondurans (see Appendix A). The validity of their responses was determined by cross-checking with available literature on this topic and by comparing to my own personal observations and experiences from two years of fieldwork in Honduras.

“The purpose of qualitative interviewing is to capture how those being interviewed view their world, to learn their terminology and judgments, and to capture the complexities of their individual perceptions and experiences. This openness distinguishes qualitative interviewing from the closed questionnaire or test used in quantitative studies. The fundamental principle of qualitative interviewing is to provide

a framework within which respondents can express their own understandings in their own terms.” (Patton 2002). Through this thesis I hope to provide a forum for Honduran farmers, ranchers, and natural resource managers to express their perceptions, attitudes, and beliefs about agro-pastoral burning and how it relates to forest fires in their country.

Eisner (1997) suggests that qualitative research projects can be assessed by the “number and quality of the questions that the work raises” as much as by any conclusions reached or solutions proffered. I hope to not only reveal the relationship between agro-pastoral burning and forest fires in Honduras and the major factors affecting this relationship, but also to raise a multitude of questions that will promote further research on this topic.

Thesis Organization

The **second chapter**, entitled Background on Honduras, gives an overview of the physical, climatological, socioeconomic, and historical features of Honduras. It also gives specific information about the historical and present use of agro-pastoral burning, and of the situation of forest fires. This chapter provides context for those readers unfamiliar with Honduras.

The **third chapter**, entitled Methodology, outlines the qualitative research approach and the specific methods used to investigate the relationship between agro-pastoral burning and forest fires in Honduras. It describes the study sample and interview process, and explains how data analysis was conducted. There is a discussion of indigenous typologies specifically relevant to Honduras. Finally, there is a description of the method of triangulation, in which a combination of personal observations, open-ended interviews, and document analysis was used in order to reveal the findings.

The **fourth chapter**, entitled Findings, is a synthesis of research data organized around the framework of the interviews. It utilizes thick description and the method of triangulation in order to reveal findings from the interviews, appropriate literature, and personal observations. Findings stay true to interview data by providing the informants' words in context.

The **fifth chapter**, entitled Discussion, interprets the findings and attempts to answer the guiding questions as well as others raised in the Findings chapter.

The **sixth chapter** concludes with a review of the most important findings. It also offers recommendations for change and direction for further research on this topic.

Chapter 2

Background on Honduras

This chapter gives an overview of the situation in Honduras and provides context for those readers unfamiliar with the country.

Geography

Honduras, located on the Central American isthmus, has an area of 112,492 square kilometers (43,433 square miles). It is bordered by Nicaragua to the southeast, El Salvador to the southwest, and Guatemala to the west. The Gulf of Fonseca and Pacific Ocean lie to the south and the Caribbean Sea to the north. The Caribbean coast consists of long and narrow lowlands that are wider in the east. Much of the southern coast consists of narrow swampy lowlands. Except for these two coastal strips the country is generally mountainous with a few broad, fertile plains and numerous intermontane valleys. More than 75 percent of the land area consists of rugged, mountainous land possessing slopes greater than 25 percent (Faber 1993). The mountains rise to maximum elevations of more than 2,800 meters (Merrill 1994, CIA 2001, Encarta 2001). The mountainous terrain makes the land difficult to traverse and thus has slowed the country's development and exploitation. The soil in the highlands is relatively poor, lacking the layers of rich volcanic ash found in other Central American countries (Merrill 1994).

Climate

The climate of Honduras is temperate in the mountainous interior and subtropical along the coastal plains. The mean annual temperature in the interior is 21° C (70° F). In the coastal regions the mean annual temperature is 27° C (80° F) and the humidity is higher as well, making it seem much hotter (Encarta 2001). Rain may fall year round in

the Caribbean lowlands, but is heaviest during the hurricane season from June to November. Precipitation is seasonal throughout the rest of the country. There are two seasons. A rainy season (*invierno*) prevails from mid-May to October and a dry season (*verano*) runs from November until mid-May. The rainy season is broken up by a few weeks of dry weather in August, known locally as the *canicula*. Average annual precipitation varies from 1,770 mm (70 in.) to 2,540 mm (100 in.) along the Caribbean coast, and from 1,520 mm (60 in.) to 2,030 mm (80 in.) along the Pacific coast. In the mountainous interior average annual precipitation may be only 1,000 mm (40 in.) (Merrill 1994, Encarta 2001). Most of the country has experienced drought conditions in recent years, specifically in 1997, 1998, 2000, and 2001.



Figure 1. Map of the Republic of Honduras

Vegetation

The forests of Central America have the highest level of biomass per unit area in the world (Ortiz-Chour 2000). This relatively tiny region contains seven percent of the world's biodiversity. The vegetation of Honduras is varied. Mangrove (*Rhizophora mangle* and *Laguncularia racemosa*) swamps are found along the Gulf of Fonseca coastline (Oyuela 1995). The Caribbean coast supports subtropical broadleaf forest, but in many areas has been displaced by permanent agriculture. La Mosquitia, in the northeast of the country, is primarily evergreen broadleaf forest. These forests consist of about 200 species, with the most common being *Virola* spp., *Vochysia hondurensis*, and *Terminalia amazonia* (FAO 2002). Extensive stands of Caribbean pine (*Pinus caribaea* var. *hondurensis*) are found along the low-lying coastal plain, at elevations from 20 to 700 meters (Hernández 1984).

Pine forests and pine-oak associations cover the cooler highlands and savanna grasses cover the drier areas. *Ocote* pine (*Pinus oocarpa*) is found between elevations of 600 and 1,600 meters in pure stands or mixed with various species of oak (*Quercus* spp.) (Hernández 1984, Vogel 1953 in FAO 2002). Between 500 and 1,900 meters there may be a mixture of *ocote* pine, *pinabete* (*Pinus pseudostrobus*), sweet gum (*Liquidambar styraciflua*), and oak. The highest peaks contain remnants of cloud forests consisting of trees from the *Quercus* and *Podocarpus* genera. Much of the southern region has been deforested and is now covered with spiny scrubland.

In Honduras fire plays a significant role in maintaining open, park-like pine stands with a grass understory. Fire return intervals may be as short as one to five years (Dixmude 2001). It is believed that the extensive pine forests of Honduras have been

maintained by shifting slash and burn agricultural practices. The major pine species found in Honduras, *ocote* pine and Caribbean pine are shade-intolerant and their seeds germinate best on exposed mineral soils. *Ocote* exhibits serotinous cones. They are seral species and without regular burning these stands are invaded by mid-successional and climax hardwoods. Fire exclusion from pine stands results in an initial growth of pine regeneration, which is gradually replaced by a hardwood community. Since there is an almost total lack of natural fire ignitions these forests are viewed as being a deflected successional community maintained by thousands of years of human activities such as regular clearing, burning, and/or grazing (Cook 1909, Stewart 1956, Johannessen 1959, Denevan 1961).

Land Use

The total land area of Honduras is 11.2 million hectares, of which 15 percent is arable cropland (Merrill 1994, AFE-COHDEFOR 1999). Another three percent of the land area is permanent cropland, most of this being banana, citrus fruit, and pineapple plantations along the North Coast. About 14 percent of the land is permanent pastureland. Forests and woodlands cover approximately 54 percent of the land area, while 14 percent of the land is under other uses (CIA 2001).

Together the Honduran government and the two major banana companies (Chiquita Brands International and Dole Food Company) owned approximately 60 percent of the cultivable land as of 1993 (Merrill 1994). Much of the rest of the cultivable land is owned by other large landowners and is used for other plantation crops such as sugar cane or melons. Most food crop production has been relegated to hillsides, with the limitations of small plots, basic technology, and low productivity that

traditionally accompany hillside agriculture. Soihet (2001) refers to a 1993 study of land possession by SECPLAN which determined that of 317,199 'farms', 72 percent occupied less than five hectares of land.

Population

About 90 percent of Hondurans are *mestizo*, people of mixed Spanish and Native American ancestry. The remainder are Amerindians (7%), Black Africans (2%), and Whites (1%) (Encarta 2001).

The population of Honduras (July 2001 estimate) was 6,406,052 (Encarta 2001). The population is 54 percent rural, but is becoming more urbanized. It is estimated that 25 percent of the population now lives in the two largest Honduran cities, Tegucigalpa and San Pedro Sula (Merrill 1994). Overall population density is 57 people per sq. km. (147 per sq. mi.) (Encarta 2001). Much of the population lives in the western highlands (in the departments that border El Salvador), and along the northern coastal plain. La Mosquitia, in northeastern Honduras, is sparsely settled. More than 40 percent of the population is settled in forested areas (Salazar 1999). The annual growth rate is 2.43 percent (2001 estimate) (CIA 2001). The literacy rate is estimated to range between 72.7% (1995 estimate in CIA 2001) and 83.7% (Encarta 2001).

Economy

Honduras is one of the poorest countries in the Western Hemisphere. Approximately 53 percent of the population lives below the poverty line (1993 estimate in CIA 2001). This figure reaches 70 percent or more in rural areas (Soihet 2001). The unemployment rate is about 28 percent (Encarta 2001).

Despite the fact that only about 18 percent of the land area is cultivated or used for plantation agriculture the Honduran economy has always depended almost exclusively on agriculture (Merrill 1994, Encarta 2001). Approximately 37 percent of the labor force is engaged in agriculture (Encarta 2001). The leading cash crops are coffee, bananas, sugarcane, and palm oil. Coffee and bananas are number three and four respectively for export income earnings. The principal food crops are corn, beans, and rice (Encarta 2001). In 2000 livestock numbered 1.95 million head of cattle and 700,000 pigs (Encarta 2001). Most rural families raise chickens for local consumption. Approximately 55 percent of the agricultural labor force subsists on less than two hectares and earns less than \$70 per capita annually from those plots, mainly by growing subsistence food crops (Merrill 1994). Shrimp and lobster production have become important exports.

The national economic focus on agriculture is slowly beginning to subside as Honduras moves towards an industrial and service economy. The government is promoting expansion of the manufacturing sector, seeking to improve transportation and telecommunications, develop further hydroelectric projects, diversify agricultural production, and encourage tourism (Encarta 2001).

Forestry is an important industry but has been hampered by rudimentary processing methods, rugged terrain and poor transportation infrastructure. In 1999 roundwood production was 7.18 million cubic meters (253 million cubic feet) (Encarta 2001). Commercially valuable timber includes *los pinos* (*Pinus oocarpa*, *P. caribaea* var. *hondurensis*, *P. pseudostrobus*), mahogany (*Swietenia humilis*), ebony (*Diospyros* spp.), walnut (*Juglans* spp.), and rosewood (*Dalbergia* spp.) (U.S.F.S. 1996).

Hardwoods and timber are major exports. Important non-wood forest products include resin, turpentine, liquidambar tannins, and chicle (FAO 2002). Fuelwood is the most important energy source in the country, accounting for 65 to 70 percent of energy generated (Soihet 2001, FAO 2002). Approximately 75 percent of the population uses fuelwood for domestic use (Soihet 2001). The collection of fuelwood accounted for at least 7.5 million cubic meters of total wood harvested in 1990 and 1993. The most common fuelwoods in Honduras are: *roble* (*Quercus oleoides*), *encino* (*Quercus spp.*), *carbón* (*Acacia pennatula*), and *pino* (Soihet 2001).

Mining is a small but important industry. Deposits of zinc, silver, and lead are exploited and are important exports. In 1999, 40,996 metric tons of zinc concentrate and 46.5 metric tons of silver were processed (Encarta 2001). Other mineral resources, such as iron ore, coal, copper, and antimony, largely remain unworked.

The Honduran manufacturing industry has grown significantly in recent decades. *Maquiladoras* (textile/clothing plants) are now the largest source of income for the country, earning \$456 million in 2001 (Rosenweig 2002). Cement, cotton, sugar, wood products, and chemicals are important exports. Detergents, light metals, and food products are primarily manufactured for in-country consumption.

The Honduran government declared 2001 as the year of tourism, realizing the economic benefits experienced for years by its Central American neighbors, especially Costa Rica and Guatemala. In 2001 tourism brought in an estimated \$300 million, making it the second largest source of income for the economy (Rosenweig 2002). It is estimated that by 2006 tourism will be the country's number one income earner.

Environmental Issues

Honduras experiences one of the highest rates of deforestation in the world. Estimates of annual forest cover loss range from 1.63 percent (OEA estimate from 1964 to 1990; Soihet 2001), to 2.30 percent (from 1990 to 1996; Encarta 2001), to 1.03 percent (FAO estimate from 1990 to 2000; FAO 2002). Much of this deforestation is occurring in La Mosquitia, the largest remaining tract of virgin subtropical forest in Central America. Here illegal logging, shifting slash-and-burn agriculture, and commercial hunting and gathering of protected species is a problem (Soihet 2001). Nationwide an increasing population has led to the clearing of forestland for farming, the farming of marginal soils on hillsides, unregulated logging, and uncontrolled development on the edges of urban areas (Encarta 2001). All of these factors contribute to deforestation and increased soil erosion.

The prevalence of steep mountain slopes promotes soil erosion. Soil erosion averages an estimated 40 to 202 metric tons per acre on approximately 5.68 million acres of agricultural land (USAID 1982, 1987 estimate in Soihet 2001). It has been estimated that soil erosion affects 40 percent of the country's land area (Soihet 2001). Severe land degradation and desertification is occurring in the western and southern regions (DeWalt 1985). It is especially evident in the southern department of Choluteca. Approximately two-thirds of the peasant families in the southern highlands cannot produce enough food to provide for their own subsistence (Boyer 1983).

Besides loss of soil fertility, erosion leads to increased pollution and sedimentation of freshwater sources. Water pollution is another major environmental

concern. Heavy metals from mining, and the lack of wastewater treatment facilities are polluting Lake Yojoa, the country's largest source of freshwater, as well as many rivers and streams (Encarta 2001). Although many urban residents have access to safe drinking water and sanitation, access is lower for many rural residents.

The government has ratified international environmental agreements related to biodiversity, endangered species, climate change (including the Kyoto Protocol), ozone layer protection, and marine dumping, among others. However the government lacks the resources to enforce these agreements and depends upon assistance from foreign aid programs and NGO's (Encarta 2001).

Historical, Political and Social Review

Western Honduras marked the southern edge of the great Maya civilization. The ruins at Copán attest to the advanced stage of the country's population at the time of the Honduran city's collapse late in the ninth century, well before the Spanish Conquest (Encarta 2001). The gradual collapse of Copán may have been due to soil exhaustion and other agricultural problems from the continuous cultivation of surrounding lands. These and other factors may have weakened the city to the point where it could no longer support a large population.

Several non-Maya tribes also inhabited various regions of what is now Honduras. The indigenous population was decimated by the *conquistadores* and the diseases they introduced. The population was subjugated between 1502 and 1530 (Soihet 2001). The number of Spanish settlers was small and included few women, which accounts for the fact that *mestizos* are the dominant ethnic group today.

Honduras was part of Spain's vast New World empire until its independence in 1821. Following independence the country was under military and/or dictator rule for most of the 19th and 20th centuries. The United States has been a dominant influence on Honduran politics throughout its history. In the 20th century U.S. fruit companies (United, Standard, and Cuyamel) made bananas the country's principal export, leading to the term "Banana Republic." They ruthlessly competed for favorable concessions from the Honduran government and developed the western Caribbean coast, constructing the country's only railway. But they contributed little to the development of the rest of the country. The fruit companies succeeded in dominating the Honduran political system into the 1970s (Jansen 1998).

Many of the class-based social problems that have plagued the other Central American republics have had little effect in Honduras. Merrill (1994) contends that this low level of social tension in Honduras had its origins in the country's colonial and early republic history. "Honduras was a backwater in the territories held by Spain. Because much of the indigenous population either had been exterminated or had died of disease, the province was sparsely populated. Ethnically, this meant that Honduras had a more homogeneous *mestizo* culture than most other Spanish colonies." The population was isolated due to the mountainous topography and the few mineral deposits present were not easily exploited. "Consequently, the colonial elite in Honduras came to be defined by their control of the province's political system rather than by their accumulation of wealth." Later, much of the accumulated wealth went to U.S. investors who owned the banana companies, keeping the Honduran class structure less divided than in the other

Central American republics. Honduras never developed so strong or coherent of an upper class as did its three neighbors (Booth and Walker 1989).

Booth and Walker (1989) described Honduran social and economic structure in other terms. Of the five Central American Common Market nations Honduras' social and economic structure was the one least altered by the growth boom and crash from the 1950s through the 1980s. Much of the economic investment in Honduras was made in agriculture. While the manufacturing industry grew, it remained the smallest in the region. The effects of rapid capital-intensive industrialization led to less severe class conflicts than in the other Central American nations. The government generally responded to demands and protests with ameliorative policies rather than with heavy-handed repression. A moderately successful agrarian reform program was instituted in the 1970s. In sharp contrast to its neighbors at that time the Honduran government often sided with poor *campesinos* over large landowners in land tenure conflicts (Brockett 1998). During the mid-1970s Honduran wage earners experienced less severe and sustained declines in wages and living standards than their neighbors. All of these factors resulted in less severe protests and rebellions than occurred in neighboring countries.

The central issue for Honduras in the late 1970s and 1980s was political instability in neighboring countries. Honduras became a haven for thousands of Contra guerrillas fighting Nicaragua's Sandanista government, and an ally to a Salvadoran government fighting leftist guerrillas (CIA 2001). The U.S. military became an enormous presence in an effort to put additional pressure on the Sandanistas. U.S. presence was so great that it prompted one U.S. Congressman to refer to the country as the *U.S.S. Honduras* (LeFeber 1983, Booth and Walker 1989).

In 1982 a freely elected civilian government came to power but the military retained considerable influence (Encarta 2001). In 1986 one civilian government peacefully succeeded another for the first time since 1929. In 1994 Carlos Roberto Reina was elected president. Reina restored civilian control by removing the national police force from the jurisdiction of the military and by implementing a plan to put the armed forces under a civilian defense minister beginning in 1999.

In late October 1998 Hurricane Mitch devastated Honduras, killing an estimated 5,000 people or more. Thousands of others were left without homes or food. The nation lost as much as 70 percent of its crops, and damage to roads, bridges, and other infrastructure was expected to cost billions of dollars to repair. Some experts said that the storm had set Honduran development back decades.

Historical Use of Agro-pastoral Burning

The indigenous of Central America have always used fire as a tool to clear and prepare land for crops (Johannessen 1959, Denevan 1961, Meyer and Meyer 1994, Montoya 1998) and to establish grasslands and provide game habitat (Stewart 1956, Montoya 1998). In Honduras, burning has probably been used for thousands of years as evidenced by the extensive fire-adapted pine forests and the near complete lack of natural fire ignitions. Some scholars believe that the collapse of the Maya center at Copán may have been due to soil exhaustion from years of continuous slash and burn land preparation without the necessary fallow periods (Meyer and Meyer 1994, Encarta 2001).

Present Use of Agro-pastoral Burning

Today fire remains the primary tool for clearing land, disposing of agricultural residues, and improving forage conditions for cattle (Jansen 1998, Dixmude 2001).

Farmers use fire to clear land in order to plant corn, beans, and sorghum, as well as to dispose of agricultural residues from previous harvests. Ranchers use fire to improve the growth of forage for their cattle, and to eliminate ticks and other parasites. Burns can be conducted at any time during the dry season, from November until mid-May, but are most common during the hottest and driest months of March, April and May. Burning of farm plots may take place in one or two steps: first broadcast burning; possibly followed by piling and burning any remaining fuels.

Farmers clear the vegetation from fallow fields by hand with machetes, removing fuelwood from the parcel. Ranchers do not cut any vegetation prior to burning grassland or forest understory for use as pasture. A farm plot is cultivated for two to four years before being allowed to go fallow for five to ten years (Faber 1993). The fallow period is critical for rejuvenation of soil fertility following intensive slashing, burning, and planting cycles. Meyer and Meyer (1994) state that in the shifting slash and burn agricultural system about four hectares should be left fallow for each hectare in cultivation. It has been calculated that in Mexico each farming family requires a minimum of 20 hectares in order to allow sufficient fallow rotations (Montoya 1998). However, growing land pressure has resulted in a shortening of the fallow period. Food-crop parcels in Honduras are used for an average of 1.8 years, then left “to rest” (*descansar*) for approximately two years (Soihet 2001). Spiny herbaceous vegetation begins to invade plots due to the repeated disturbance by burning. It has been reported that the decision to allow a plot to go fallow may be due more to the increased labor demands for weeding invasive species, rather than to decreasing soil fertility (Watters 1971, Jansen 1998).

Opposition to agro-pastoral burning

In Honduras there has been a long tradition of natural resource managers condemning agro-pastoral burning, believing that it destroys soil fertility and leads to erosion and deforestation (Jansen 1998):

“If there is reform necessary, urgent, in our agriculture, it is the abolition of the barbarian method of burning, because burning in agriculture begins to be the ruin of the earth and concludes being the barrier which impedes the development of our villages and agricultural populations.” (Campos 1910).

“Burning the fields for sowing has been an ancestral practice for our people. Nothing is more fatal, nothing is more detrimental for the fertility of a field... This is not a way to cultivate the earth. It is a destructive practice which we should ban from our agriculture.” (Pinel 1939).

These same attitudes prevail today among Honduran natural resource managers. There has been a tradition of viewing burning by *campesinos* as an ‘uncivilized’ act. Burgos (1941) is one of many who have linked agro-pastoral burning to ‘ignorance.’ This idea is prevalent in Honduran newspaper articles and letters to the editor (Jansen 1998). Others argue that urban dwellers have lost their daily connection with fire, and thus in their view burning is ‘uncivilized’ and characterizes ‘ignorance’ (Redclift and Goodman 1991, Goudsblom 1992 in Jansen 1998). Since agro-pastoral burning is ‘traditional,’ it is the opposite of ‘modern.’

The general assumption that burning leads to a crucial loss of minerals, nutrients, and organic matter is not entirely correct (Jansen 1998). Research reveals that burning may decrease total nitrogen content on a site while increasing available nitrogen (Peters and Neuenschwander 1988). Burning can increase nutrient availability of nitrogen, calcium, magnesium, and phosphate. Most importantly, soil pH rises following a burn, crucial for crop production on the acidic soils of the Honduran interior.

Burning is an acceptable tool under conditions of low population density and land pressure (Webster and Wilson 1980, Bandy et al 1993, Jansen 1998). Studies view burning as a site-adapted, rational agricultural method that results in adequate yields with low labor costs. However, the literature generally concludes that growing land pressure and shortening fallow periods cannot sustain intensive agricultural burning and that alternative methods should be promoted.

Forest Fires in Honduras

Throughout Central America forest fires are a seasonal event and generally only occur during the dry season. Like agro-pastoral burns, forest fires are most common at the height of the dry season, in March and April. In Honduras the majority of forest fires occur in pine forests (Soihet 2001). Although fires do occur in the inland broadleaf forests of La Mosquitia they are of minor importance here for several reasons. Nearly all fire ignitions are due to human causes. Since La Mosquitia, in northeastern Honduras, is the most remote and least densely populated region of the country there are less fire occurrences. Almost no literature exists concerning either agro-pastoral burning or forest fires in La Mosquitia, although slashing and burning is used as a land clearing method. For these reasons this research has focused exclusively on fires occurring in pine forests.

Honduran pine forests exhibit a high frequency occurrence of low intensity fires. The majority are low intensity surface fires. Crown fires have been known to occur occasionally in La Mosquitia. Because of the traditional use of fire by *campesinos* and the general public's position as cause of the majority of fire ignitions there is no *natural* fire return interval. The fire return interval may be five years or less in many pine stands (Dixmude 2001), resulting in destruction of all pine regeneration. However the majority

of fires in Honduran pine stands cause little ecological harm. Mature *ocote* and Caribbean pine are fire-adapted species and are well able to resist the high frequency, low intensity fires which mark most pine stands.

Fire Management

While an organized fire management program has existed in Honduras since at least 1974 there has been little institutional capacity to compile statistical data or to even manage wildfires. The Honduran government lacks the necessary resources, and many times the political will, to successfully implement a fire management program. "Forest fires, commonly set off by accident when burning for agricultural purposes, are still frequent. Forest fires have not diminished in size or frequency and AFE-COHDEFOR has no budget for fighting them." (U.S.F.S. 1996). International assistance has been the major impetus behind fire management in Honduras, mainly from United Nations' aid through the Food and Agriculture Organization (FAO) and the World Food Program (*Programa Mundial de Alimentos*) (Canchón Avellaneda 1990). Specific information on fire occurrence, causes, and area burned would be useful in order to determine target audiences for fire prevention campaigns, and for the monitoring and evaluation of fire management program performance. At present this information is based upon unreliable estimates and does not exist in a systematized format.

Quantitative Fire Data

Much of the current quantitative data regarding fire occurrence in Honduras comes from remote sensing data from NOAA/AVHRR³ satellites. This data is provided free of charge by NOAA and is easily accessed at local stations. In Honduras an antenna

³ National Oceanic and Atmospheric Administration / Advanced Very High Resolution Radiometer

is located at the national forestry school in Siguatepeque, Comayagua. Data is available daily since the satellite passes overhead twice every 24 hours, but practical and technical problems commonly prevent this (PFA 2000).

The AVHRR sensors have the capability of determining the number and location of fires in a specific area with a precision of 85 to 90 percent for fire detection, and from 90 to 99 percent for the confirmation of fire absence (1995 study by EOS-NRI-SERCO, in PFA 2000). However there are a number of factors that limit this capability. A single image from an AVHRR sensor covers the entire Central American isthmus, resulting in a very low spatial resolution. At the nadir each pixel represents a 1.1 km by 1.1 km area, but a 2.5 km by 5.5 km area for those pixels at the edges of the scanned area. If the sensors indicate that this pixel is a heat source it could be a forest fire, an agro-pastoral burn, or various numbers of both. Generally, a heat source must be at least 50 meters wide to be detected. Only fires that are active when the satellite passes overhead are detected. Possible sources of error include clouds and bodies of water. A large amount of smoke in the atmosphere could limit the land area monitored. Computer malfunctions and electrical blackouts limit data collection.

Due to these limitations it is believed that AVHRR data results in conservative estimates of fire occurrence. In Honduras the AVHRR system detected the following numbers of fires from 1996 to 1999 respectively: 1,430; 7,376⁴; 6,983; and 3,306 (PFA 2000). Due to the major limitations of the system the data should be used as indicators rather than absolute quantities of fire occurrence. The data indicates an approximate number of fires, yet estimating the land area burned is much more difficult (Dixmude

⁴ Both 1997 and 1998 were extreme fire years across Central America due to climatic effects from El Niño (Allard and Mutch 2000).

2001). In some instances remote sensing data is verified by field surveys. However, most of the time they are not verified due to the lack of resources to do so. Many studies and policy papers about forest fires in Honduras cite quantitative data without addressing the collection methods used to gather this data.

Land Area Burned

Because of the limitations of the AVHRR remote sensing system and the lack of resources to do field surveys of burned areas we have little better than rough estimates of the amount of land area burned annually in Honduras. The most accurate estimates available come from COHDEFOR, gathered from the various National Parks and National Forests. According to a COHDEFOR report, from January to sometime in April 2001 approximately 52,600 hectares of land were burned by more than 1,830 forest fires (PDF 2001), but these are likely just the fires actively suppressed by COHDEFOR. Nearly 600,000 hectares of Honduran forests and brush/grasslands are estimated to have burned from December 1997 to May 1998 (Mutch et al. 1999). In the recent past COHDEFOR has reported that on average an estimated “60 percent of the total area of pine forests in the country burn annually” (Programa Social Forestal 1996). This represents an area equal to more than 1.5 million hectares (AFE-COHDEFOR 1999). An earlier study estimated that from 20 to 50 percent of Honduran pine stands burned annually (FAO 1968). Prescribed burning is a tool recognized to reduce fire hazard and maintain current pine stands. It has been used in Honduras since the 1980s, but there is no data available of the number of prescribed burns conducted or the area burned annually.

“Well, according to the statistics from the registrations that we have, there are about 75,000 hectares of forestland burned (annually). However, there burn about 800,000 hectares nationally...because

we only protect a small portion of the forestlands in Honduras. In reality in Honduras there burn about 800,000 hectares. I believe that the amount of land burned nationally is being reduced. In the past it was estimated that around one million hectares were burned (annually), about six or eight years ago they estimated this. I believe that this has lowered greatly on a national level because we have created a bit of consciousness among the population with respect to the problem of forest fires. We have reduced fire occurrence. Statistically they have been reduced. [This 800,000 ha. is forest?] The majority of lands most affected by fires are the private and municipal forests, and lastly, the national forests. The majority of national forests are constituted of broadleaved forests that are reserves, protected areas. They are in the higher elevations and have been declared as protected areas. Many of them have a belt of pine forest where we are doing much protection work, more than on...privately owned (land). (On private land) the majority of the land is dedicated to grazing. This is where they burn the zone, of this 800,000 hectares, land that is dedicated to agriculture and cattle ranching.” [i1]

While most of the NRM’s mentioned the above informant by name as having the appropriate data, others were openly skeptical of COHDEFOR estimates: “No one knows in Honduras. Nor can anyone tell you. He who says (they know) is a liar. And I don’t want to guess about this. If COHDEFOR says that 2,000 hectares burn annually it’s a lie. This burns in only one fire in La Mosquitia. If they say 100,000 hectares burns, this isn’t certain either. This burns in one Department in Honduras. Thus there is no institution in the country that has an audit. And any data that they give is wrong. It’s not wrong – it’s not correct, it’s not real. There is no data.

Here at ESNACIFOR there is a system, NOAA. This organization detects the fires in Central America through satellite systems. But it detects heat sources. And they have numbers of heat sources, but not of fires because a heat source could be the burning of a sugar cane plantation, it could be an agricultural burn, or it could be a forest fire, or it could be fire in a market in Tegucigalpa. Thus, they are not necessarily fires. But there is an approximate idea that in Honduras...to this date (from January to April 2001) COHDEFOR says 52,000 hectares burned in more than 1,800 fires. This is what COHDEFOR says, but the reality is that there are more than 200,000 hectares, maybe more than one million hectares that are burned in Honduras (annually). And there are more than 3,000 or 4,000 fires. There is no one that has this data. But the official data is that which COHDEFOR has.” [i7]

According to data reported at an August 1998 regional wildland fire conference in Mexico, in that same year 59 percent of the total land area burned in Honduras was agro-pastoral land (148,227 ha.) and 41 percent was forestland (102,080 ha.) [See Table 1]. It was not reported how this data was collected. Also, 1998 was considered an extreme fire year because of the drought conditions due to El Niño, and we have no comparative data from other years.

Table 1: Land area burned in Honduras in 1998

Total number of fires and burns	Forestland burned (hectares)	Agro-pastoral land burned (hectares)	Total area burned (hectares)
9,594	102,080	148,227	250,307

Source: Alvarez and Benítez 1998.

Causes of Forest Fires

Most forest fires in Honduras are human-caused. Lightning-caused fires are extremely rare because of the heavy rains that generally accompany electrical storms. Forest fires are commonly reported to be due to farmers burning their fields, ranchers burning their pastures, and incendiaries (arsonists and pyromaniacs).

“A review of fire conditions in Mexico and Central America indicates that the number of fires is often related to traditional burning for land clearing and agriculture.” (Allard and Mutch 2000).

“The principal causes of forest fire occurrence have been the burning of property for the preparation of agricultural crops and the burning of pasture for fodder renewal. In both cases the principal reason was the lack of preventative measures and carelessness by the farmers and ranchers. They have also identified other causes such as honey extraction, hunters that leave campfires without extinguishing them, and woodcutters, as fire originators.” (Programa Social Forestal 1996).

The most accurate fire data comes from COHDEFOR. The information is collected from a number of sources, including field surveys in the National Forests and National Parks, as well as remote sensing data from ESNACIFOR. According to

COHDEFOR estimates from 1994 to 1998 [see Table 2] about 54 to 59 percent of forest fire ignitions are due to incendiaries, 9 to 16 percent due to pastoral burning, 8 to 11 percent due to the burning of cropland, and 12 to 19 percent due to other causes.

Table 2: Forest Fires fought and their Causes (1994-1998)

Year	Number of fires fought	Incendiaries (%)	Pasture Renewal (%)	Agricultural Burns (%)	Travelers at night (%)	Others (%)	Total (%)
1994	1,444	57	16	11	4	12	100
1995	1,109	58	12	8	5	17	100
1996	1,145	56	12	8	5	19	100
1997	1,850	54	16	10	4	16	100
1998	2,260	59	9	9	4	19	100

Source: Departamento de Protección Forestal (AFE-COHDEFOR 1999)

Legal Framework

While a new forestry law has been written it continues to be revised and debated by the Honduran Congress (since 1999). The new law will create the *Servicio Forestal Nacional* (SEFONAC; National Forest Service). Until then, AFE-COHDEFOR remains in charge of forest management of federal lands. COHDEFOR is responsible for preparing the national fire protection plan with the participation of municipalities and private landowners (AFH 2001). The responsibility for the execution of the plan, implementing preventative measures, and combating forest fires lies with the landowner, whether on state, municipal, or private land.

Burning in forested areas without permission is considered a 'forest crime' (*delito forestal*). Punishment is a jail term of six to twelve years. Illegal cutting on forested lands is punished by a jail term of one to three years. However, these crimes are rarely prosecuted due to many factors. These include the difficulty in legally proving arson in

court, an under-funded and inefficient national police force, a weak judicial system, and the widespread existence of bribery and corruption.

Many forestry policies have not been coordinated with other agrarian and economic policies (Soihet 2001). There continues to exist a very low level of application of these laws, due to the lack of finances and other resources and the lack of political will to do so.

Methodology

Research Approach

This research project exists within the realm of applied qualitative research. Its purpose is to contribute knowledge that will help reveal the connection between agro-pastoral burning and forest fires in Honduras, allowing more informed decision-making. It addresses a desired need for a better understanding and utilization of local knowledge regarding fire use (FAO 1999). The intended audience is policy makers, directors and managers of development organizations and other NGO's, government forestry officials, and other professionals working within the fields of forestry, agriculture, or natural resource management in Honduras.

This project was conducted within the framework of social constructionism. Constructionism is based on the premise that the world of human, social interactions is different from the natural, physical world and must necessarily be studied in a different manner and with different methods (Guba and Lincoln 1990). The central questions for social constructionism are: "How have the people in this setting constructed reality?; What are their reported perceptions, 'truths,' explanations, beliefs, and worldview?; What are the consequences of their constructions for their behaviors and for those with whom they interact?" (Patton 2002).

The constructionist researcher attempts to capture different perspectives through open-ended interviews and then examine the implications of these different perceptions/perspectives without declaring one set of perceptions to be more 'right' or more 'true' than other sets (Patton 2002). This framework is particularly helpful to

remain unbiased while attempting to determine the various perspectives of two diverse demographic groups – one ‘poor’ and ‘uneducated’ and the other ‘wealthy’ and ‘educated.’ Just as one’s experiences shape one’s perspectives, so too do perspectives affect experiences. Knowledge is relative to time and place, thus a reluctance to make generalizations that cut across cultural or demographic boundaries.

Research Methods

The units of analysis for this study were the occupational groups of *campesinos* (farmers and ranchers) and natural resource managers (NRM’s). These two occupational groups were selected because of their specialized experiences working with agro-pastoral burning and/or fire management, and the research objective of comparing and contrasting their perspectives on these topics. The perspectives of these groups are important because of the implications they hold for formulating natural resource management policies and regulations, and for implementing these policies in the field.

While quantitative research methods focus on large randomly selected samples in order to make unbiased generalizations, qualitative research methods focus in-depth on relatively small samples selected purposefully (Patton 2002). The purpose of random sampling is to make generalizations from the sample to a larger population while controlling for selectivity bias. In purposeful sampling this ‘bias’ becomes the intended focus, and thus the strength of the method, by sampling information-rich cases that will illuminate the questions being asked. Analyzing information-rich samples yields in-depth understanding rather than empirical generalizations (Patton 2002). If I had conducted this study using random sampling I very well may have received inaccurate or distorted responses from informants who were not well informed on this topic.

Within the realm of the purposeful sampling approach there are a number of different strategies that can be selected to best meet the objectives of the study. I chose to use the snowball or chain sampling method (Patton 2002). In this approach one begins by asking well-situated people for the names of others who may have specialized experience with the chosen topic. In this way one locates information-rich key informants and, in turn, asks them for the names of other informants. Initially this snowball gets bigger and bigger, or the chain diverges, as more informants are mentioned. The chain then converges as a few key names are recommended again and again. These key people, recommended as valuable sources of information by many different informants, take on a special significance. In my search for key informants this occurred within both occupational groups.

The Sample

I interviewed a purposeful sample of twenty Honduran citizens. Of the twenty informants interviewed, nineteen were male and one was female. This skewed gender balance reflects the lack of women directly participating in the fields of agricultural production and natural resource management in Honduras. The average age among all informants was 55, ranging from 27 years to 80 years of age.

Twelve of the informants were small-scale *campesinos* (farmers, ranchers) that lived in the town of Nueva Armenia, Francisco Morazán. The average age among the *campesinos* was 58, ranging in age from 27 years to 80 years. The majority (eight) owned their own land and two of them also rented other land to cultivate. The two youngest *campesinos* had no land of their own and either leased land and/or worked as a laborer on someone else's land. Among all *campesinos* that owned their own land, they

averaged 6.4 hectares each. These *campesinos* worked from 0.5 to 7.7 hectares of active farmland, averaging 4.2 hectares each. The average size of each agricultural plot was 2.9 hectares. At least three of them had land that was currently in fallow, averaging about 2 hectares each. Three of them owned plots of pastureland, ranging from 2.8 to 20 hectares each. One of the *campesinos* owned 2.8 hectares of forestland.

I will refer to this group as *campesinos*, the term that they use to refer to themselves. Their primary work is in *el campo* (the field), whether cultivating food crops or raising cattle. Although I will sometimes refer to this group as farmers it is important to recognize that they are not solely dependent upon farming as a means of income. Those with more capital have invested in cattle and/or pigs, having from a couple head up to a dozen. Thus some of them could be referred to as ranchers instead of as farmers. These terms will be used interchangeably, depending upon the specific context.

All of the *campesinos* I interviewed supplement their agro-pastoral income methods by working part-time in such positions as laborer, logger, mason, carpenter, agricultural promoter, security guard, or Justice of the Peace. One of them had briefly worked as a forest fire lookout for the former Ministry of Natural Resources.

All twelve *campesinos* shared their highest level of educational attainment with me. One had not attended school, two had completed 2nd grade, two had finished 3rd grade, one had completed 4th grade, one had finished 5th grade, five had completed 6th grade, and one had gone on to study for two years at the John F. Kennedy Agriculture School in La Ceiba, Atlántida, Honduras. Two of the *campesinos* had previously attended a workshop about forest fire prevention and suppression that had been organized

by the Ministry of Natural Resources. The other ten *campesinos* had not attended any workshops or lectures on this topic.

Eight of the informants occupied an occupational group that I have labeled natural resource managers (NRM's), based upon their professional experiences in the fields of natural resource management and forestry. One of the informants was a police judge for a rural municipality and, as such, was responsible for issuing permits for conducting agro-pastoral burns. He was 70 years old.

Seven of the informants were forest engineers and managers in the field of forestry or natural resource management. The average age among them was 47, ranging from 34 years to 56 years of age. They were working in various positions: director of the Forest Management agency; head of fire protection at a national park; managers in the Natural Resources program of Peace Corps-Honduras; director of the Department of Forest Protection at COHDEFOR; and forest engineers at ESNACIFOR and the USAID-funded Forest Development Project.

These seven natural resource managers had one or more B.S. degrees from universities in Honduras (five informants) and/or the United States (three). Five had post-graduate degrees. They had from seven years to 32 years of experience working in the field of forestry or natural resource management. Collectively, they had more than 140 years of experience working in the field of natural resource management.

The sample size of twenty informants was limited by the depth of interviews conducted and the amount of time available during my last two months in Honduras.

The Interviews

Interviews were conducted over a seven-week period from 25 June to 13 August 2001. It was a dry start to another rainy season, in what would become the fourth year of drought in five years. All informants were contacted a day or more before the interview either in person or by telephone. I informed them of my position as a Peace Corps Volunteer and graduate student researcher in forestry, and of the objectives of the study.

In an effort so that they would be most comfortable and thus would speak more openly, I let each of them set the time and place of their interview. Interviews were conducted in various locations, from offices in Tegucigalpa and Siguatepeque, to farmers' homes and worksites in Nueva Armenia. I assured them that all demographic information and interview questions were voluntary and that their identities would be kept strictly confidential. All interviews were conducted on an individual basis.

I used a standardized open-ended interview that I had prepared by carefully and fully wording every question before any of the interviews were conducted (see Appendix A). This was to ensure that each informant was asked the same question in the same way, using the exact same wording for each question, as a way to reduce possible bias between interviews. I felt this approach was best for limiting the variability that could occur due to the cross-cultural/Spanish-as-a-second-language interview process. This approach results in a highly focused interview that makes the best use of the informants' time. It also allows the comparability of responses between interviews and facilitates data organization and analysis.

Interview questions were generally asked in the same order except in cases where the informant began to speak of a topic covered by another question. In these cases the

informant was allowed to continue their train of thought. If their response completely answered the subsequent question then that question was not asked later. If their response did not seem to fully answer the question, then the specific question was asked either immediately or in its proper place in the interview order. This was important as a way to let the informant feel that they were directing the course of the interview.

Informants were asked a total of 19 to 26 questions. The farmers were generally asked a few more questions because of their specialized experience doing agro-pastoral burning (questions 15a-19, Appendix A). Only one of the natural resource managers had personal experience doing agro-pastoral burning.

Following the standardized questions informants were asked if there were other related topics that they would like to talk about, or past responses that they would like to expand upon. This sometimes extended the interview for another half-hour or more. Finally, informants were asked for the names of others with pertinent experience.

I tape recorded ten interviews and also took notes of the expressions the informant used as well as my own impressions (i.e. if I felt they were lying to me). Ten of the interviews were not recorded because of the unfortunate loss of the tape recorder. Notes were taken during these interviews as well and were expanded upon following each interview. Interviews ranged in length from a half-hour to two hours, with the average length being 50 minutes.

Data Analysis

The narratives of the interviews provided the basic textual data for analysis. I transcribed all interviews from the cassette tapes, translated them into English and

entered them into the computer. I did this myself, allowing me to get immersed in the data and giving me a chance to see it for the first time as a whole.

I used QSR's NVivo version 1.1 computer program (NUD*IST 1999) to assist me in data coding and analysis. The name of this program comes from the term *in vivo* coding, where data is coded based upon the terms used by the informants (Bernard and Ryan 1998). This was especially relevant for my project, where using my own labels to code the interview data may have obscured what the informants were telling me.

The central task of qualitative research is “to extract and abstract – to locate significant themes in complex data, consider them together and abstract from them, providing rich descriptions, categories, and theories.” (Richards 1999). The process of extraction involves coding the data. The interviews were coded at nodes – categories based upon the terms and labels used by the informants themselves. These nodes were then browsed, revealing the responses from all interviews that fit into a specific node. The node itself then became an item for analysis, allowing not just data retrieval but also the creation and exploration of new sub-categories. From this primary node the data was ‘coded-on’ (Richards 1999), allowing me to create new nodes with finer distinctions and categories, and to raise new questions. By creating more nodes and grouping similar ones together into ‘tree nodes’ it allowed me to make distinctions between categories, to re-think the response data, and to begin to reveal their significance. The original documents could then be re-coded based upon the new observations. All of this coding and re-coding allowed hypotheses to emerge from the informants’ responses.

Triangulation

Qualitative research may be viewed by some as ‘soft science’ because of its reliance on purposeful samples of ‘subjective’ data, rather than on the random sampling and ‘hard,’ ‘objective’ data of quantitative research. By using the method of triangulation I utilized the strength of both of these approaches. I have used a combination of personal observations, open-ended interviews, and document analysis in order to triangulate between these three data sources (Burchfield 2002, Patton 2002). Each data source was used to validate and cross-check findings from the other sources. This method is particularly valuable in the way that the strengths of one approach compensate for the weaknesses of another approach (Patton 2002).

My personal observations from two years of living in a small Honduran town can be compared with answers given by the informants or data from appropriate documents. The interview data can be corroborated or refuted by checking it against available literature. Also, by receiving very similar answers to the same questions from the majority of informants (or of informants within one occupational group) is indicative of the accuracy of the data, or at least of a commonly held perception. In addition, the perspectives of Hondurans from the two different occupational groups studied are compared and contrasted.

The limitations of interview data include possibly distorted responses due to anxiety, anger, personal bias, politics, and ignorance of the topic (Patton 2002). I attempted to subvert these limitations in a number of ways. In order to limit informant anxiety I let each of them select the time and place of the interview so that they would be most comfortable. I also had previously informed them of the purpose of the interview

and of the confidentiality of their identities, as I have described above. The use of the technique of purposeful sampling limited distorted responses due to ignorance, since each informant had years of experience with the topic.

My previous relationship with the informants ranged from never having had a conversation, to casual acquaintance, to close friend, to my Peace Corps supervisor, to my host father. Some readers may doubt the unbiased nature of the interview responses, believing that informants would have a tendency to tell the *gringo* what he wants to hear. I admit that this is possible, but I believe that with my years of experience in Honduran culture and language I was able to determine those instances where the informant was 'feeding me a line.' For example, when some Hondurans are about to make an excuse or tell a lie they precede the statement with the phrase "*Fijese que,*" ("Listen to this,") which would serve as a clue to regard the following statement with suspicion.

As a foreigner I may have been viewed as an outsider. While this outsider status may have been a detriment under certain social circumstances I believe that it worked to my advantage during the interviews. I was not viewed as a threat or as one involved in the Honduran forestry/political scene since I was outside of the system. In one instance an informant speaking of Honduran political corruption whispered a response so that I could hear it but the other Hondurans in his office could not. This outsider status may have also worked to my advantage because of the chance for the informants (especially the *campesinos*) to talk to an uninformed *gringo* about a topic of which they had a wealth of personal experience. I was giving the *campesinos* a rare chance to talk about experiences that they were never asked about.

While the conclusions drawn using the method of triangulation are revealed in the Findings section, the actual method remains hidden from the reader. Following are two examples of how I attempted to reach the most accurate and well-informed conclusions by triangulating between informant responses, personal observations, and appropriate literature.

Through my personal observations local fire suppression efforts seemed to be extremely limited by the lack of available tools other than *machetes*. This observation was confirmed by the responses of informants amongst both occupational groups, who often spoke of this as being a major problem. This same problem was discussed in some of the recent literature, specifically in Dixmude 2001, Allard and Mutch 2000, Jansen 1998, SEMARNAP 1998, and Canchón Avellaneda 1990.

Prior to delving deeply into my research I was unsure of the veracity of the claim that agro-pastoral burning was a major cause of forest fires in Honduras. My perceptions were that *campesinos* generally took some basic precautions when conducting burns and worked hard to prevent forest fires from spreading. This matched the narratives of the *campesinos* interviewed. Eight of the twelve *campesino* informants believed that incendiaries were the primary cause of fires. However, six of the eight natural resource managers claimed that agro-pastoral burning was the primary cause of fire ignitions. Several natural resource managers and some of the literature revealed a trend of placing blame on *campesinos* for fire ignitions. Some of this bias was blatantly obvious, as in the case of Soihet 2001. [see quote on p.53] The little quantitative data available on fire ignitions and their causes (AFE-COHDEFOR 1999) revealed that the primary cause of forest fires are incendiaries. In this case the majority of quantitative and qualitative

evidence pointed to incendiaries as the primary cause of fire ignitions, and *campesino* burning practices as a secondary cause. The evidence reveals a bias in perceptions of fire causes among natural resource managers and in some of the literature.

Indigenous Typologies

Indigenous typologies are classification systems used by people in a specific setting to identify and name some aspect of their world, thus breaking it up into distinguishable parts (Patton 2002). Demographic groups, cultures, and families each “develop their own language systems to emphasize distinctions they consider important” (Patton 2002). “These indigenous typologies provide clues to analysts that the phenomena to which the labels refer are important to the people in the setting and that to fully understand the setting it is necessary to understand those terms and their implications.” In my analysis of the interview and literature data I came across many terms that began to reveal the nature of the phenomena of agro-pastoral burning and forest fires. The most important terms will be addressed here so that the reader can begin to understand them and the setting from which they arose. A comprehensive list of the terms and their definitions can be found in the **Glossary**.

During Peace Corps training I learned the term *talar y quemar* (to slash and burn), yet during my two years of service and in all of the interviews conducted I never once heard a Honduran use this term. *Talar y quemar* is a land clearing method, as opposed to a land preparation method. Much of the land area in Honduras has already been appropriated by the federal and municipal governments and by private landowners. Only in the remote region of La Mosquitia is there unclaimed land that is being cleared for the first time (in modern history). Although Honduran *campesinos* do slash the trees and

brush from a fallow field before burning it, the label that they used was *quemadas agrícolas* (agricultural burns). Because this method is being used on fallow land (land that was previously farmed), a *quema agrícola* is a land preparation method rather than a land clearing method. This is an important distinction: agro-pastoral burning as separate from shifting slash and burn land clearing. The term *quemadas agrícolas* is also used by ranchers burning grassland or forest understory for use as pastureland. The term agro-pastoral burning will be used interchangeably with *quemadas agrícolas*.

When talking about the clearing of trees, brush, and weeds from fallow fields Honduran farmers often use the terms *limpiar* (to clean, to clear) and *botar* (to throw something away). *Limpiar* is used when talking about cutting vegetation with a machete. Thus from the perspective of their language, not only are they clearing the land, they are also cleaning it up. Once their parcel has been cleaned the farmers either burn the residues to get rid of them, or *botar* them, that is throw them away somewhere off of the parcel. In this way they are looking at the slashing and burning/mulching of vegetation and agricultural residues as a way to clean up their parcels.

Hondurans use the term *incendios forestales* (forest fires). For this reason, in order to stay true to the interview data, I will also refer to forest fires rather than to wildland fires, which is the preferred term in current fire literature (Pyne et al 1996, Mutch 2000).

Findings

Interviews were conducted with twenty Honduran farmers, ranchers, and natural resource managers. The interviews provided a forum for the informants to express their perceptions, attitudes, and beliefs about agro-pastoral burning and how it relates to forest fires in their country. Direct quotations from the interviews are used in order to convey informant perceptions in their own words. This chapter will attempt to answer each of the major guiding questions posed on page six (p. 6). There will first be a discussion of antecedents to the issue of forest fires, followed by analysis of the major causes of fire ignitions. Then there will be a description of incendiary-caused fires and the factors affecting them, followed by a description of the relationship between agro-pastoral burning and forest fire ignitions and an exploration of the factors affecting this relationship. Throughout this chapter, the varying perspectives of *campesinos* and NRM's will also be compared and contrasted.

I. Antecedents to the Fire Issue

Attitudes about Forest Fires

Years of fire prevention education campaigns by various government agencies, NGO's, and development organizations, and negative media stories transmitted by radio, television, and the newspapers have instilled in much of the Honduran public the idea that all forest fires are bad, and therefore should be actively prevented and suppressed. Forest fires are viewed as a problem for various reasons. Unregulated forest fires may have severe effects on soil composition and character, promote soil erosion on steep slopes, cause water and air pollution, damage flora and fauna, cause changes in plant

succession, and damage the aesthetics of a landscape. Forest fires also have effects on human health and the economy. Honduran NRM's generally perceive uncontrolled forest fires as a problem that needs to be dealt with. They are working to reduce fire occurrence and the amount of land area burned.

Both groups of informants generally mentioned the same problems due to unregulated forest fires. One NRM spoke of the following negative effects:

“To burn areas, practically, the destruction of the forest, destruction and loss of the fauna and the biodiversity, reduction of the water sources, deterioration of the natural landscape. When one burns one loses the aesthetics of the natural landscape. If you go to a place where there was a burn, “How ugly it has become,” but if one goes to a place where it has never burned, to see the forest, “How pretty the forest is.” ...What else? Well, negative effects on health, respiratory problems. What else? Well, it has much influence on the economy of the country as well. [How?] Normally here the airport is closed every year. They close the airport because there is poor visibility. This affects the economy of the country. It affects the tourists that come to visit. It affects the hotel business. It affects the taxi drivers. It affects the government because they lose the entrance tax for these people. It affects the businessmen that travel, those that bring merchandise into the country. The imports and exports are affected. Thus it has a strong economic influence on the economy of the country. There are times when the airport is closed for a week. There are no flights, neither commercial nor passenger flights. Thus it affects the economy of the country.” [i6]

Another NRM mentioned many of the same fire effects, as well as other effects:

“What I said before, it weakens the forest. The pests can attack it more easily. Also if it is (in) a young stand the fire will completely destroy it. It also causes soil erosion because when the rains come there is nothing to retain the soil. It also destroys the habitat of many animal species, for example the food of some species, insects and everything else is destroyed by the fire. And it pollutes. There is high air pollution. It can reduce the visibility for airplanes and vehicles. It causes respiratory illnesses in humans. It also pollutes the water.” [i3]

The majority of *campesinos* spoke of many of the same negative effects:

“The forest ends up destroyed. The hillsides are washed of their soils and there is only a pure stone slab. It burns the trees and all of the vegetation.” [i11]

“The bad effects are the pollution of the environment, the destruction of the wildlife. It burns the forest and there is no water. It diminishes the amount of water ” [i13]

While all *campesino* informants perceived forest fires as only having negative effects there is a growing awareness amongst NRM’s of the true role of fire in Honduran forests. In recent decades foresters in Honduras have recognized the need for pine forest management policies to change from “fire control to fire management.” (Hudson and Salazar 1981). Rather than seeing numerous unregulated forest fires each year, many NRM’s would like to reduce fire danger through the use of prescribed burning. Many NRM’s mentioned how fire suppression and exclusion in pine forests creates heavy fuel loading conditions and higher dangers of catastrophic wildfires:

“What would happen if there weren’t any fires? A lot of (organic) material would accumulate in the forest. Thus, the fear that I have is that if we don’t do anything.. we could have a time bomb. And one day we could have a wildfire where the damage would be greater and more dangerous. An out-of-control fire can be very dangerous when there is a lot of accumulated fuel.” [i2]

Many NRM’s also recognized the fire-adapted nature of the most common Honduran pine species, *ocote* and Caribbean pine, and the need to use prescribed burning to manage and maintain these stands.

“Fire is part of the cycle of nature. It has burned for years. For years and years nature has lived with fire in the forest. It’s only when it’s used by man very frequently that it is damaging. It’s only when man can’t use fire intelligently, in a controlled manner, like I said, for example with controlled burns or prescribed burns. Because the pine needs fire in order to survive. We say that they are fire-dependent species. The pine is a fire-dependent species. It needs fire in order to survive. But one needs to do it in a controlled manner.” [i3]

Since the 1980s prescribed burning has been used as a forest management tool in some Honduran pine forests. Many NRM's spoke of the benefits of using fire as a forest management tool. There have been many pine bark beetle (*Dendroctonus frontalis*) epidemics in Honduras, causing the loss of valuable timber. Prescribed burns can be used to maintain current pine stands, reduce fuel loadings and fire danger, and to slow the spread of insect pest and disease infestations.

“When we apply prescribed fires we do them with various purposes: one is to reduce the volume of fuel, because there is an accumulation of two tons of fuel per hectare per year...In this case, we know to what intensity we can have in a pine forest in order to be able to manage the fire in favor of the forest in order to reduce fuel volumes. Or rather, we can reduce the quantity of fuel so that in the dry season, if a fire starts in March or April, well, the fire will not be very destructive. The burns are done between the months of November, December, January, and until February when the weather conditions permit it...We don't do controlled, prescribed burns in areas where there is regeneration. We do them when the trees are between five and seven years, reaching a height of eight to ten meters. These trees develop certain defense mechanisms that permit them to resist these heat intensities.” [i1]

“I only see one benefit, in some areas where there are insect pests fire is beneficial. It is a benefit, because for example, there is a pest in this stand and so that it doesn't spread to another stand I light a fire, and with this it kills the pest. And it avoids the further spread of the pest. Normally many people just cut the infested tree. Here, what COHDEFOR does to infested trees is to cut them and burn them. Thus, this is a benefit.” [i6]

Despite a shift in NRM behavior towards the use of prescribed fire there remains a limited understanding of fire ecology in Honduran pine forests. Literature on this subject, specific either to Honduras or other Central American pine forests, is noticeably absent. It is understood that there is a problem in Honduras with unregulated fires.

“No, fires are not good. Fires are bad. What is good is to use fire in a controlled manner, but not forest fires, controlled burns.” [i3]

All twelve *campesinos* responded that there are no benefits that come from fires in the forests, generally saying something such as, “They have no benefits. Fire destroys everything.” [i14]

Environmental Awareness

There is a growing environmental awareness among the Honduran public as revealed by informant responses. Many *campesinos* spoke of the need for fire suppression and everyone’s role in fire prevention.

“A person is smoking and lets the match or cigarette drop and from here a fire starts. Maybe they don’t know what they are doing. They don’t know that with that cigarette or with a match they can light thousands and thousands of trees. They have no idea of what they are doing. If I see this I tell them, ‘Don’t throw that there because you are going to burn the forest, and it’s something we shouldn’t do.’ It is our responsibility to look after, to protect the forest. Primarily we should protect the forest because it is the source of life... Thus if there is a fire one has to stop it. For me, one has to combat it as fast as possible if you can, because if you don’t we are screwed.” [i4]

A few *campesinos* mentioned the importance of protecting riparian zones:

“One has to take care and not cut the fallow near the streams. One has to leave about 30 meters around the springs. If there is water in one part then you have to leave 30 meters around it, where one doesn’t cut the fallow. Sometimes one leaves more depending on the stream. If it is a stream that has a lot of water one leaves more space, more meters. Where there is water one must protect the forest and not cut the trees. If one cuts them the water dries up. One has to protect them.” [i5]

Many *campesinos* spoke of the changing attitudes of the population in regards to forest fires, about protecting the forests and helping to prevent forest fires.

“In the past there was more freedom to do things. There were fires that burned and no one went to put them out, but today no. Today we go to put the fires out because we don’t want to let them burn the forests. This is in order to avoid having a problem with the environment. In the past there wasn’t such forest protection like there is now. We lacked understanding and we lacked culture. We didn’t know what

we were losing when there was a fire. The attitude of the people has changed much. It's changed much."
[i9]

Many of the NRM's also spoke of a growing awareness among the general public about the problem of unregulated forest fires: "You know there's not a national emergency, not even when they close the airport. But I think there is an awareness in the population, a greater awareness I would say, than before. Now when there is a forest fire, they probably won't take any action but at least they will acknowledge that there is a fire. Whereas before nobody would comment on the fire. That's a big change that I noticed too, you know, since the 1970s, the '80s and the '90s, that the people now at least acknowledge and they say that forest fires are not good, are not beneficial. Probably in the rural areas this is less, less than within the urban areas. But I think that there is a greater degree of awareness. And that can be said because also the radio, TV, the newspapers, they report on fires every year. So that's an indication that people are more educated or more aware nowadays." [i2]

"It (the public's attitude) has changed a little, and the people worry more because of fires. There is a little more anxiety because of the fires. The truth is that they can't reduce the number (of fires) for inexplicable reasons. But there is more anxiety among the people because of the fires. This is real. The people don't want to see fires but there are always fires. But there is more worry (about fires)." [i7]

"It is really difficult to be able to say what has changed or what hasn't changed. But I think that little by little it is taking root...The step that we are at, at this moment, we have been reducing the quantity of hectares burned year by year. Each time that we start a campaign I say, 'Our goal is to burn much less than what we burned last year.' And we are succeeding." [i6]

While many of the informants spoke of a growing environmental consciousness in Honduras it is not clear why this change is taking place. Many times it is cited that the change is due to educational campaigns by the government and various NGO's and development organizations. Reporting on unregulated forest fires and other environmental problems in the media lends visibility to the issues and promotes dialogue. However, the reported reduction in both the number of forest fires and amount of land

burned annually could be due as much to the urbanization of the population and the move away from an agricultural economy as to the educational campaigns.

Some *campesinos* spoke about how urban migration has resulted in fewer people remaining in the rural areas, and how, consequently there are fewer agro-pastoral burns conducted now than in the past:

“There is much less burning now. Sincerely, here in this place it is because of the people that are working here. They don’t work in agriculture. They only study and leave (town). They don’t know what it is to be a farmer. Because of this it is very expensive to pay laborers. In past years all of the foothills had burnt fields, now no. There are very few parcels with cornfields.” [i16]

“Now there are neither cornfields nor are there fires, because everyone is going to Tegucigalpa. Now they don’t want to work (in farming). Now there’s only us, the caretakers. God knows how it is, right?” [i5]

“There are fewer burns than in the past, except in Olancho where the ticks are huge. There are fewer burns now because they are prohibited.” [i14]

Fire Suppression in Honduras

In the recent past AFE-COHDEFOR oversaw forest protection and management nationwide. They were responsible for approving fire protection and forest management plans for private and municipal forestland, as well as in the national forests. They also coordinated resources between forest property owners, the Armed Forces, and other institutions in firefighting efforts. A few firefighting brigades were organized by COHDEFOR. However these squads were under-funded and poorly equipped. They were limited by their poor transportation and communication abilities, sometimes taking a day or more to arrive at a fire. Although these fire brigades sometimes fought fires on private or municipal land, by law they were only required to protect national forests. COHDEFOR encouraged private landowners and municipal governments to form their

own fire brigades. However, a lack of resources, incentives for forest protection, and technical assistance for firefighter training generally led to no action being taken.

Perceptions of Responsibility for Fire Prevention and Suppression

It is interesting to examine the varying perspectives of NRM's and *campesinos* about the responsibility for fire prevention and suppression. There exists a certain symmetry in how the NRM's generally spoke of the responsibility for forest fire control as belonging to professionals (officials from COHDEFOR and the municipalities), essentially 'us' from their perspective, and spoke of forest fires as caused by 'them,' the uneducated *campesinos*. The *campesinos* also spoke of fire control as being 'our' responsibility, and of forest fires as being caused by 'them,' in this case the bad criminals, "people without a conscience" [i10].

Several NRM's mentioned that while COHDEFOR and each municipal government held the ultimate authority it was also the responsibility of every citizen to do their part to prevent and combat forest fires.

"Well, the direct responsibility goes to AFE-COHDEFOR, but also the Army and the (structural) firefighters. But those who work in protection and forest fire prevention ought to be all Hondurans, preventing and educating about firefighting, prevention more than anything." [i3]

"Really it is something personal. I believe that all of us citizens are responsible, because we all live here in this country ..It appears to me to be the responsibility of everyone, not only of COHDEFOR, not only of the government, not only of AMITIGRA, not only of the mayor's office, not only of the assistant mayors. It is the duty of everyone. All of us have to participate in this. It is the responsibility of all of us as citizens. It is the duty of everyone. Here it ought to be the obligation of all of the citizens to help in one way or another, to help. If one has a physical impediment to go and fight (fire), one can go to a telephone to report it, 'Listen, in such and such place there is a fire,' or call a radio station, 'There is a fire

in such and such place, call someone.’ We can all help, in one way or another. But it is our duty to do it.” [i6]

Some of the NRM’s lamented the lack of public participation in forest fire prevention and suppression: “And you can see people passing by a fire and none of them will go to put it out, absolutely no one. They will say, ‘No, it’s the responsibility of COHDEFOR.’ No civilian feels responsible to put out a fire, no one.” [i8]

“Everyone says, ‘I am a Honduran.’ But to say, ‘I am a Honduran’ implicates that I have many obligations as a Honduran. If I am in my car...I travel a lot to the North Coast and if I see a fire near Siguatepeque I stop, park my car. Normally in my private vehicle I carry a fire axe and I stop to put out the fire. If the attitude was like this, if there were twenty people traveling, each one in their own vehicle, and they see that there is a fire, and we all go to put it out, this fire won’t continue. It will be stopped. And this would demonstrate that there is a civic consciousness, that this forest is ours, this country is ours, these lands are ours. If we don’t want this, really we can’t say, ‘I am a Honduran.’ Thus, we are Hondurans in order to say, ‘We are Hondurans’ when there is a benefit for us. But when we have to protect our resources no one is ‘Honduran,’ no one has the civic consciousness to be able to say, ‘I am going to put out this fire. I am going to get out of my car. I am going to lose half an hour, but I am going to do something positive.’ Really, no, we don’t do it.” [i6]

When asked about fire protection and suppression ten *campesinos* responded that generally the people were the ones responsible for fire control, under the direction of their municipal government.

“The municipality, the town itself (fights fires). The people go to put it out. The municipality manages it all. We, the townspeople, go to put out the fires.” [i19]

“I believe that there is only us. The (government) employees want us to request permission if we want a piece of *ocote* to make a door, but without us the forest fires would spread and there wouldn’t be any *ocote*. We are taking care of the forest.” [i18]

“When there is a fire, what I do is to invite other companions or the neighbors to go and put the fire out. Like we said the last time when there was a fire on this side, in Aceitunas, Roberto told us about it

and we formed a group from all of the Colinas soccer team and we went voluntarily. And there was a lot of fire. It really beat us down, but we had a big fire and it was burning a lot of property and the animals were suffering, the springs were suffering. They are the things we need in order to survive: the water, nature, the fresh air. And when it is burned, then there isn't any fresh air, only polluted air when there is a forest fire. And the forests appear to be destroyed – they look ugly. Because of this it is something that we always have to do, to go and put out the forest fires. Here or wherever, not only in one's own municipality, but anywhere where one is one can cooperate because it's part of Honduras that is burning. One must take care of where they are, not just because it is (Nueva) Armenia. If I am in San Buenaventura and it is burning and I can help, I help, because it is somehow to serve the country. Fires take the raw materials, the wood for the construction of our houses. Thus it doesn't matter what is burning. We can go and help, knowing that we are protecting our own roof. The forest is our roof.

“Oneself is responsible, each man, or the highest authority, which is the mayor. More than anyone, COHDEFOR is protecting the land from fires. COHDEFOR is in charge of combating forest fires. But, as I said, in (Nueva) Armenia one can't wait until COHDEFOR arrives. One has to go oneself and combat the forest fires. And if you wait, how much forest has burned? There is not going to be any more land left.” [i4]

Four *campesinos* responded that COHDEFOR was principally responsible, but they usually added that those nearest to the fire were the first to respond.

“COHDEFOR and also the municipal mayor's office. The citizens of the municipality have the right to watch over the municipality, for each town and village, to collaborate and look for people to send to put out fires. By the time those from COHDEFOR come the fire has spread. Thus it's the municipal government that is first to alert the people, in order to control a fire. When the people come from COHDEFOR the fire has already burned too much. Thus the principal people (responsible) are us who live closest, the townspeople. We are the first that have to go and control the fire. Later, the firefighters arrive. But when they arrive we have it under control.

“One time I saw one here on Cerro Capire. A fire spread from a *milpa* to the hill, from Agua Blanca. They were burning a fallow field that they were preparing in order to plant a *milpa* and there was a spark. Thus in a part where there was a lot of pine it lit on fire. And it was difficult to control it. This time

a lot of people came from COHDEFOR, and from all over around here, from all of the villages, to put the fire out, in order to be able to control the fire. It wasn't a fire that five people could have controlled. There were about 100 people before it was controlled. In this area, on Cerro Capire, there is a lot of pine and it wasn't easy to put out, only with many people using water and rakes." [i5]

Unregulated forest fires continue to be a problem because of a general lack of funding for fire suppression, incentives for forest protection, and technical training for firefighters. In reality the responsibility for forest fire suppression lies with each particular landowner and those citizens living nearest to the fire.

Causes of Forest Fires

More than 95 percent of fire ignitions in the region are due to human activities (Salazar, SEMARNAP 1998, *i1, i6*). Natural ignitions are very rare due to the wet conditions during lightning storms.

"Normally, the majority of forest fires are caused by people. Here we are talking and here we can see twenty trees. If neither of us two starts a fire these trees are going to remain. A deer is not going to light the forest on fire, or a *tepisquintle* is not going to light a fire, or you are not going to see a cow smoking and starting the forest on fire. Thus it has to be a human being. The situations where nature is implicated in causing a fire are rare. For example, we have had an experience of a lightning bolt that hit a tree and suddenly a fire started, but these are rare, one thousand to one, the rest are caused by man." [i6]

Forest fires are commonly reported to be due to farmers burning their fields, ranchers burning their pastures, and incendiaries (fires intentionally lit by arsonists and pyromaniacs). According to COHDEFOR data and responses by the most knowledgeable and experienced Honduran expert on the subject approximately 55 to 65 percent of forest fire ignitions are caused by incendiaries. About 18 to 27 percent of ignitions are due to agro-pastoral burning (AFE-COHDEFOR 1999, *i1*). Of agro-pastoral burning, estimates generally indicate that in some years pastoral burning may lead

agricultural burning by five to six percent as a cause of fire ignitions, while in other years they may be nearly equal. [See Table 2, p. 28]

“This is the situation: 65 percent of forest fires are intentional; 15 percent are with the purpose of renewing pasture; 10 percent with the purpose of (clearing land for) agriculture; and 10 percent from other causes.” [11]

Despite evidence that the majority of forest fire ignitions are due to incendiaries, a disproportionate amount of blame for forest fire ignitions is given to *campesinos* and their agro-pastoral burning methods. This shifted blame is common in both published literature and in interview responses by Honduran NRM’s:

“In Honduras the major incidence of forest fires occurs in pine forests where more than 2,000 fires annually cause the loss of millions. The majority of the fires are (human) caused; *the principal causes of these fires are the burns of agricultural plots and of pastures by the farmers and ranchers that do not heed the prevention practices*. many times the burn becomes a forest fire. *In 1998, of the 2,260 fires fought and reported by COHDEFOR 59% were caused by incendiaries and 18% by burns of agricultural land and pasture.*” (Soihet 2001). [emphasis added]

While this shifted blame is not always as blatantly obvious as this, a bias does exist and seems to be significant and widespread. Some of this bias may exist because of the prevalence of agro-pastoral burning as a cause of fire ignitions in Mexico, and the implied belief that the situation must be the same in Honduras. In Mexico agro-pastoral burning accounts for 50 to 60 percent of forest fire ignitions (SEMARNAP 1998). One NRM was happy to rank the causes of fire ignitions by importance:

“If we are talking of human causes of fires in Honduras we can arrange them in a ranking. The major cause of fires in Honduras is for the renewal of pastureland. This is the principal cause. Because the pine forests in Honduras have a function as forest and also as an area of pastureland. The second cause is the agricultural burn, because of carelessness. There are no precautions – in making a good firebreak, in burning in adverse topographic conditions, in the meteorological conditions. The correct preparations don’t

exist among the communities. The third cause we know as travelers in the forest who are gathering food: the fishermen, beekeepers, and hunters. These are the three principal causes. And the last cause is the pyromaniac... These are the general reasons of the fires in Honduras.” [i7]

In fact, the majority of NRM's (six) believed that the principal cause of forest fires was the practice of agro-pastoral burning, while the majority of *campesinos* (eight) believed that incendiaries were the principal cause of forest fires in Honduras. Other less common causes mentioned fairly equally between the two occupational groups were: the carelessness of smokers, travelers, honey collectors, hunters and woodcutters; lightning strikes; and glass and plastic bottles left in the forest.⁵

II. Incendiary-caused Forest Fires

No literature is available which focuses on incendiary-caused forest fires in Honduras. Almost nothing is known about the demographics of those grouped under incendiaries. This is due to the criminal nature of arson and the difficulty in collecting such knowledge. Are the incendiaries mainly pyromaniacs who only light fires “to be bad”, cattle ranchers burning public forestland to use as private pastureland, farmers hoping to expand their farm plots, travelers failing to properly extinguish campfires or cigarettes, or those mysterious ‘others’ *limpiando la tierra* (cleaning the land) with fire in much the same way that it has been traditionally used by many cultures worldwide (Pyne 1995). Since so little is known about this group of Hondurans intentionally lighting fires, much is merely conjecture. *Campesinos* generally mentioned that these fires were caused by careless smokers or by bad people. The NRM's generally blamed incendiary fires on *campesinos* lighting a fire at the edge of their parcel, or purposely allowing a burn to escape, as a way to expand their land holdings.

Major Factors Affecting Incendiary Fires

There are a number of major factors that lead to incendiary fires. These include land access issues and the lack of incentives to protect forestland, a weak and inefficient judicial system and law enforcement that fail to deter arsonists, and the use of fire as a form of social protest.

Land Access and Lack of Incentives to Protect Forests

More than half of the Honduran population lives beneath the poverty line. The majority own no land. Most forestland in the country is managed by the government, either as National Forests or National Parks, or by local municipal government. Much of the remaining forestland is owned by private landowners who often do not live near their forest. The rural poor often receive no benefits from the forests in their area (other than the benefits of watershed protection and aesthetics), a fact sometimes mentioned during my interviews. They are prohibited from cutting timber on private land, and must petition the municipal board to do so on municipal forestland. With no sense of forest ownership or benefits there are no incentives for protection of the resource.

“There are a lot of people who do it (light a fire) simply for revenge or to hurt a forest owner. ...Because another problem that we have here in Honduras is that there is a lot of private forestland – thirty percent of the forestland in Honduras is privately owned – and on these lands the property owners don’t allow the *campesinos* to make use of a single tree for domestic use. Thus, the farmer says, ‘Well, it’s not ours’ and if there is a forest fire they don’t go to fight it, or sometimes they light one.” [11]

A few of the NRM’s mentioned the importance of land possession or benefits from local forestland and how these translate to forest protection.

⁵ A few *campesinos* and NRM’s mentioned that occasionally a glass or plastic bottle left in the forest will act as a sunlight magnifier, heating dry fuel and causing a fire ignition.

“I believe that...when the people see a benefit from the forest, then they protect it, rather than it being an obstacle...This is a key point – land possession. If a *campesino* is the owner of his land and he gets an economic benefit he is happy with his forest and he is going to take care of it. It’s the same with the private property owner, the large-scale properties. If he benefits from the forest he protects it. If he doesn’t profit from the forest then it’s not important to him. This is another factor that helps with the protection of the resource...I believe that insofar as Honduras incorporates the population more in the benefits of the forest the people are going to be responsible for that same forest.” [i7]

A couple of the NRM’s expressed concern about how the educational system in Honduras encourages agriculture and cattle ranching at the expense of the forests.

“If 87% of Honduras’ surface area is forest, it ought to be the base that sustains, supports the economic development of this country, the forests. However, they are not doing this. If you are looking at the most important parts of Honduras’ economy, it’s coffee and agricultural crops and cattle ranching. When in reality Honduras is neither agricultural land nor cattle ranches nor coffee plantations. The forest resources ought to form the economic base of Honduras, but we still haven’t done this, we haven’t taken advantage of this fact.

“Education is basic. Education in the last fifty years has not thought of the forests as the most important sector of Honduras. They have concentrated on agriculture and cattle ranching. Thus, the educational system in Honduras has been poorly guided in which we have formed people with attitudes towards agriculture and cattle ranching. Thus, we have not appraised the magnitude of the problem that we have in Honduras. Honduras is a country rich in natural resources of forests but we have not seen it in this way. It’s because, for many, it’s the land they are looking for. It’s not important to them if it has forest, nor what are the functions and importance of the forests, because of this same lack of education.” [i1]

This attitude expressed through the public education system indirectly leads to forest fires. Forestland may often be seen as a barrier by farmers hoping to use the land to cultivate food crops. A large percentage of incendiary fires may be due to farmers burning forestland in order to convert it to cropland. However there is no data available to substantiate or refute this hypothesis.

Judicial System

Agro-pastoral burning is regulated by each municipality under the direction of COHDEFOR. In many municipalities, including Nueva Armenia, COHDEFOR no longer allowed the issuance of burning permits. Despite this legal ban of agro-pastoral burning the practice continues annually. *Campesinos* continue to burn, while still using precautions to prevent it from spreading onto other land. The majority of *campesinos* interviewed knew the former requirements and regulations for conducting burns. They were also aware of the legal ramifications of allowing an agro-pastoral burn to spread onto someone else's property. Some informants also knew of the punishment applied for this infraction, or for committing arson.

"I try so that the fire doesn't spread into someone else's property or someone else's forest, because I would have to pay for what that property owner had." [i4]

"There was a 2,500 *Lempira* fine (approximately \$167) for a guy near El Raicero, where his burn escaped and burnt the *ocote*. The municipality fined him. This happened last year. Generally the people make sure that they have enough people looking over their burn. They don't want to pay 2,500 *Lempiras*. It is better to look over the fire well than to pay a fine." [i15]

Many informants mentioned that although there were good laws often they were not enforced, either because of the difficulty of legally proving arson, "Well, if they can't prove it, then there is nothing. According to the law if there aren't any witnesses then there is nothing that they can do." [i11], or because of a lack of political will to prosecute, "Listen, the laws, sometimes a man may violate them but they aren't enforced. We don't apply the law because he (the person in charge of enforcement) is a politician looking for votes." [i15]

Some of the *campesinos* mentioned a class disparity when the laws are applied.

"Yes, of course there are laws. There is the right to get a fine and to go to jail. The fine depends upon what the (government) employees decide. [Is the law enforced?] Nah. They don't do anything to the

rich people, but for a poor farmer they apply the law. The only reason to change anything would be to enforce the law, but to enforce it for everyone, not just apply it to the poor people.” [i17]

A couple of the NRM’s also talked about this injustice:

“Generally it’s the poorest people who go to jail for damaging the forests, but the people with power, no. [Why?] The laws here in Honduras are like that. They are unjust. They don’t apply them on a general level. They are not for all people. It’s only for the poor, for those who don’t have shoes. They ought to apply the laws. There are many laws, but what happens is that there is not a system that can apply the law with justice.” [i3]

“This is one of the deficiencies in Honduras. We are great for making laws. We have very good, excellent laws but we don’t apply them. [Because of a lack of funding?] Well, for a lack of funds could be one reason, but I believe that, more than anything, it’s a lack of political will. There are many political pay-offs here. Or rather, there is a lot of influence from politicians and for this they don’t carry out the law like they should. It should be impartial, regardless of who committed the crime. They should be sanctioned right now. But in some cases here, because of political influences, the law isn’t enforced. Thus, [he whispers] this is one of the big problems that we are facing.” [i1]

Several NRM’s spoke of the importance of enforcing the law and prosecuting arsonists, “. . . to have examples of the application of the laws, to capture an arsonist and convict them as the law requires, the application of the law for arsonists.” [i7]

Fires as a Form of Social Protest

The lack of an efficient and just judicial system and present under-funded law enforcement in Honduras encourages intentional fire ignitions in two ways. The near-complete lack of law enforcement fails to deter arson or encourage suppression of escaped agro-pastoral burns through the threat of punishment. Also, the weak judicial system allows vigilante behavior, resulting in people dealing justice by their own means.

A few NRM’s mentioned that some fires are ignited intentionally as a form of social protest against the government or COHDEFOR, or as revenge on a neighbor.

“Sometimes the people have a culture, a way to protest tacitly. The people have to conform socially in many ways. Thus, one way to protest is to light the forest on fire. This is social nonconformity. Many people do it to protest. They are troubled by someone, by some institution, by some municipal council, by some water board, thus what they do is light a fire in the forest. It is a way to be able to do this (to protest).” [i6]

“In my opinion, the other cause (of forest fires) is that every four years there is a change of the government. Every four years there are political changes. And every four years there are people hired politically, people who go and light fires. This creates uneasiness. Every four years there are higher incidences of fires. They are simply due to people who start fires only to take revenge on the State, political misfortunes or any reason. And this has been seen every four years.” [i8]

“The principal cause are fires intentionally started by human beings. .Many times it’s also because they are discontented with their neighbors or with the government. There is a little social resentment.” [i20]

A couple of the *campesinos* also mentioned that some forest fires are due to people lighting them as a form of social protest.

[What is the principal cause of forest fires?] “When the municipal government passes new laws and the *campesinos* become angry, because they are taking away their rights, the freedom to cut a tree. Now one has to request permission in order to cut a pine tree. Sometimes the *campesinos* feel bad because of this. They say, ‘The forest is not ours, one has to burn it.’ It is a form of revenge by the farmers.” [i15]

“Sometimes what happens is that the people walking along a trail, they are drunk or one wants to see a fire, or because of revenge for something on an enemy.” [i16]

A weak and inefficient judicial system, along with the semi-corrupt and underfunded national police force, fail to curb the problem of escaped agro-pastoral burns or reduce incendiary-caused fires.

III. Agro-pastoral Burning as Cause of Forest Fires

Use of Agro-pastoral Burning

Fire is a tool that has been used for centuries by small-scale farmers and ranchers in Honduras. Many *campesinos* explained it simply, “My dad burned, so I burn.” [i15]

In much of the country fire is used annually by farmers to clear herbaceous vegetation from fallow fields, remove agricultural residues, and improve access to their fields. Farmers spoke of their reasons for using fire as a land preparation method:

“The purpose is to remove the spiny plants, and in order to have less work. It is easier to burn. It is more practical. In half an hour one could burn an enormous amount of land.” [i19]

“The benefit is to burn the *basura* (trash) so that it doesn’t hinder crop growth.” [i14]

“One burns in order to get rid of the weeds. When one has a lot of weeds one has to burn because there are a lot of weeds, a lot of spiny plants. Thus one burns it to get rid of it. Because here there is a lot of spiny *carbón* and you have to burn it.” [i5]

“The benefits are to take advantage of the ashes that remain as fertilizer for the land, to remove the weeds, in order to use less herbicides and pesticides.” [i13]

Ranchers use fire as a tool to renew their pasture’s forage and in order to kill ticks and other parasites. Ticks are known to transmit protozoal diseases like anaplasmosis and paraplasmosis (Faber 1993).

“It is a question of renewing the grasslands for the cattle. It is cheaper to clear the land using fire. It kills the ticks. It kills the spiny plants and all of the weeds and the land ends up *limpia* (clean).” [i11]

If a fallow field is being cleared the trees, brush, and weeds are cut by machete and left to dry. If present on the parcel fuelwood or timber may be cut by hand and removed. Farmers generally slash the vegetation midway through the dry season.

Ranchers do not slash their pastures before burning, but may remove fuelwood from the parcel. The majority of agro-pastoral burns are conducted in March, April, and May, at

the height of the dry season. Farmers burn before planting the *milpa*, and may or may not burn before the *postrera*, a second *maize* crop planted during the *canicula* or at the end of the rainy season.

Of the seven *campesinos* who practice agro-pastoral burning and revealed more detail about this practice, they burn from $\frac{1}{2}$ to 4 *manzanas* (0.35-2.8 ha.) per burn. The average burn size was 2.3 *manzanas* (1.6 ha.), a substantial fraction of the 6 *manzana* average (4.2 ha.) of active farmland per *campesino*. Burn size is essentially fixed by parcel size, since existing field boundaries serve as firebreaks (i.e. trails, rock walls, forest edge).

“It depends on the property owner of the field. Each one burns how they like. Most farmers burn one or two *manzanas* at a time.” [i13]

“I burn a piece of pasture, about half a *manzana*, and two *manzanas* of *milpa* every year in order to clear it and to plant.” [i16]

To the question of how often *campesinos* burn a specific parcel many said, “One burns each parcel every year” [i13] while others “wait three to five years for the (fallow) plants to grow before burning again.” [i14]. Of course burn repeatability is affected by each farmer’s access to land. Those with more land, or more money to rent land, are able to rotate among fallow fields and leave longer fallow periods per parcel than those with less land access.

Interviews with twelve *campesinos* revealed that in their perceptions they use burning in an appropriate manner, taking adequate precautions and following government regulations. The majority of *campesinos* spoke of the same preparations that one must make to conduct an agricultural burn: inviting friends to help and informing one’s neighbors; making a firebreak of one to five meters wide; burning in the late afternoon when winds are not strong; using backing fires to reduce the chance of fire escapes;

monitoring the burn and putting out spot fires immediately. A burn is conducted in a single afternoon, with a firebreak having been built that morning or on a previous day. *Campesino* responses revealed a sophisticated understanding of how the factors of fuels, weather, and topography affect fire behavior. This is traditional knowledge passed down from *campesino* fathers to sons over generations.

“We burn in the summer, in March and April when it is dry. In August one burns only for the *postrera*. One doesn’t burn every year. One burns every three years in the pastures, to kill the weeds and for the ticks. First one goes and cuts the *carbón*, stacks it and takes it to use as firewood if it’s big enough. We remove all of the heavy fuels first so that the fire isn’t quite so intense.” [i11]

“One informs their neighbors and asks for their help in order to do a burn. One tells them what time to come, but if the wind is blowing we aren’t going to burn, and so the neighbors don’t come. First we make a firebreak according to the parcel to be burned. We make a wider firebreak if it is a big parcel with lots of heavy fuels. In general the firebreak is one-and-a-half to two meters wide, but it can be up to five to six meters if there are a lot of heavy fuels present.” [i10]

“One always watches how the wind is blowing and does the burn at night if it’s too dangerous in the day. When the parcel has all been burned they review the firebreak for any burning stumps and put them out with water, because the roots can burn underground and start another fire.” [i11]

Campesinos understand that the backfire is the gentlest and slowest moving type of fire and poses the least danger of fire escape. A hillside slope may be used for backfiring when little or no wind is present (Martin and Dell 1978). The majority of *campesinos* described how a backfire was used to conduct burns.

“Then one looks where the wind is at and begins to burn against the wind, moving away from upslope and going downslope, not from the bottom going up. One moves away from the high point, burning all of the edges of the parcel first. One looks at the stumps at the edges of the parcel to make sure they don’t throw sparks...For tools we only have machetes and branches of *ocote*. We use the branches in order to apply fire to the parcel.” [i13]

The NRM's expressed very strong opinions regarding agro-pastoral burning. Many of them expressed the same wholly negative perception of agro-pastoral burning as expressed by Campos (1910) and Pinel (1939). [See p.21]

“For me, the problem is rooted in agriculture, in the cultural part of the communities. It's from an age-old tradition of burning the land in order to cultivate it. It appears to me that it is not an appropriate technique. It never has been. At this point in the century they shouldn't burn the land. There are other methods to prepare one's lands. But normally the culture of burning is well set and the people say, 'Ah, let's go burn.' And they go and they burn, and they burn without any precautions. Really what we are looking at is that the people understand that fire is an enemy of the forest, but knowing how to use it is more useful for them. It is important that the people learn to leave behind burning once and for all and adopt new techniques that they can use to cultivate their land, or burn with precautions for life and with the appropriate control. They say, 'If we are not going to burn, we are not going to farm.' But many people farm without burning.” [i6]

While many of the NRM's spoke very negatively of the use of fire by small-scale farmers, they accepted its use by ranchers. This same bias seems to be expressed in the literature by the lack of research done into the 'problem of pastoral burning', as compared to the amount of literature concerned with the 'problem of agricultural burning.' Some of the literature seems to take this bias one step further by categorizing pastoral burning as another type of forest prescribed burn since much of the land used as cattle pasture is pine forest understory composed of herbaceous shrubs and grasses (Hudson and Salazar 1981, Dixmude 2001). All of the pertinent literature fails to address how pastoral burns are separated from forest fires. It remains unclear how pastoral burning is classified. Obviously a rancher burning private grassland is conducting a pastoral burn. However if he has trees on this parcel is it then an *incendio*? Would it also

be classified as an *incendio* if the forest understory being burned was on municipal or State forestland?

This bias was explicitly expressed by at least one NRM: “Thus, to try to use fire with the proposition of renewing the pastureland is something that is acceptable, because the fire isn’t causing damage in the root systems of the plants. Thus, it’s a good renewal, in the case of the grass *jaraguá* (*Hyparrhenia rufa*). *Jaraguá* is a plant native to Africa, brought here by the Spaniards, that also needs fire for its survival. To manage it appropriately, one can use fire but in an appropriate manner, managing it.” [11]

Several other NRM’s implicitly expressed this bias for pastoral burning over agricultural burning. It is unknown why this bias exists. It could partly be because burning is perceived as the only method available to ranchers to renew forage, while farmers are viewed as having a number of different land preparation methods to choose from. Ranchers do have the option of cutting forage grasses by hand, but this is considered highly impractical by most. Since ranchers have no other pasture-renewal methods available to them pastoral burning is widely accepted. This bias against agricultural burning could partly be an extension of the class discrimination that exists in Honduras against the poor. Ranchers occupy a bit higher position on the social ladder than farmers because cattle are an *ahorro* (savings account). Owning cattle is a sign of wealth and prestige. The small-scale Honduran farmer is the poorest of the poor and is often the subject of class discrimination.

Fire Suppression

COHDEFOR is only responsible for fire suppression in National Forests and National Parks. While their fire brigades occasionally assist private landowners with fire suppression, it could be days before they arrive. *Campesinos* spoke about how they are

essentially on their own when it comes to local fire suppression activities. Without any traditional firefighting equipment or technical training *campesinos* depend upon local resources and traditional knowledge for fighting fires. Many of the NRM's spoke of how an insufficient number of *campesinos* using inadequate equipment often failed to keep an agro-pastoral burn under control. The tools *campesinos* use to combat spot fires are the same ones used to construct firebreaks. These generally include only machetes and branches cut from nearby trees (Jansen 1998). In some instances there may be someone on hand with a rake or even a backpack herbicide sprayer for use as a water pump.

Campesinos spoke about their equipment:

“When they are ready to burn they bring a lot of people, in order to make the firebreak. And with a lot of people they can cut the firebreak very rapidly. We use rakes, hoes, brooms made out of weeds or tree branches to sweep the firebreak well.” [i5]

“They make well-swept firebreaks, and if there are sparks that jump the line they control them with rakes and backpack pumps. One has to put the spark out immediately.” [i15]

The majority of *campesinos* interviewed (eleven) had not had any fire suppression training although training sessions have been hosted in some rural areas by the Natural Resources Ministry, COHDEFOR, and the Peace Corps (Programa Social Forestal 1996). Despite a lack of professional training *campesinos* exhibited a sophisticated understanding of fire behavior and also revealed a good understanding of firefighting techniques, including the use of burnout fires.

“And if the fire has spread in the forest they do a burnout fire. So that when the fire arrives at the spot where it's already been burned then it doesn't go any further.” [i5]

Alternative Land Preparation Methods

Burning is the most common method used in Honduras to prepare land for cultivation or cattle grazing. Taking into account the various advantages and

disadvantages of using agro-pastoral burning I asked the *campesinos* and NRM's about alternative methods. A couple of the NRM's, but none of the *campesinos*, mentioned alternative methods to burning as a tool to renew pastureland. They spoke of controlling the size of grasses by cutting them before they grew too large and unpalatable.

“They can practice methods of weed control and control of the size of the grasses, but generally they don't do it and for this they have to burn it.” [i2]

For ranchers hoping to rejuvenate pasture, burning is seen as the only viable solution in savanna and forests adapted to frequent, low intensity fires. It is also viewed as an excellent way for them to kill ticks and other pests in their pastures. Literature on the subject of burning generally ignores pastoral burning, likely because it is seen as having no alternative. The fact that none of the *campesinos* spoke of alternative methods to pastoral burning reveals either that they are considered too unfeasible to mention, or that they have their own categorization for pastoral burning that falls outside of the *quemadas agrícolas* category.

While seven of the twelve *campesinos* interviewed used agro-pastoral burning at least occasionally the majority of them had knowledge of the alternative land preparation methods available to farmers. The majority of *campesinos* only mentioned two alternative methods to agricultural burning. One alternative method is plowing the land with oxen (or, even more impractically, with a tractor).

“When I have to get rid of the waste yes I burn, but not much, just a small part. The rest is plowed using oxen in order to plant. [Thus this is the other option instead of burning?] Yes, in order to cultivate the land. Thus they don't use fire...well, the first time they burn it, and the second time, when there aren't a lot of weeds, they only need to plow the soil. Thus they plow the soil instead of burning. Thus the weeds remain and it's useful as fertilizer, because the remains serve as fertilizer. And if we burn the remains then we are burning the fertilizer.” [i11]

Another alternative method to agricultural burning is the slashing of vegetation, followed by various ways to get rid of the *basura* (trash, garbage). Following slashing the material may be thrown away (*botar*) somewhere off the parcel, composted, or chopped up finely and incorporated into the soil.

“In other parts of the country I have seen them plant with the brambles left there, but here the crops won’t grow well like this.” [Are there other ways to prepare the land?] “Only by cutting it all and throwing it away (*botar*). But it is a big job and difficult to cut it all.” [i14]

“Yes, by cutting the weeds and taking them outside of the parcel. But the people prefer to burn. They use the burn more.” [i13]

“I don’t like to burn. I haven’t burned in eight years. I like to conserve the soil. One can make a humped row of the cut vegetation and let it decompose. It takes two years for it all to decompose. One does it in each parcel, in the middle of the cornfield... Also, one can plow the land with oxen. Or use the stubble from the corn harvest, put it in a long row, chop it up finely and then incorporate it into the soil.” [i15]

In many instances these methods are not seen as feasible alternatives. Plowing can only be used on relatively flat farm plots without large rocks, a rarity for poor farmers who have been pushed onto hillsides. Also it is a method restricted to those *campesinos* that own oxen or have the resources to rent them. For the majority of poor Honduran farmers plowing their fields is not possible. Some *campesinos* spoke of burning as the only method available to them because of the steep, rocky plots that they were forced to farm.

“If I don’t burn, I don’t plant...My land is in the foothills and it is rocky. There are many rocks and there are trees and spiny plants. There is no other way to prepare the land.” [i16]

“The only other way is to till the land with oxen.” [Why aren’t the other methods used?] “Because they (*campesinos*) don’t have the appropriate land for this. They plant in the foothills, on broken land.” [i17]

Many farmers do not view the slash-and-mulch or composting methods as reasonable alternatives because of the amount of time, labor, and financial resources needed. All of these methods also fail to fully achieve a major benefit of burning, the destruction of invasive weeds and their seed banks in the soil. This is the major advantage of agricultural burning. The majority of the literature that encourages the use of alternative land preparation methods fails to address this important advantage. Some farmers talked about how only the method of burning worked well to kill all weeds and their seed bank:

“I have a flat field with a brook running through it. It is prohibited to cut the vegetation or burn around a brook. I rented it to a man who then cut it with plans to burn it. The municipal government said that he couldn’t burn it so he left it as it was. The next year he cut the new growth and still could not burn it because of the law. He then planted a part of the field where the cows had stomped the stubble down. The corn began to grow, along with an enormous number of weeds. He used a herbicide but it didn’t reach the ground because of the decomposing stubble, so the corn didn’t grow.” [i16]

Another alternative method mentioned by a few informants was the use of herbicides. The fact that herbicides were only mentioned by a couple of farmers reveals that from their perspective it is not a feasible alternative. The use of herbicides is impractical for the majority of subsistence farmers due to the prohibitive cost.

“Also one can utilize herbicides when the weeds are small. When they are larger, thicker, one cuts them and burns them.” [i13]

“The burning is the same as it was in the past. .Now with the weeds, the people use chemicals (herbicides) in order to kill the weeds. It is easier and quicker than doing it with a hoe.” [i11]

Interviews conducted with Honduran *campesinos* by Jansen (1998) found that a *campesino*’s discontinuance of the practice of burning could not be associated significantly with the use of new inputs such as herbicides.

Another alternative method mentioned in the literature is the planting of intermediate cover crops such as *frijol abono* (“fertilizer bean”; *Mucuna spp.*). *Frijol abono* is a leguminous cover crop planted between food crops in order to slow weed invasion and rejuvenate soil fertility. Although it has been promoted by a few NGO’s in Honduras it was not seen in Nueva Armenia. It is rarely mentioned in literature about alternative methods to burning. It was not mentioned by any of the informants interviewed. Animal or chemical fertilizers are not alternative methods to burning because they are not land preparation methods.

Major Factors affecting Agro-pastoral Burning

None of the alternative land preparation methods offered to *campesinos* are viewed by them as being feasible methods. Let us now explore other factors that influence the relationship between agro-pastoral burning and forest fire ignitions, and which influence the acceptance of alternative methods. These factors range from micro-scale causes in the field, such as fire behavior and the lack of sufficient personnel and proper equipment, to more macro-scale conditions such as the ‘culture of burning,’ land access and tenure issues, and the effects of poverty. These factors will now be described, beginning with the most important factors.

The Culture of Burning

Time and time again many informants, both *campesinos* and NRM’s, talked of burning in the terms of *por tradición* (by tradition), *por costumbre* (by custom, by habit), and as being a part of *la cultura* (the culture). Agricultural burning has been a land preparation and land clearing tool in Honduras for centuries. Some *campesinos* stressed that they had learned the method of burning from their fathers and that it is the only way

they know how to farm. Shifting slash and burn agriculture has proven itself as a sustainable practice under conditions of low population density and low land pressure.

Patton (2002) suggests that “awareness of the importance of culture has found its way into popular culture and mass media to such an extent that the term shows up nearly ubiquitously as an implied explanation for all kinds of social problems and phenomena.” Both NRM’s and *campesinos* used the term to explain the phenomena of burning.

One NRM used the term to explain burning in this way: “For me, the problem is rooted in agriculture, in the cultural part of the communities. It’s from an age-old tradition of burning the land in order to cultivate it. It appears to me that it is not an appropriate technique. It never has been. At this point in the century they shouldn’t burn the land. There are other methods to prepare one’s lands. But the culture of burning is well set and the people say, ‘Ah, let’s go burn.’ And they go and they burn, and they burn without any precautions.” [i6]

At least one NRM expressed disagreement with this explanation, viewing the practice as a habit rather than as a true cultural tradition. He believed that many Hondurans use the term *la cultura* as an easy way for *campesinos* to justify their methods.

“In Honduras it has been said for many years that fire is part of the culture. Personally I am not in agreement with this. But it is a culture that has been forming out of necessity, and this necessity is based on habits: the habit of clearing the land of weeds with fire; also the habit of clearing pastures with fire because it is more economical for the people; also to get rid of insects, animals, and ticks is much cheaper with fire. This is the mentality of our farmers. Thus, all of this has created a habit that has become the culture. But the reality is that fires are not caused only by these reasons.” [i7]

One NRM spoke of his attempt to change his father’s mind about using agro-pastoral burning annually: “We did tests to demonstrate that there are other ways to prepare the land. But he is a father that believes that he knows more than everyone else. Because he had done it this way all

his life, and I don't believe that he was ready to change. He listened but he didn't follow the advice. Thus, it was a very tough struggle. And I believe that it wasn't only this. It's part of the culture." [i2]

Whether or not agro-pastoral burning is a true cultural event, it is *perceived* to be one. The majority of informants used these labels as part of their everyday typology. These are solid words: culture, tradition, custom, habit. They express societal ideas that are difficult to change through individual action, something that we we're born with, like a language that we're forced to speak throughout our lives. The very words the Honduran public uses to talk about this *costumbre* makes it difficult to even begin a dialogue about changing these actions – there is a certain implied dependence on burning; it is their destiny to burn. Many NRM's and even a few *campesinos* acknowledged the inherent difficulty of changing *campesino* attitudes about burning.

As one farmer said, "It's hard to educate the *campesino*. The process is long-term. Sometimes it is because it is a tradition for them so they are not going to leave it, 'My dad burned, so I burn.' " [i15]

Many of the informants spoke of agro-pastoral burning as a social event for *campesinos*. This activity, more than any other in the *campesino*'s agricultural calendar (i.e. planting or harvesting), brings friends and neighbors together.

One NRM revealed that, "I used to like forest fires. I believed that it was the only way to clear your land and when I was a child I enjoyed seeing the fires, especially when we burned at night. It was a spectacle...I believe that we enjoyed it, because we brought food and much *dulce* (processed sugarcane concentrate) to eat with water in order to get energy. Thus it was a great event for all of us, these burns, when I was a child and a teenager. It was part of the agricultural calendar." [i2]

One farmer seemed to speak of helping with other's burns as a community obligation: "We bring other people in order to look after the fire so it doesn't spread. This is how we help each other here, one helping another." [i5]

Land Distribution and Access

The best agricultural land in Honduras has been appropriated to cultivate export foodstuffs such as banana, pineapples and melons, while other arable farmland in interior valleys is owned by absent landlords that occasionally do not cultivate it. The majority of small-scale farmers have been relegated to small plots of marginal farmland, pushed onto the steep, rocky hillsides of the mountainous interior. The alternative land preparation method of plowing, by oxen or tractor, is entirely impractical to the majority of *campesinos* due to the topography of the land they are cultivating. This *campesino* relies on the thin acidic soil of former pine forestland to support his family, living on the scary edge of subsistence. More than 70 percent of *campesinos* have less than five hectares of land (Soihet 2001). Without access to larger parcels and/or more productive agricultural land they are relegated to maintain their positions as subsistence farmers. They are forever hoping that next season's crop will be more productive and that maybe they will be able to harvest enough to meet their family's needs and have an excess to sell in local markets. Despite an ambitious agrarian reform program in the 1970s there are more landless families now than there were before the implementation of Decree Law 8 in 1972 (Brockett 1998).

In many cases *campesinos* do not own the land they work, but are working it for a relative or are renting it. While ranchers generally seek to gain land tenure, many farmers do not (U.S.F.S. 1996). This may be because of the more wealthy position of ranchers and their ability to use this wealth to take time from their work and travel into the city to begin the long, tedious process of gaining legal land tenure. They are always looking for a way to gain access to more farmland. In some instances *campesinos* light a

forest fire on the edge of one's *milpa* as a way to expand the agricultural frontier. Many NRM's realized the difficulty in protecting a forest resource that occupies land perceived by *campesinos* to be more useful to them as farmland:

“Our country was taught, from the time of its colonization, to do one thing – to plant in order to eat. This is your culture. And this has been happening since the time of the Mayas, only the production of corn and beans to eat. And this is what I know – that what happened was that the agricultural lands were taken over by those people who had money, and the other people had to emigrate to the mountains. And in the mountains what do we have? Forests. Great, but they have to eat because they can't sell the wood. There are few incentives. There is no market system so that the small producers can harvest the wood. Thus, all they want is to eat by planting the land, so they have to slash the forest in order to create cropland. The problem is that forest succession continues. The farmers don't have cropland. They have to obtain land and the only way for them to obtain land is by invading the forest. All they want is to prepare land in order to plant with crops and as pastureland. And this only means that they will have to affect the forest. They don't have another alternative.”

“Some people that are looking for more land to plant frequently burn part of the forest in order to occupy it later with their crops or cattle.. The law doesn't permit conversion of forest to other uses. But if you burn it and (then) there is nothing, then it's available for other uses. Thus, it's an attitude taken by many people. And the fact is that for the people, the people with the level of poverty that this country has, the pines are useless as food. But if the land is changed then it can produce rice and corn and beans.”

“If you go to the countryside and you see a farmer preparing a field to plant and the burn crosses into the forest and provokes a forest fire, the farmer will be waiting for someone else to put it out. But he doesn't feel responsible. This is how I see the attitude of the population.” [i8]

Interviews conducted with Honduran *campesinos* by Jansen (1998) indicated that those with access to more land or with more land in fallow used burning less. Research also revealed that cropland owned by the *campesino* or a close family member is burned less often than rented or communal land. In many cases *campesinos* may choose not burn their own parcel but will burn rented or communal land. Even those *campesinos* who

claim to not burn will still use burning in certain instances. Jansen concluded that land tenure is a more important factor affecting use of burning than the amount of land being worked. We are more apt to protect something for which we have a sense of ownership. Ownership implies a responsibility for protection and sustainable use.

Several NRM's spoke of the need to encourage cultivation of unused farmland, while a couple of NRM's implied that there was need for a land redistribution plan.

"If you look at the valley of Comayagua, a very beautiful valley, but it is all private property. Yet it is not used (as farmland). It is private property and you can't trespass. You can only find the farmer on the mountain. And on the mountain there is only forest. But the problem is that they can't sell the forest. They have to eat." [i8]

Current land distribution patterns, limited land access, and land tenure for the rural poor are very important factors contributing to the problem of agro-pastoral burning. *Campeños* with hillside plots of agricultural land are unable to utilize the land preparation method of plowing. Small, marginal land holdings encourage the persistence of subsistence farming. Land tenure is associated with increased protection of the land.

Poverty

Poverty is an inescapable fact of life for the majority of Honduran *campesinos*, and for much of the rest of the population as well. Without 'disposable' income most subsistence farmers have no way to utilize alternative land preparation methods. Subsistence farmers cannot purchase herbicides to control invasive vegetation, buy improved seed strains, or hire laborers to clear fallow fields by hand. Those farmers with the appropriate farmland may not be able to purchase or even rent oxen (not to mention tractors) to plow their parcels. The lack of credit for the rural poor is commonly mentioned in the literature as a problem slowing development and progress in Honduras

and other 'underdeveloped' countries. Without credit a poor *campesino* holds few options for renting or buying additional land or for utilizing alternative methods.

Just as few *campesinos* mentioned herbicides as an alternative method (likely because of the prohibitive cost), few spoke of poverty as being a limiting factor. This may be because of various reasons. First, *campesinos* may not speak of their state of poverty because of a sense of embarrassment. As mentioned earlier, there exists in Honduras overt class discrimination against the poor. Also, their state of poverty may be viewed as a permanent condition, as something that can't be changed, as an inherent part of life in rural Honduras.

None of the alternative land preparation methods offered to Honduran *campesinos* are viewed as feasible options due to their state of poverty, lack of available credit, and their small, hillside parcels.

Advantages of Agro-pastoral Burning

Despite acknowledgement by *campesinos* of the various disadvantages of agro-pastoral burning many still use the method annually. Burning remains the most popular land preparation method because it is the cheapest, easiest, and most effective method. None of the available alternatives offer the same benefits as burning does. Also, none of the alternative methods are perceived as feasible options due to the limitations of poverty and land access.

Burning continues to be the cheapest land preparation method since generally no day laborers need to be hired and there is no investment in other resources. *Campesinos* invite their friends and neighbors to come and cut a firebreak, light the burn, and watch

over it, preventing spot fires. Each of them works together with others, moving from one *campesino's milpa* to another's during the burning season.

One NRM acknowledged this benefit of agro-pastoral burning over other alternative methods: "In order to do a burn, it doesn't require very many people, just him with his children and maybe one or two laborers. You only need to light a match. Thus, you don't need to invest much money in order to burn. The main investment is to make the firebreak in order to protect the fences, the posts and the wire." [i2]

It is also considered to be the easiest method since relatively little preparation is needed. Once the firebreak has been constructed one only needs to wait for the right weather conditions and then light a match.

One farmer told me, "The biggest benefit to burning is to avoid having to do so much work, in order to avoid a little bit of work. [i9]

Also, it is viewed as being the most effective method to completely kill spiny vegetation and its seed bank in the soil. This point was reiterated again and again by the informants. It is also viewed as a good way to kill destructive soil pests and diseases.

While many *campesinos* acknowledge the various disadvantages due to agro-pastoral burning they do not view them as outweighing the inherent benefits.

"In my opinion, it is a problem to burn. But in Honduras it is something that always has to be done, even though we are harming ourselves. But it is a way for us to obtain our agricultural products, because we are not going to have products if we don't burn. [So it is necessary to burn?] In about 50 percent of the cases, I believe that yes it is necessary to burn, because to grow it needs it. There is property that is very full of trees, thus we can't plant beneath the shade and we have to burn in order to obtain our products." [i4]

[Some people say that it is bad to burn because there is a loss of nutrients. What do you think?]
 "Yes, it's bad. I am telling you that we burn out of necessity, because maybe there is no other alternative. But burning destroys the land. In other parts of the country they don't burn. They don't burn because they

have other opportunities. There are farmers that have the opportunity to clear the land with tractors. They clear the land with tractors and remove the wood from the edges of the fields in order to avoid fires. Here we do it because there is no other solution.” [i9]

Many NRM’s insisted that *campesinos* should use alternative methods to prepare their land in order to preserve soil fertility, or at least learn to take the appropriate precautions when burning in order to reduce forest fire occurrence.

“It is important that the people learn to leave behind burning once and for all and adopt new techniques that they can use to cultivate their land, or burn with precautions for life and with the appropriate control. They say, ‘If we are not going to burn, we are not going to farm.’ But many people farm without burning. Many people farm without the need to burn their parcel.” [i6]

A few of the NRM’s did acknowledge the various factors that make agro-pastoral burning such an attractive method for Honduran *campesinos*.

“*O sea*, the farmer and the rancher don’t always follow the technical recommendations that COHDEFOR or the municipality gives. [Why not?] I believe that partly it’s because of *tradición* (tradition). Principally for economic reasons they don’t want to eliminate the weeds nor the ticks in a different manner. Thus, the easiest and most economical method for them is fire.” [i2]

“Well for the farmers it’s economics, because he doesn’t clear the land (by hand). It’s easier to burn it and save the money instead of paying day laborers.” [i6]

At least one of the NRM’s seemed to side with the *campesinos*, accepting that burning is likely to continue to remain a popular land preparation method for years.

“The efficient use of fire as a tool is an excellent tool to prepare the soil for agriculture. It is an excellent tool to control the ticks. They are useful tools that humanity has used through the years. The only thing we request now is that it be used in a technical manner.” [i8]

Fire Behavior

On a basic fire behavior level the possibility of an agro-pastoral burn spreading to become a forest fire is dependent upon the factors of fuels, weather, and topography.

Honduran *campesinos* have a relatively sophisticated understanding of fire behavior and control due to their long traditional use of fire as an agricultural tool. *Campesinos* expressed knowledge of how local topography affects fire behavior. They used less intense backing fires in order to prevent fires from racing upslope and spotting across the firebreak. They also spoke about how weather conditions affected burning. Some spoke of how drier weather led to drier fuels and more intense fires. They mentioned that it was necessary to burn late in the afternoon, when there were lower temperatures and windspeeds. They also had an intimate understanding of how the presence of fuels affected fire behavior. They commonly spoke of removing heavy fuels from the parcel before burning, and of spreading out dense concentrations of fuels. Many *campesinos* spoke of the importance of recognizing where there was greater danger of fire spotting across the firebreak, areas where there were many heavy fuels and/or where the slope was exceptionally steep. *Campesinos* purposely wait to conduct burns until the hottest and driest months of *el verano* so the fuels are extremely combustible. They spoke about how this was the best time to burn because the intense fire could completely *destruir* (destroy) all of the fuels, weed seeds, ticks, parasites, and plant diseases.

Among the *campesinos* ten responded that agro-pastoral burns do sometimes cause forest fires, although only three view it as being a problem or being common. Three *campesinos* responded that it is not a common occurrence. One *campesino* estimated that, “about 20 percent of the burns expand from agricultural burns into forest fires.” [i4]

Many of the *campesinos* did admit to having a burn that spotted across the firebreak, but insisted that in the majority of cases they worked together to stop the spot fire. They seemed to be motivated to stop escaped burns because of concern over:

destruyendo el bosque (destroying the forest) and its soil, water, flora and fauna; having to pay the landowner for damages; or being prosecuted for the *delito forestal*. Many of the *campesinos* told of personal experiences where an agro-pastoral burn spotted across the firebreak and spread into forest or other land.

“We made a firebreak first so that the fire couldn’t spread. But the fire jumped the line. It was a firebreak of three to four meters wide, from the edge of where we were going to burn, outwards from there. [But the fire still jumped the line?] Yes, it jumped the line because there were a lot of heavy fuels, and this wood threw sparks and hot coals across the firebreak, where it began burning where we didn’t want it to burn.” [i4]

Among the NRM’s four responded that agro-pastoral burns becoming forest fires was a common problem. Many of the NRM’s said that there was a problem because so many *campesinos* did not use fire in an appropriate manner, not taking all of the necessary precautions. Many responded that agro-pastoral burns often spread onto forestland, either accidentally or sometimes intentionally as a way for them to expand the agricultural boundary.

“It is a serious problem. Because of this they ought to train the people in order to manage the soil, manage it in an adequate manner, manage their burns and how to make better firebreaks, to burn against the slope, about the hour of doing burns, putting available people in the area in case there is a problem, to have the proper equipment.” [i7]

While informants from both occupational groups mentioned the same basic reasons for burns becoming fires, they spoke of the problem in different ways. NRM’s generally spoke of escaped burns as being due to carelessness (not making a wide enough firebreak or having enough people there) and/or to bad timing by farmers (who were burning during the “adverse weather conditions” of high temperatures, low humidity, and

strong winds). The majority of *campesinos* spoke of the main reason as being spot fires caused by high winds or heavy fuels.

Many of the NRM's spoke of *campesino descuido* (carelessness, negligence), while both NRM's and *campesinos* sometimes spoke of other *campesinos* as being *haraganes* (lazybones).

One NRM expressed his perception of agro-pastoral burns spreading onto other land in this way: "Imagine that you are going to prepare three *manzanas* of land. And you have two or three people watching over the fire. Sometimes, depending on what time of day you do it, the intensity is very high. And once the fire crosses the firebreak, no one is going to stop it. It's very difficult (to stop) and it's easier to just go and ignore the problem." [i7]

This same negative attitude towards *campesino* use of fire is also expressed in some of the literature. Chinchilla (1980) writes, "Man constitutes the risk due to his ignorance, negligence, and carelessness. In order to eliminate the risk (of forest fires) we have to remove these three negative elements from man."

Among the *campesinos* the majority of responses (seven) indicated that the major reason for agro-pastoral burns becoming forest fires was due to spot fires caused by high winds or due to heavy fuel loads.

"Yes, when there is wind this is a mess. It is a serious thing. To put out a fire - this is tough. Here one respects the forest and doesn't touch it. Sometimes it's because of a strong wind that grabs a flame and pushes it across the firebreak. One needs to look at how the wind is blowing and then light the burn against the wind." [i14]

"Yes it happens but very few times does it spread because the people are already there and they fight it right away, they don't wait. Someone yells, 'The fire jumped the line.' They put more people at the places where there is more danger of a fire jumping the firebreaks, where there is more fuel, in case of problems." [i10]

There is a basic difference in viewpoint expressed here, with the NRM's viewing escaped burns as more of a personnel problem (carelessness/bad timing) that can be addressed through *campesino* education programs, while the *campesinos* see the problem as due to a factor out of their control (wind). While *campesinos* do wait until the end of the dry season to burn, it is for the purpose of getting the most complete fuel consumption and destruction of weed seeds. They also insist that they take adequate precautions to help prevent spot fires from spreading.

Due to the numerous factors described above Honduran *campesinos* are unlikely to suddenly change their behavior and give up the practice of agro-pastoral burning. The traditional culture of burning, poor land access and tenure, and the effects of poverty are all major factors contributing to the use of agro-pastoral burning as a land preparation method. Agro-pastoral burning is viewed by *campesinos* as being the best method available because of its inexpensiveness, ease of use, and effectiveness in meeting their land preparation needs.

Discussion

The aim of this study was to explore the relationship between the practice of agro-pastoral burning and forest fire ignitions in Honduras. This connection was explored through individual interviews with twenty Honduran *campesinos* and natural resource managers. These interviews allowed *campesinos* and NRM's to express their perceptions, attitudes, and beliefs about agro-pastoral burning and how it relates to forest fires in their country. The validity of interview data was determined by triangulating with available research documents and my personal observations during two years of fieldwork in Honduras. The interviews were guided by the following main questions: What is the relationship between agro-pastoral burning and forest fires? What influences this relationship? How is fire used by *campesinos*? How is fire (*quemar y incendios*) perceived by *campesinos* and NRM's? Do their perspectives vary greatly?

The Connection between Agro-pastoral Burning and Forest Fires

It is elementary to acknowledge that a relationship does exist between agro-pastoral burning and forest fire ignitions in Honduras. It is more difficult however, to quantify this relationship with anything more than a rough estimate. There is a basic lack of quantitative data for many aspects of forestry and agriculture in Honduras. The best estimates about forest fire ignitions indicate that about 18 to 27 percent of ignitions are due to agro-pastoral burning, while approximately 55 to 65 percent are due to incendiaries. While not the primary cause of forest fire ignitions, agro-pastoral burning does have an important effect. However, NRM's generally perceive that farmers and ranchers are the principal cause of forest fire ignitions.

While it is interesting that a majority of the NRM's see agro-pastoral burning as the primary cause of fire ignitions, it is difficult to determine why their perspectives vary so much from known causes. NRM perspectives and subsequent forest fire prevention efforts may be focused on the *campesino* population because they are a more visible group than the faceless incendiaries that start the majority of forest fires in Honduras. *Campesinos* are out in force in the months of March and April, burning their fields and pastures while the incendiary remains hidden for fear of being prosecuted. There is no available research attempting to determine the demographics of these arsonists, obviously being a difficult subject to research due to the criminal nature of arson.

A few *campesinos* acknowledged escaped agro-pastoral burns as a cause of forest fires but insisted that most of the time the fire was quickly controlled. *Campesino* responses revealed a sophisticated understanding of fire behavior and of fire suppression techniques. This knowledge was commonly reported to be traditional knowledge passed down to them from their fathers. Many *campesinos* also revealed an environmental consciousness that encouraged forest fire prevention and suppression. This environmental consciousness may be at least partly due to their traditional knowledge base about how burning affects the land and water resources. Many NRM's stated that the environmental consciousness of the Honduran public was growing due to environmental education programs by government agencies, NGO's and other development organizations, and subsequent media campaigns.

Despite educational extension programs aimed at reducing fire ignitions and agro-pastoral burning, and a COHDEFOR ban on the practice, it continues yearly. Many *campesinos* continue burning each year because it's the cheapest, easiest, and most

effective method of land preparation. In many of their eyes it's the best method despite the obvious disadvantages. They explained that none of the available alternative methods were feasible or offered the same benefits as burning. Considering the conditions of culture, poverty, and poor land distribution and tenure that *campesinos* face it is obvious that they will continue using agro-pastoral burning despite a ban on its use or educational programs promoting alternative methods.

Honduran NRM's must come to realize these numerous factors that contribute to continuance of the use of burning. They must recognize the reality of *campesino* perspectives and their reasons for using burning. Agro-pastoral burning is a traditional method that will continue despite the best efforts of environmental education programs. Occasionally agro-pastoral burns will escape and become forest fires. The negative and disparaging comments of NRM's against this practice (and thus against the *campesinos* themselves) is a destructive attitude that does not help the situation. The burning ban itself forces *campesinos* with few or no options into a position as criminals. This is counterproductive, further enforcing the 'us vs. them' mentality and making change even more difficult. Instead, NRM's need to work with *campesinos* to reduce the occurrence of escaped burns and other forest fire ignitions. There should be a focus on collaboration rather than the current opposition.

Use of Prescribed Burning

There is a limited but growing understanding of the fire ecology of Honduran pine forests. Fire can have many positive impacts in these stands under the proper conditions. The 'problem' of fire in pine forests is really a problem of unregulated fire. NRM's have begun to view fire as a positive input in Honduran pine stands more than five years old,

where pine regeneration is able to survive low intensity burning. Prescribed burning is conducted in some pine stands with the purpose of reducing fuel loadings and wildfire danger, of killing successional vegetation in order to maintain current pine stands, and of slowing the spread of insect pest and disease infestations.

The faceless incendiary does his own independent 'prescribed burn,' reducing fuel loading and wildfire danger, albeit usually under the most hazardous weather conditions. Incendiary-ignited fires could be viewed in a positive light if they occur under the proper conditions and accomplish the same benefits as prescribed burning. However these are unregulated fires conducted by the general public and the NRM's only want resource management professionals, like themselves, to do fire management. However they do not have the resources or support to conduct a national fire management program. The lack of support for a prescribed fire program in fire-adapted pine stands may be due to a greater fear that the public will perceive such a program as encouragement to light more fires or fail to actively suppress escaped burns. This has been the attitude taken by NRM's in other developing countries (Singh 2001), and I believe that it is also a valid concern shared by many Honduran NRM's.

Fire Suppression in Honduras

Fire suppression capabilities in Honduras are very limited due to the lack of resources and transportation abilities. The legal responsibility for fire suppression rests with the landowner. In many instances forest fire combat is extremely difficult due to a lack of proper firefighting equipment and training. *Campesinos* conducting an agro-pastoral burn are the ones responsible if that burn escapes onto other land. They depend upon local resources and traditional knowledge for fighting fires. Their fire suppression

equipment generally includes nothing more than machetes, and tree branches used as brooms to clear firelines or as flappers to extinguish flames. While the majority of *campesino* informants had not received any fire suppression training they revealed a good understanding of the techniques. Many had a good understanding of and experience with using burnout fires as a fire combat method. Their solid understanding of fire behavior and fire suppression is due to annual experience conducting burns as well as to traditional knowledge passed down from their fathers.

It must also be emphasized that a completely effective fire prevention and suppression program will lead to unprecedented fuel buildups in the forests and future catastrophic wildfires. Fire prevention and suppression efforts must be balanced with the use of prescribed fire in order to successfully manage fire-adapted pine stands.

Judicial System

Despite a ban on agro-pastoral burning in many municipalities the practice continues annually. The *campesinos* continue to follow the former regulations and take the proper precautions to prevent escaped burns. There is an understanding that they are responsible for compensating the landowner for damages incurred by an escaped burn. Yet there is little true worry of being prosecuted. The national police force is underfunded and under-staffed. The lack of an efficient and just judicial system and effective law enforcement fail to deter suppression of escaped agro-pastoral burns. It is difficult to determine just how much influence this factor has had on the relationship between agro-pastoral burning and forest fire ignitions.

Educational System

The Honduran economy has always been principally focused on agro-pastoral activities, although this is beginning to change. The public education system supports this focus by encouraging agro-pastoral activities over forest management. Public education fails to inform about the true ecological role of fire in Honduran pine forests. There is relatively minor environmental education conducted, especially concerning the subject of fire's effects on soil, water and other natural resources. Many environmental education programs have been conducted by various NGO's and development organizations. Informants from both occupational groups generally had good things to say about what the various NGOs, development organizations, and government agencies have done in environmental education, and fire prevention and suppression work. Several NRM's spoke of the importance of environmental education programs.

"In my way of seeing of what is the attitude of the people about fire, there are various reasons why the attitude of the people in Honduras is changing in regards to forest fires. There now exists an anxiety because of the fires. Now the people have begun to say, 'How dangerous it is. There are many fires,' although the fires are not disappearing. But there has been much education, comparatively much education. There has been environmental education in the country...Education from all areas: one part from the schools, another part from the NGO's, another part from the government. Each one makes their own contribution. They have also made examples of the application of the law, and these have begun to work." [i/]

Many informants, both NRM's and *campesinos*, requested more foreign assistance. One NRM stressed the important effect of the "international context."

"I also believe that another aspect that is generating change is the international context. There are several international agreements that are also forming (an environmental) consciousness in the country. Also, one has to take into account that in the country there exist many projects with international

cooperation or projects with funds from international agreements that are giving greater responsibilities to the people in the field. They are giving them equipment. They're promising them that they will protect their area. And this has also reduced many of the fires...The other part that can strongly collaborate is the educational system, to put much more in education, in the educational programs, formal or informal." [i7]

A few *campesinos* also spoke of the importance of education and the progress made in Honduras by various international development organizations.

"Yes, people have changed through the workshops of the NGOs, from Proyecto LUPE, Save The Children, World Vision, CPH. They have trained many people and now they don't burn so much. They have transformed the soils, the essence, by not burning and by the incorporation of the stubble into the soil. They have transformed many people to not burn. They have done good work and now they have changed fields with drainage ditches, contour lines and terraces, and rock walls. They have built very good chicken coops and pig pens. There are good harvests." [i15]

The path that Honduran NRM's take in order to attempt to reduce forest fire ignitions is by changing *campesino* methods and attitudes regarding agro-pastoral burning through educational programs. This is viewed by most NRM's as the easiest and most obvious method to affect escaped agro-pastoral burns. NRM's insist that if farmers do not switch to alternative land preparation methods they must learn to use agro-pastoral burning in an appropriate manner. Many of them spoke of the importance of education to achieve this end, saying things such as, "Education is basic." [i1]

This same insistence on education as a way to change *campesino* behavior is supported by much of the literature on the subject:

"We are going to remove ignorance by means of a well-managed media and education campaign. This campaign ought to be permanent and ought to be directed at those sectors of the rural population determined to be problematic, after studying the causes of (forest) fires." (Chinchilla 1980).

Some *campesinos* also agreed with the assessment that there needs to be a change of their habits, but said that it would be difficult.

“We have to think differently, because they say that it destroys the earth. Fire destroys the soil fertility. But to burn is the only solution that there is. I don’t heed the advice that they give, the advice that they give on the radio, on television.” [i17]

Since agro-pastoral burning has been part of Honduran culture for centuries there is little hope that messages transmitted through the media will change Honduran attitudes and beliefs regarding burning. There needs to be a long-term educational plan.

One NRM concurred with this, saying, “I believe that mass communication doesn’t make strong impacts. I believe that formal or informal education can make strong impacts, training and the formal system of education of the country. I believe that these can have a strong impact on nature conservation in general, and on forest fires in particular. I believe that it’s there that we can make a message for improving the mentality of the people.” [i7]

One NRM spoke of the preponderance of human-caused fire ignitions over natural ignitions as being a relative advantage, because of the perceived ease of controlling human actions over the actions of storms.

“We think that up to a certain point it’s advantageous to have a cause of this type compared with the causes that you have in the north, in the U.S., where about 60 percent of fires are caused by lightning...Or rather, up to a certain point this is advantageous for the fact that we can control the problem by working, developing a very strong extension program, prevention that will help raise the level of consciousness of the population that causes these fires.” [i1]

While a strong educational system and extension programs are obvious and necessary steps to begin curbing forest fire ignitions, they are insufficient steps without additional actions addressing the larger issues, such as poverty and land access and a burning ban which is counterproductive.

Major Factors affecting Agro-pastoral Burning

The relationship between agro-pastoral burning and forest fire ignitions is

influenced by a number of factors, both small-scale issues such as burning practices and the larger issues of poverty and land access for poor *campesinos*. Together all of these factors form a complex, interconnected web.

Culture of Burning

The Honduran ‘culture of burning’ has an enormous effect on the use of agro-pastoral burning and the occurrence of forest fires. Agro-pastoral burning has been used in Honduras since at least pre-Colombian times. Burning is an entrenched habit that informants from both occupational groups spoke about by using the terms of tradition, custom, habit, and culture. Many informants expressed that the practice of burning has been passed down from fathers to sons for generations with few changes. Some NRM’s view this cultural tradition as an easy excuse used by the public as a means to justify *campesino* methods.

Whatever the actual role burning occupies in Honduran culture, still it is *perceived* to be an integral part of the culture, at least of the culture of the rural poor. The labels of culture, tradition, custom, habit all express societal ideas that are difficult, if not impossible, to change through individual action. The language itself poses obstacles to even begin a dialogue about changing these “habits” (*costumbres*). The majority of informants view burning as an inherent part of their culture. There is an implied cultural dependence upon burning. Informants from both occupational groups agreed that changing this habit would be a difficult and long-term process.

Many informants would agree that fire prevention messages transmitted through the media have little or no effect on the public’s actions. Many informants stressed the need for more environmental education as a way to begin to break the habit of burning.

However, education is a tool that works to increase knowledge and decrease ignorance, and has little effect on behaviors influenced by more than just intellectual knowledge.

Agro-pastoral burning is a cultural practice influenced by tradition, emotion, and many other conditions. Even long-term educational programs likely will have little effect due to the host of other factors influencing this practice.

Poverty and Land Access

Poverty and land access are basic issues that have major effects on Honduran society, and specifically on the practice of agro-pastoral burning and its relationship with forest fire ignitions. Many natural resource managers agree that agro-pastoral burning is an acceptable tool under the proper conditions, but would argue that those conditions do not currently exist in Honduras. These conditions not only include taking the proper precautions when burning, but also the larger concerns about allowing sufficient fallow periods. Growing land pressure problems and shortening fallow periods make intensive agro-pastoral burning unsustainable. Policy makers and NRM's generally respond by encouraging the use of alternative land preparation methods. However, the daily actions of Honduran *campesinos* are extremely limited by labor and economic resources, and by their access to arable farmland. These limitations prevent them from completely giving up the practice of agro-pastoral burning. The method of plowing can only be used on the appropriate (non-rocky, flat) farmland by those with access to oxen. The lack of credit available to the poor Honduran *campesino* further limits their options. Without credit, subsistence *campesinos* with little available cash cannot purchase herbicides or chemical fertilizers or improved seed strains, cannot hire laborers to prepare the land by hand, or

rent oxen if they have the appropriate farm plot. Poverty is an inherent problem limiting the majority of *campesino* families.

Poverty also implies limited land access. Like many countries, Honduras exhibits highly unequal land distribution patterns. The rich coastal lands are owned by multinational corporations, while the few, large intermontane valleys are privately owned. In many instances the interior valleys remain uncultivated, and may or may not support cattle production. The majority of Honduran *campesinos* have been relegated to steep, rocky hillsides that once existed as pine or pine-oak forests. About 70 percent of Honduran farms are smaller than five hectares (Soihet 2001). Subsistence farming is the reality in Honduras, with many families struggling to meet their dietary needs. Poor *campesinos* are unable to rent or purchase additional land in hopes of harvesting more crops than just to meet their subsistence needs. Those *campesinos* who own the land they work are more likely to attempt to use alternative land preparation methods and use soil conservation techniques. Ownership of land is a basic incentive for protection.

Incentives for protecting forestland are also lacking. Again, much of the forestland is owned by large private landowners, federal National Forests, or communal municipal forests. In many cases the property owner is never present on his land, because he lives in Tegucigalpa, or it being federal land. While several *campesinos* spoke of the importance of protecting forests for the benefits of watershed protection, a few mentioned that they don't get any direct benefits. One *campesino* spoke about how rural Hondurans are expected to protect the forest by preventing and suppressing forest fires yet they are not given permission to cut a single tree. This lack of incentives for the

campesino to protect forestland may contribute to escaped agro-pastoral burns being allowed to burn uncontrolled in forestlands.

There is a complex interconnection of factors at work here. Widespread poverty, unequal land distribution patterns, lack of land tenure for the rural poor, and the lack of incentives to protect forestland are all factors which contribute to the problem of escaped agro-pastoral burns. Many *campesinos* continue to reject alternative land preparation practices in favor of burning. From their perspective none of the alternatives offered are feasible methods due to their state of poverty, lack of available credit to make changes, and their small, hillside farmplots.

Advantages of Agro-pastoral Burning

The alternative land preparation methods offered continue to remain unused by the majority of *campesinos* because they fail to offer the same advantages as the practice of burning. Agro-pastoral burning is the cheapest and easiest land preparation method available. No resources are needed to conduct a burn other than the help of one's friends and neighbors. Alternative methods also fail to address the biggest advantage of burning, the destruction of all invasive vegetation and their seeds.

Fire Behavior

The actual practice of agro-pastoral burning is most affected by the basic factors affecting fire behavior: fuels, weather conditions, and topography. *Campesinos* have a good understanding of fire behavior and use techniques to assure a "good" burn while maintaining it under control. *Campesinos* realize how fire races upslope and thus use backing fires to reduce the danger of fire escape. Before conducting a burn they remove many of the heavy fuels from the parcel in order to reduce fire intensity. Large fuel

concentrations at the edges of the parcels may also be spread out in order to reduce spot fire danger. The greatest fire behavior factor influencing escaped agro-pastoral burns is that of weather conditions. *Campesinos* understand how wind affects fire behavior and wait to conduct a burn in the late afternoon when winds are less strong. Burning in the late afternoon also offers the advantages of lower temperatures (and possibly higher humidity) for less intense fire conditions. The majority of *campesinos* purposefully wait until the hottest and driest months of the dry season to conduct agro-pastoral burns. While burns conducted at this time of year are more likely to escape from the parcel and may have more severe ecological effects, *campesinos* view this as the best time to burn. The burn's high intensity will most completely consume fuels and destroy weed seeds in the soil, and kill ticks and other insect pests and diseases.

The NRM's view this "bad timing" as a major reason for burns becoming forest fires. Some of them spoke of this same timing of burns as being *descuido* (carelessness, negligence) by the *campesinos* because of the inherent fire danger. The majority of *campesinos* spoke of the main reason as being spot fires due to high winds or sometimes to heavy fuels. Despite their best efforts agro-pastoral burns occasionally spread onto forestland.

Conclusion and Recommendations

Nearly all forest fires in Honduras are due to human causes. Because of the growing population it can be expected that forest fire ignitions will also increase if major changes do not occur.

Years of fire prevention and suppression education programs have resulted in mostly negative attitudes regarding forest fires in Honduras. *Campesinos* expressed an almost wholly negative attitude regarding forest fires. They exhibited the growing environmental consciousness present in the country, mentioning the importance that forests have in watershed protection. While a few NRM's expressed negative perceptions of forest fires, several stressed the essential role that fire holds in fire-adapted pine forests. There is a growing awareness among land managers of the importance of prescribed burning to reduce fuel loading and wildfire hazard, as well as to maintain current pine stands and to slow insect pest and disease infestations in some stands.

Fire has traditionally been used as a land preparation tool by Honduran farmers and ranchers. Farmers use fire as a way to clear cropland for planting, dispose of agricultural residues, and kill successional herbaceous vegetation and their seeds in the soil. Ranchers use fire to rejuvenate pasture growth for their cattle, and to eliminate ticks and other parasites. Despite a ban on burning, *campesinos* continue to use agro-pastoral burning annually. *Campesinos* generally follow the former regulations regarding burning and use the proper precautions to prevent escaped burns.

The majority of NRM's viewed the practice of agro-pastoral burning in a negative light. They stressed that the practice is the principal cause of forest fire ignitions in the

country, despite evidence to the contrary. A few NRM's allowed that agro-pastoral burning is an acceptable practice when used under the proper conditions and when there are sufficient fallow periods to rejuvenate soil fertility. While many *campesinos* do perceive the disadvantages of using burning annually they continue the practice because of a lack of feasible alternatives.

As expected, a relationship does exist between the practice of agro-pastoral burning and forest fire ignitions. While agro-pastoral burning is a cause of fire ignitions it is not the principal cause. There is a complex web of interconnected factors that influence this relationship. The principal factors are the traditional culture of burning, inherent conditions of poverty, and unequal land distribution that affects the majority of Honduran *campesinos*. *Campesinos* are relegated to working small parcels of land located on steep, rocky hillsides. These small parcels have generally been cut out of pine forests where the acidic soils do not promote good crop harvests. These parcels may or may not meet the subsistence needs of the *campesino's* family. The majority of *campesinos* are unable to purchase or rent additional agricultural land as a way to earn more money. A lack of 'disposable income' and labor resources limits their options. Credit is generally not available to poor *campesinos*. Without credit or available cash many *campesinos* have no way to utilize alternative land preparation methods. Subsistence farmers cannot purchase herbicides to control invasive vegetation, buy improved seed strains, or hire laborers to clear fields by hand. Those farmers with the appropriate farmland may not be able to purchase or even rent oxen to plow their parcels. Other factors influencing the relationship include the physical conditions under which *campesinos* utilize burning, the lack of fire suppression equipment, and an inefficient

judicial system and weak law enforcement that fail to deter escaped agro-pastoral burns. Some environmental education programs have been conducted which attempt to reduce both agro-pastoral burning and forest fires.

Recommendations

A major barrier to reduction of forest fire ignitions and agro-pastoral burning is the negative attitude expressed by NRM's towards *campesinos*. Responses by NRM's commonly revealed an 'us vs. them' mentality. NRM's must recognize that agro-pastoral burning is the only feasible land preparation method available to the majority of *campesinos* and it will continue despite their support of environmental education programs and promotion of alternative methods. Occasionally agro-pastoral burns will escape and become forest fires.

There needs to be recognition that the ban on agro-pastoral burning is entirely counterproductive. This ban forces *campesinos* with few or no options into a position as criminals. Rather than helping the problem of escaped agro-pastoral burns it leads to opposition between *campesinos* and NRM's. The ban on burning should be lifted and an active alliance built between these groups to reduce the occurrence of escaped burns and other forest fire ignitions. There should be a focus on collaboration rather than the current opposition that exists today.

While agro-pastoral burning is not the principal cause of fire ignitions it is the most visible cause and may be the one most easily addressed. However, fire occurrence will only be reduced by a small amount since *campesinos* are not the principal cause of ignitions. Small reductions in forest fire occurrence and spread could be addressed through the funding and training of local fire brigades. While this has been attempted in

some municipalities the scale was so small as to have no visible effect. Rural citizens are the ones there in the fields and forests when fires occur and are in the best position to quickly get to and suppress forest fires. These community fire brigades could also be trained in the proper methods of conducting burns. With the proper training and adequate equipment escaped burns could be greatly diminished. Another useful recommendation would be for the government to issue daily radio spots of wind reports, letting the *campesinos* know if it was a good day to burn or not. These community fire brigades would increase the control over agro-pastoral burning operations and unregulated forest fires. A similar program enacted by COHDEFOR in the late 1980s formed *Comités de Defensa Forestal* (Forest Defense Committees) to achieve these ends. They had little success, likely due to a lack of funding and incentives for local participation. International assistance was requested by many informants and would be a great help in meeting this recommendation.

“Community based fire-management projects in Indonesia, Africa and the Amazon, have seen real improvements through engaging efforts with people to address underlying causes of fire.” (Rowell and Moore). The importance of involving local peoples in forest protection and fire management cannot be overstated, especially in countries such as Honduras where the federal government has neither the resources nor funding to adequately carry out such programs. In Costa Rica “the formation of regional and local fire management committees has been instrumental in improving fire management responses in the country...The Central Government provides funding for tools, equipment, training, education, etc....The committees are formed by volunteers, with professional and technical assistance provided by the government. These

committees are responsible for preventing fires, as well as organizing to suppress fires.” (Goldammer and Mutch 2001). Guatemala also promotes a similar community fire management program.

The Central American Commission for Environment and Development (CCAD), formed in 1989, is an example of regional policy making and coordination in Central America. One of its goals is to foster citizen participation in addressing environmental concerns. The CCAD should be promoted and used to exchange ideas and techniques between the nations of Central America. Honduras could gain valuable advice and recommendations from community based forest management groups from Costa Rica and Guatemala. Honduran NRM’s should promote community based forest management and ensure that communities receive benefits from the forests they live near and protect. This is an important strategy for better resource use, conservation, and fire reduction efforts.

In the face of limited funding and resources a farmer-to-farmer extension program should be adopted. Local *campesino* leaders could be trained in fire management activities and then work to train other locals. Similar programs have been used in Honduras as a way to promote soil conservation techniques.

Community participation in forest management and protection is key. There should be a promotion of incentives for forest protection. The Honduran citizens who live and work in the forests need to receive benefits from them in order to increase their participation in forest protection, and fire prevention and suppression efforts. This is key in order to achieve significant fire occurrence reductions, since nearly all fires in Honduras are human caused. These incentives may include the promotion of small community-managed and operated sawmills. These mills would contribute to the

economic development of poor, rural communities and bring a sense of forest ownership to the people.

It is also important to balance fire suppression programs with prescribed fire programs and sustainable land management practices, in order to avoid the inherent problems caused by fire's exclusion from such a landscape (Mutch 2002).

If the goal is to reduce forest fire occurrence in Honduras the fact must be addressed by NRM's that incendiaries are a much more common cause of forest fires than agro-pastoral burning is. Research should be conducted to learn more about incendiaries, as a way to confront the major cause of fire ignitions. Determining the principal causes of forest fires allows agencies to target these sources with fire prevention messages specifically tailored to the actual causes. Despite the difficulty in such an endeavor research should be attempted to determine the reasons why incendiaries are the principal cause and the major factors encouraging incendiarism.

While not as principal of a cause as incendiaries, agro-pastoral burning is more easily addressed since those responsible are not faceless "arsonists" and "pyromaniacs." Natural resource managers have attempted to persuade *campesinos* to burn under less adverse conditions and to take the proper precautions to prevent forest fires. NRM's claim that a successful reduction of forestland burned by escaped agro-pastoral burns necessarily involves behavioral changes among *campesinos*. This will be difficult since burning is perceived to be a tradition, as part of their culture. Recommendations by Honduran NRM's and policy makers about reducing forest fire ignitions caused by agro-pastoral burning generally focus on the importance of environmental education programs. However this step alone will be insufficient to bring about positive, lasting change. The

problem can only be successfully addressed by attacking the broad range of factors that influence the relationship. Long-term educational programs that attempt to subvert this ‘culture of burning’ can only be successful if paired with poverty reduction and land redistribution measures, and an increase in forest resources benefiting communities.

The larger underlying problems of poverty and land access of the rural poor need to be addressed in order to begin to curb agro-pastoral burning. Poverty and land access are factors limiting the options available to *campesinos* and preventing the use of alternative land preparation methods. There is a real need for meaningful economic and agrarian reform in Honduras. The federal government has not done enough to address these issues. International aid and economic stimulation packages should focus on where aid is needed the most and can do the most good – poor, rural *campesino* families. There should be a push for programs that offer credit to small-scale farmers and ranchers as a way for them to begin to change their situation. Alternative land preparation methods will only be employed by those able to afford them or with access to appropriate land.

These two issues of poverty and land access are the most important factors encouraging the practice of agro-pastoral burning. Unfortunately these factors are well entrenched in Honduras. It will be extremely difficult to bring about real change without also addressing the issues of political corruption, and a capitalist export economy that strips the country of its wealth and resources and ships it to the United States and other ‘developed’ nations. Also the corruption and inefficiency of the Honduran judicial system and law enforcement should be addressed.

Natural resource managers have the best chance of successfully reducing forest fire occurrence by communicating with and working with the public, specifically with the

small-scale *campesinos* who use agro-pastoral burns annually. Understanding how the public perceives and uses fire is essential in order to formulate mutually acceptable forest management and fire management plans. Natural resource managers need to listen to *campesinos* in order to understand their reasons for burning and to develop feasible alternative land preparation methods that are sensitive to their economic and labor limitations.

Basic and applied research is needed to delve more deeply into many of the sub-topics covered here. A basic lack of quantitative data hinders a realistic understanding of the situation. More research is needed to look into fire occurrence and its causes, and the fire ecology of Honduran pine species. It is necessary to have accurate data concerning fire occurrence and causes in order to design effective fire prevention programs. Knowledge of the historic fire frequency, and the intensities and sizes of past fires would aid in prescribing appropriate management practices on a landscape scale. It would also be of interest to determine how Honduran perspectives vary on the separation of a pastoral burn from a forest fire.

This study points to the need to begin a dialogue in order to increase understanding between natural resource managers and *campesinos*. An intimate understanding of local *campesino* knowledge and conditions can be instrumental in formulating effective resource management policies. Researchers can play a vital role in promoting this dialogue in order to achieve a mutually acceptable balance between *campesino* needs and ecologically sound and sustainable practices.

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Glossary

This glossary explains local Spanish words and plant species, abbreviations, acronyms, and a few key agronomic terms.

AFE	<i>Administración Forestal del Estado</i> (State Forest Administration – Honduras)
AMITIGRA	<i>Amigos de La Tigra</i> (Friends of La Tigra National Park); a private organization responsible for the management of La Tigra National Park.
<i>Barrera muerta</i>	Literally, dead barrier. This is basically a fence constructed of “dead” materials such as rocks, logs and spiny branches.
<i>Botar</i>	To throw away. Often used by <i>campesinos</i> to describe the removal of agricultural wastes and weeds from a farm plot.
<i>Campesino</i>	Literally, peasant. Derived from the word <i>campo</i> . Used to refer to one who works in the field, such as farmers and ranchers. May be used to refer to rural people in general, regardless of occupation.
<i>Campo</i>	Literally, country, countryside, or field. Used to refer to a field but also refers to rural areas in general.
<i>Canícula</i>	Translated as dog days or midsummer’s heat; locally it refers to the two or three weeks of dry weather in August that breaks up the rainy season.
<i>Carbón</i>	<i>Acacia pennatula</i> ; a spindly tree 15 to 20 feet in height with very spiny branches; wood used as fuelwood and branches used as part of fences to discourage people and cattle from crossing them. There are a number of similar species existing in Honduras, including: <i>Mimosa tenuiflora</i> ; <i>Mimosa zacapana</i> ; <i>Cassia pinacula</i> and other <i>Cassia</i> spp.
Caribbean pine	<i>Pinus caribaea</i> var. <i>hondurensis</i> ; known locally as <i>pino costanero</i> (coastal pine) or <i>pino curtidor</i> (tanner pine).
COHDEFOR	<i>Corporación Hondureña de Desarrollo Forestal</i> (Honduran Corporation for Forestry Development)
<i>Conquistadores</i>	The colonial Spanish military, literally conquerors.
<i>Cultura</i>	Literally, culture.
<i>Departamento de Protección Forestal</i>	Department of Forest Protection, AFE-COHDEFOR.
<i>Dulce</i>	Processed, concentrated sugar cane; eaten by field laborers for an energy boost.
<i>Encino</i>	<i>Quercus</i> spp.
ESNACIFOR	<i>Escuela Nacional de Ciencias Forestales</i> (National School of Forest Sciences – Siguatepeque, Comayagua, Honduras)
FAO	Food and Agriculture Organization of the United Nations

<i>Fijese que...</i>	Essentially means ‘listen to this’, ‘pay attention’, or ‘imagine that’. In Honduras it is often spoken just before making an excuse or telling a lie.
FRA	Forest Resources Assessment Programme (FAO – United Nations)
<i>Gringo</i>	Literally foreigner, but used in Honduras to refer exclusively to Caucasians from the United States. Supposedly the word comes from the English “green go”, from Latinos telling U.S. troops (wearing green uniforms) to go home. Although in some instances it may carry a negative connotation, most of the time it does not.
<i>Guamil</i>	Secondary growth of shrubs or forest on a fallow field, considered to be ‘rested’ enough to give good yields when burned and sowed. According to Membreño (cited in Jansen 1998) fallow systems must have existed in pre-Columbian history because <i>guamil</i> has Nahuatl roots: it may have arisen from <i>guammilli</i> which refers to “bastón, palo delgado” (Membreño 1908); or from <i>ouatl (espiga tierna de maíz)</i> and <i>milli (campo)</i> (Membreño 1982). Chapman (1985, citing F. Santamaría 1959, <i>Diccionario de Mejjicanismos</i>) believes that <i>guamil</i> stems from <i>huac-milli</i> , of <i>huacqui</i> (dry) and <i>milli</i> (field).
[i3]	Indicates the source of the quote as interview/informant #3
Incendiaries	People who deliberately burn property; includes arsonists and pyromaniacs.
<i>Incendios forestales</i>	Literally, forest fires.
<i>Invierno</i>	Literally winter; the rainy season that runs from mid-May to October.
<i>Jaraguá</i>	<i>Hyparrhenia rufa</i> ; a fast-growing pasture grass introduced from Africa; it is very palatable to cattle when it is young but soon grows mature and unpalatable; farmers burn it to cause it to re-sprout and regain its palatability.
<i>Lempira</i>	The unit of Honduran currency. In June 2001 the exchange rate was 15 <i>Lempiras</i> = \$1 U.S. It is named after an indigenous Lenca chief who resisted the Spanish <i>conquistadores</i> .
<i>Limpiar</i>	Literally, to clean, cleanse; to clear, rid; to clean up. Often used by <i>campesinos</i> to indicate the clearing of weeds by use of a <i>machete</i> .
<i>Maize</i>	Corn.
<i>Maquiladoras</i>	Textile/clothing factories.
<i>Manzana</i>	The traditional land area measurement in Honduras; approximately 0.7 hectares.
<i>Mestizo</i>	People of mixed Spanish and Native American ancestry
<i>Milpa</i>	A field used to grow <i>maize</i> (corn). Also specifically refers to the first corn crop of the season. Also see <i>postrera</i> .
NRM’s	My abbreviation for natural resource managers. This group included natural resource managers, forestry project directors, fire management specialists, and forest engineers.
<i>Ocote</i>	<i>Pinus oocarpa</i> ; the national tree, and symbol, of Honduras.

<i>Pinabete</i>	<i>Pinus pseudostrobus.</i>
<i>Por costumbre</i>	Literally, by custom, by habit.
<i>Postrera</i>	The second <i>maize</i> crop of the season. It is usually sown near the end of the rainy season, in October or November, but may be sown as early as August.
<i>Programa Mundial de Alimentos</i>	World Food Program (United Nations)
<i>Quemas agrícolas</i>	Literally, agricultural burns. This is a land preparation method. It may refer to the burning of a <i>milpa</i> or beanfield, or of the burning of pastureland.
<i>Roble</i>	<i>Quercus oleoides.</i>
SECPLAN	<i>Secretaría de Planificación</i> (Secretariat of Planning).
<i>Servicio Forestal Nacional</i> (SEFONAC)	National Forest Service
<i>Talar y quemar</i>	To slash and burn. This is a land clearing method where all large trees and shrubs are cut and (generally) removed from the plot before being burned.
USAID	United States Agency for International Development. A development organization that gives millions of dollars of funds annually for projects in Honduras and many other countries.
<i>Verano</i>	Literally summer; the dry season that runs from November until mid-May.

Appendix A

Interview Format

Demographics collected: name, age, occupation/work, level of education, have they attended any workshops about forest fires/agricultural burns?, do they own land?, how much land do they own?

“In your opinion...”/ “What do you think...”

- 15) Do you burn your farmland? When?
- 15a) Do you burn each parcel every year?
- 16) [if no] Why not?
[if yes] How much land do you burn at one time?
- 17) What is your purpose for burning your land?
- 17a) Are there other methods to prepare the land?
- 17b) Why don't you use them? / Why aren't they used?
- 18) When you burn do you do it alone?
- 19) When you burn do you make a firebreak first?
- 20) Have you fought any forest fires? Where? How was the experience?
 - 1) Have you seen forest fires? Where? How were they?
 - 2) How do forest fires start?
 - 3) What is the principal cause of forest fires?
 - 4) During what time of year are there more forest fires? During which months?
 - 5) Is there more land burned by forest fires or by agricultural burning?
 - 6) Do you think many fires extend from agricultural burns into the forests? Is it a problem?
 - 7a) Are there benefits that come from forest fires? [if yes] What are they?
 - 7b) Are there benefits that come from agricultural burning? [if yes] What are they?
 - 8a) Are there disadvantages or bad effects that come from forest fires? [if yes] What are they?
 - 8b) Are there disadvantages or bad effects that come from agricultural burning? [if yes] What are they?
 - 9) Who is responsible for combating forest fires?
 - 10) Do you know if there are laws about the regulations for burning agricultural land? What are they?
 - 11) Do you know if there are laws regarding forest fires? What are they?
 - 12) Are these laws enforced? By whom? [if not] Why not?
 - 13) In reality, are there consequences for not following these laws?
 - 14) Do you believe that there is a need to change these laws? What ought to change?
 - 24) Regarding fires, has your attitude changed over the years? [if yes] Why do you think it has changed?

Original Interview Format (in Spanish)

Datos Demográficos: nombre, edad, ocupación/trabajo ¿a que se dedica Ud?, nivel de educación, ¿ha asistido algún taller o ha recibido alguna capacitación sobre incendios forestales?, ¿Ud es dueño de terreno?, ¿cuánto terreno tiene Ud?

“¿En su opinión...” / “¿Que piensa Ud...”

- 15) ¿Ud quema su terreno agrícola? ¿Cuándo?
- 15a) ¿Ud quema su parcela cada año?
- 16) [si no] ¿Por qué no?
[si sí] ¿Cuánto terreno quema a la vez?
- 17) ¿Cuáles su propósito en quemar su terreno?
- 17a) ¿Hay otros métodos para preparar el terreno?
- 17b) ¿Por qué no se usa?
- 18) ¿Cuándo Ud quema, lo hace solo?
- 19) ¿Cuándo Ud quema, hace una ronda cortafuego primera?
- 20) ¿Ha combatido algún incendio? ¿Dónde? ¿Cómo fue la experiencia?
- 1) ¿Ha visto algunos incendios? ¿Dónde? ¿Cómo estuvieron?
- 2) ¿Cómo empiezan los incendios?
- 3) ¿Cuál es la causa principal de los incendios?
- 4) ¿Durante cual periodo del año se ven más incendios? ¿Durante cuales meses?
- 5) ¿Se ven más incendios en terreno agrícola o en el bosque?
- 6) ¿Piensa Ud que muchos incendios extienden de terreno agrícola a los bosques?
¿Es un problema?
- 7a) ¿Hay beneficios que vienen de los incendios? [si sí] ¿Cuáles son?
- 7b) ¿Hay beneficios que vienen de las quemas agrícolas? [si sí] ¿Cuáles son?
- 8a) ¿Hay desventajas o mal efectos que vienen de los incendios? [si sí] ¿Cuáles son?
- 8b) ¿Hay desventajas o mal efectos que vienen de las quemas agrícolas?
[si sí] ¿Cuáles son?
- 9) ¿Quiénes son los responsables en combatir los incendios?
- 10) ¿Sabe Ud si existen leyes sobre los reglamentos de quemar terreno agrícola?
¿Cuáles son?
- 11) ¿Sabe Ud si existen leyes que se tratan de los incendios forestales? ¿Cuáles son?
- 12) ¿Hacen cumplidos esas leyes? ¿Por quien? [si no] ¿Por qué no?
- 13) ¿En realidad hay consecuencias por no seguir esta ley?
- 14) ¿Cree Ud que hay necesidad de cambiar esas leyes? ¿Qué debe cambiar?
- 24) ¿Ha cambiado su actitud hacia los incendios entre los años? [si sí] ¿Por qué piensa Ud ha cambiado su actitud?