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thesis entitled

Land Use Evolution Along the Dominican Republic's Agricultural Frontier: A Comparative Analysis of Two Hill Land Regions

presented by

Mark Oliver Zweifler

has been accepted towards fulfillment
of the requirements for

Master of Arts degree in Geography

Major professor

Date 10/4/90

LAND USE EVOLUTION ALONG THE DOMINICAN REPUBLIC'S AGRICULTURAL FRONTIER: A COMPARATIVE ANALYSIS OF TWO HILL LAND REGIONS

By

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Geography

1990

ABSTRACT

LAND USE EVOLUTION ALONG THE DOMINICAN REPUBLIC'S AGRICULTURAL FRONTIER: A COMPARATIVE ANALYSIS OF TWO HILL LAND REGIONS

By

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The colonization and inappropriate management of the Dominican hill regions has resulted in significant deterioration of their natural resource potential. This thesis emphasizes the importance of understanding the history of land use when identifying the key constraints and potential improvements for existing hillside farming systems.

The land use history of Las Auyamas, a mountainous region first colonized in the early 1900's, is compared to that of El Jaimito, which was not intensively settled until the late 1950's. Based on data from a social survey and an airphoto time series, the study demonstrates how the great disparities in present land use and productivity are largely explained by the two regions' distinct stages of development along a common land use evolution continuum. The less degraded soils of El Jaimito support a relatively diversified and prosperous peasant farm economy; while massive out-migration and the predominance of unproductive coffee plantations reflect the more degraded condition of the Las Auyamas landscape.

ACKNOWLEDGEMENTS

The personal and professional support from family, friends and colleagues was an essential and deeply appreciated dimension of this research. Dr. Gary Manson and Dr. Judy Olson, Chairpersons of the Department of Geography, and Dr. Paul Roberts, of the Institute of International Agriculture, secured employment opportunities and other financial assistance throughout my graduate career. A fellowship from the Inter-American Foundation covered expenses during my stay in the Dominican Republic.

Rafael Yunén, Vice-Rector of U.C.M.M., and Pedro Juan del Rosario, Director of C.E.U.R., provided institutional support for my field work as well as guidance and encouragement in the development of this thesis. Santiago Rossi, Freekye Olivo, Helmut Schorgmayer, Julio Baez, Julio Santana, Horacio Lopez, Frans Geilfus, Fernando Arturo Russell, Romaine Paquette, Luc St.-Pierre, Andre LaMarche, all members of C.E.U.R. and/or the "Uso del Suelo" project, generously shared their time and expertise during the course of my field investigations as well as their good humour and friendship when I felt lonely for my family. Research assistants, Pedro Mencia and Pedro de la Cruz, were excellent guides and companions. The good people of Las Auyamas and El Jaimito answered my many questions with great patience and insight.

Dr. Robert Thomas and Dr. Michael Gold, members of my thesis committee, never bridled my enthusiasm but demanded the intellectual discipline to successfully complete this challenging thesis. My parents, Ruth and Andy Zweifler, have always been there whenever I needed it. Finally I want to thank my wife Donna and my children, Jasmine and Caleb, who endured my abscences, both physical and emotional, and gave me the love to carry on.

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Theoretical, Regional and Historical Context of Study

As we come to comprehend the finite nature of our planet, the search for more sustainable uses of our natural resources has become a major topic of global concern. Of all human activities, agriculture is the greatest user of land and water resources and therefore requires particular attention if we are to insure a habitable future. While many technologies have been developed to increase productivity, the expansion of agriculture onto uncultivated frontier lands remains an important response by farmers to social demands for increased production.

Nowhere is recession of the agricultural frontier proceeding at a more rapid pace and with more devastating effects on the environment than in the countries of Latin America and the Caribbean (hereafter referred to as Latin America). Denevan (1989) estimates that over 80% of Latin America's land base is "fragile" or susceptible to severe degradation under conventional land uses such as ranching or monocultural farming. The expansion of agriculture into these ecologically vulnerable regions has serious, negative implications.

Until recently, relatively small populations and limited world markets meant that commercial land use was generally restricted to regions of gradual slope, with adequate rainfall or irrigation, and good agricultural soils. Throughout the colonial era and up to the first half of this century, the fragile lands of Latin America (e.g. tropical rainforest, steep slopes, and arid zones) were sparsely populated. Given low population densities, the people who lived in these "fragile" areas utilized traditional resource management practices that had few adverse effects upon the environment (Browder et. al., 1989; Hills & Iton, 1983; Wilken,1987). More recently, the burgeoning population of Latin America and its rapid and socially

inequitable form of economic development has resulted in expanding colonization and degradation of Latin America's fragile land base. (Leonard, 1987; Maguire & Brown, 1986). While many aspects of fragile land colonization are universal this research will focus on areas of steep slopes[1].

Statement of Problem

The hill lands of Latin America are experiencing significant declines in their value for human use due to inappropriate land use practices. Current methods for analyzing the human causes of hill land degradation are inadequate. This thesis advocates an analytical method that emphasizes the study of the historical and evolutionary origins of current land use as an indispensable tool for determining sustainable improvements to contemporary systems.

Posner and McPherson's (1983) estimate of the contribution of steep slope[2] agricultural production for all countries of Tropical America, finds that these areas;

1) comprise over 50% of the total land area
2) produce 20-40% of total agricultural output
3) have 20-50% of the total agricultural land in annual crops
4) produce 50-75% of domestic food staples
5) contain 30-50% of the farming population. The vast majority of these farmers have land holdings under 5 hectares, including the 40-60% of the rural population (los campesinos) considered "absolutely poor" by World Bank criteria.

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[1] "Steeply sloped areas" refer to hilly and mountainous regions in terrain and at elevations where access typically becomes problematic. Usually the text will refer to these areas as "hill lands".

[2] The authors considered slopes exceeding 8% as steep; most of the land referred to in their study have slopes in the range of 15-25%.

These figures indicate that any effort in Latin America to increase food production and raise income levels of the rural poor, must address agricultural production on the steep slopes. Even if governments are not highly motivated to meet the needs of politically marginal hill land people, downstream problems created by a neglected, upland agro-economy has forced an awareness of hill land development issues. Increased land pressure in the hills results in rampant forest clearing, massive soil erosion, declining hillside farm productivity, siltation of hydro-electric and irrigation projects, damaging sedimentation of coastal fisheries, and a steady stream of upland emigrants crowding into already overpopulated urban centers. (Bremer et. al.,1984; Eckholm, 1975; Mosher, 1986; Nations & Leonard,1986; Wilson,1976)

A great need exists for the development of more sustainable agricultural land use systems for hill land areas that will support resident populations, preserve the fertility of the resource base and protect downstream investments. Numerous researchers in the natural and social sciences concerned with the current state of contemporary agriculture have adopted the term "sustainable agriculture". However, despite the widespread interest in "sustainability" the concept has proved difficult to operationalize.

How can we measure sustainability? The ability of an agricultural system to maintain its ecologic and economic viability over a long period of time commonly forms a part of most definitions. This is not to say that an agricultural system must remain unchanged over time; in fact, the ability to respond to constantly changing environmental and social conditions is an indispensable asset of any sustainable land use. No matter how detailed and careful the study of the present agro-ecological and socio-economic

components of a land use system, research that fails to incorporate the historical dimensions will likely fail to reveal sustainable modifications. Apart from long-term studies which are expensive, difficult to fund and entail a long wait before producing research results, analysis of the history of actual agricultural land use provides the only method to study the long-term, human-environment interaction that sustainable agriculture research hopes to modify.

Calls for further research to determine the most appropriate use for fragile lands tend to emphasize the present and the future; e.g., development of better regional classification systems, more information on deforestation and erosion rates and the mapping of current use patterns, etc. (Bremer et. al.,1984). Research which looks to the past does so to find indigenous models of land use that may be adapted to present day conditions (Browder et. al.,1989). This study argues that history should be more than just an obligatory preamble to the actual analysis of land use systems.

Richard's (1989: 40) criticizes conventional agricultural research for its "out of time" analyses of traditional intercropping systems:

> The crop mix-the layout of different crops in the field-is not a design but a result, a completed performance. What transpired in that performance and why can only can only be interpreted by reconstructing the sequence of events in time. Each mixture is a historical record of what happened to a specific farmer on a specific piece of land in a specific year, not an attempt to implement a general theory of inter-species ecological complementarity (as plant ecologists might suppose).
>
> Researchers are looking at the wrong problem. They are looking for the combinatorial logic in intercropping where what matters to the Hausa farmer is sequential adjustment to unpredictable conditions. It is important therefore not to confuse spatial with temporal logic- not to conflate plan and performance.

For the same reasons researchers mistake design for result at the scale of a farmers field; regional land use systems cannot be understood solely by dissecting their component parts (e.g. soils, climate, socio-economics, etc.). We cannot understand current land use without recognizing that it represents a snapshot of an evolutionary process, with a specific genealogy. By understanding both the present social and agro-ecological context as well as the history of land use, we can better anticipate future problems and recommend more sustainable approaches to regional development. To utilize this method of analysis, the author carried out fieldwork in two mountainous agricultural regions of the Dominican Republic [D.R.] that shared generally similar ecologies, but were at two different stages in their developmental histories. Lowland peasants first colonized Las Auyamas around 1910; while intensive settlement of the second site, El Jaimito, commenced in the late 1950's (Figure 1). In order to place the Dominican study area within the Latin American regional context that this study intends to represent, the following section profiles land use in Latin America's hill lands.

Land Use in the Hill Regions of Latin America

History

The Pre-Hispanic Era:

With the exception of the Caribbean basin, where aboriginal populations tended to concentrate along the coasts, the hill areas of Latin America were a preferred zone for food production. Mountain soils tend to be more fertile than the heavily weathered ultisols and oxisols common in

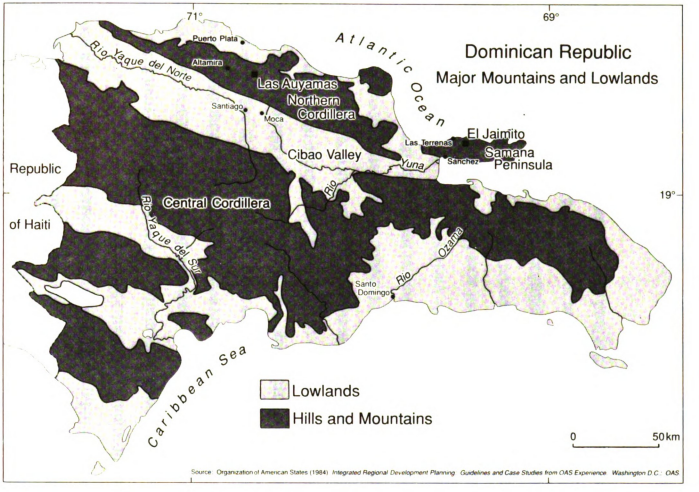

Figure 1 Major Mountains and Lowlands of the Dominican Republic

the tropical lowlands. Open forests, without tenacious lowland grasses, made the clearing of farm plots easier on hillsides. Hill land updrafts increased fire intensity to produce a cleaner burn. The consistent tendency of fires to burn uphill, assisted the management of controlled burns (Posner, 1982). The prevalence of insect borne diseases discouraged settlement of the humid lowlands. Even today, Latin Americans associate highlands with a good healthy environment (Plunkett,1976).

In drier climates, mountains were a region of year-round stream flow. Mountain soils, typically, are shallow making them droughty. Aboriginal farmers built cross-channel terraces on seasonally flowing stream beds to collect water and alluvium. The deep soils that built up behind terrace walls improved moisture retention, and addition of fertile silts carried by seasonal floods permited permanent cropping. The prevalence of pre-Hispanic terraces in semi-arid regions suggests that moisture retention rather than erosion control was the primary function of these structures (Donkin,1979).

Exploitation of various ecological zones along the vertical gradient enabled the production of a wide variety of crops, livestock and forest products within a relatively small area (Brush, 1976). This was a distinct advantage in a time when transportation and trade were difficult and often dangerous. Widespread archaeological remains of intensive agriculture features provide evidence of the sophisticated adaptations of pre-Hispanic societies to the complex hill land environment (Erickson and Candler, 1989).

The Colonial Era:

The Spanish conquistadores decimated the native population by a combination of war, forced labor and most devastating, the introduction of

Europeon diseases, for which the Indians had no natural immunities (Sauer,1966). The population of Latin America did not achieve pre-conquest levels until the 1950's and in many hill regions populations have yet to completely recover (Warman,1981). Labor deficiencies and the Spaniards purposeful dismantling of indigenous social institutions crippled the complex highland agricultural civilizations of the Andes and Meso-America. The Spaniards expropriation of villages' labor to work the colonial mines and haciendas caused the collapse of reciprocal labor arrangements, which were critical for the performance of timely agricultural tasks in Native American traditional society, and the abandonment of many of the indigenous labor- intensive terrace/irrigation systems.

The colonial era drew Latin America into an international commercial economy. The monetarization of peasant society made non-cash subsistence inadequate. Highland natives needed to earn money in the colonial cities and flatland plantations in order to pay their taxes and purchase those industrial products that had become indispensable (Stern, 1982). Coastal ports, colonial capitols, and plantation agriculture transferred the locus of power and the centers of population from the hill lands to the flat lands.

On the Caribbean islands, a quite different flatland/hill land interaction evolved. The hill areas, which had little history of significant aboriginal land use, were gradually occupied by the unwilling immigrants from West Africa. Plantation owners provided slaves with small parcels on unutilized backslopes for the cultivation of food crops (Rankine, 1976). Black slaves developed their hillslope farming skills on these "provision grounds". After the abolition of slavery, many former slaves established their own farms in the unoccupied hill areas.

The Modern Era:

It is difficult to sort out current demographic trends on the steep slopes of Latin America. Every day, the new roads that have penetrated the rugged interior carry highland campesinos fleeing poverty and seeking opportunities in the cities, however, many hill regions continue to receive a substantial flow of in-migration. Large, commercial agro-enterprises frequently displace small-scale flatland farmers, and many of these farmers choose to colonize lands still available in the hills. Lowland colonizers of hill regions often have to farm areas unsuitable for annual cropping, or may not possess the agricultural knowledge necessary for utilizing steeply sloping lands in a sustainable manner; in either case, the likely result is deforestation and soil erosion (Sanchez,1976).

Net migration rates in the hill lands may vary but one demographic trend is universal. The rapid rate of natural population increase creates intensified pressures on fragile, steep slope areas. Increasing demands for agricultural production by governments, seeking to repay massive foreign debts, and peasants, who need to survive in an inflationary economy, exacerbate population pressures on the hill lands. Short-term exigencies threaten the adaptiveness of traditional hill slope farming practices which depend on the long-term stability of their natural resource base.

Ecology

The dynamic and heterogeneous character of the physical environment of Latin America's hill lands make distributional descriptions virtually impossible. Soils vary greatly within short distances and with

changes in altitude (U.S.D.A. S.C.S. World Soils Map, 1972). Adiabatic cooling decreases temperature with elevation and orographic precipitation causes cloudcover and rainfall to increase with altitude (Strahler&Strahler, 1984). Slopes on the windward side of mountains receive greater precipitation than slopes in the leeward "rain shadow". Paralleling the vertical zonation and topographic discontinuities of climate are the complex patterns of natural ecosystems found in hill land areas.

Relief, or slope, is the environmental characteristic which most effectively defines the ecology of hill lands. Slope length and gradient are primary factors in the erodibility of a land surface. Long, steep slopes, shallow soils and erosive heavy rains associated with montane climates constitute the primary reasons why hill lands are considered fragile. Under forest cover hillside soils are fairly stable; but once deforested, slopes are susceptible to catastrophic soil losses.(Hartshorne et. al., 1981). Deforestation of the Dominican Republic's upper watersheds is linked to a greater than 300 percent increase in river silt load over the period 1968-1980 (Santos, 1981).

The dynamic, environmental diversity of Latin America's hill lands, that historically had been used to advantage by traditional farmers, is now an impediment for modern, less ecologically sensitive, forms of production. Conventional agricultural research is geared for the uniform conditions of flatland areas and has failed to adequately serve the needs of hillside farming (Posner, 1982). The complexity of hill land soils and climate severely restricts the range of applicability for any specific agronomic prescription. Soil conservation technologies, which could help mitigate the erodibility of cultivated slopes, require capital and/or training to which many hill farmers do not possess or have access.

Political Economy

The marginal socio-economic position of hill land communities limits their ability to effect changes needed to make their land use systems more sustainable. Erik Eckholm (1975) writes;

> The difficulty of adapting cultural practices to rapidly changing environmental circumstances is exacerbated by the tendency of mountain populations to be those with the least income, ... education, and political power in the country.

Hill lands are isolated both spatially and politically from lowland centers of trade and power. Poor transportation links compound the great physical distances which typically separate hill regions from commercial hubs. A bus ride into the Dominican Republic's hill lands can easily take twice the time and cost double the fare of an equivalent trip in the lowlands. The hill lands of Latin America are primarily rural and poor. The rural poor in general have little influence in setting government priorities; the problem becomes extreme when physical isolation combines with low socio-economic status.

Hill lands are typically underserved by public services such as schools, clinics, roads and electricity. High transportation costs lower the price that hill farmers receive for their crops while increasing the costs they pay for consumer goods. The necessity to increase short-term production to compensate for marginal economic returns works against sustained yields (Collins,1986). The fragility of steep slopes and the price squeeze faced by farmers can precipitate a downward ecologic/economic spiral. Blakie and Brookfield (1987, p.13) summarize this interactive effect; " Land degradation can undermine and frustrate economic development while low levels of

economic development can in turn have a strong causal impact on the incidence of land degradation". Land use technologies that sustainably maintain viable economic returns to hill land farming are desperately needed. Unfortunately the politically and spatially isolated nature of these areas has meant that the special needs and limitations of Latin America's hillside farmers have been underserved by development and research programs (Posner, 1982).

Land Use in the Hill Regions of the Dominican Republic

No local study site can represent all the diversity of landscapes and cultures of Latin America's hill lands; but as this research is as much a study of methods as a regional description, the Dominican Republic provides a particularly useful case study for the broad phenomenon of colonization and deterioration of Latin America's hill lands. The same degenerative process of intensification of use, reduction of fallowing and loss of soil fertility that occurs in the Peruvian Andes also takes place in the Caribbean hills.(Treacy, 1988; Wilson, 1976). The recent initiation and rapid progression of the degradation process in the Dominican Republic make it a well qualified study area.

In the pre-hispanic era, hill land settlements [Including the great Aztec and Incan Empires] were located throughout the mainland. In the Caribbean, intensive settlement of the islands' rugged interiors had to await the era of European colonialism. Escaped African slaves began establishing renegade hill land communities as early as the 1600's (E.P.I.C.A. Task Force,1979). Although the Dominican Republic provided the first site of European settlement in the New World, the colony quickly became relegated

to a "backwater" status. At the time of the Dominican independence in 1844 the population numbered only 300,000 inhabitants, concentrated primarily in the major lowland cities and their immediate coastal plain and valley bottom surroundings (Hoetink, 1982). The country's extensive mountainous areas remained virtually uninhabited [Figure 1] .

In the early 1920's, the forester William Davies Durland (1922, p.206) surveyed the forests of the Dominican Republic and wrote "Least known of the Greater Antilles, Columbus's island of Hispaniola had been least changed since pre-Columbian times. At least 75 percent of the land area is still forest clad with trees that can be classed as timber." The original hill land forests are now restricted to a few isolated national parks where they continue to be vulnerable to the axes of colonizing farmers. Durland foretold the unfortunate fate of this now endangered ecosystem;

> Although the republic is greatly behind the times in its industrial and commercial developments, it has a decided advantage over the neighboring islands in having maintained its forests in almost a natural state. But if this wealth is to remain a permanent asset, measures must be taken to control the destruction that has already begun. The commonly known system of "conuco making" (shifting agriculture) which is directly responsible for the destruction of the forest...should it continue in the Dominican Republic, that country will suffer the same fate (as Puerto Rico)- many devastated areas and a scarcity of wood for even the most humble of domestic uses.
>
> p.220

In the study area of Las Auyamas, several farmers of that generation of "conuco makers" referred to by Durland have experienced the clearing of natural forest, decline of soil fertility, abandonment of the land and depopulation of the hill lands. A cycle that has taken place over many centuries in the Andes has occurred within the span of a lifetime in the D.R..

The recent and rapid evolution of hill land use means that a relatively complete record can be reconstructed. Airphotos, national censuses and, most importantly, oral histories can be utilized instead of incomplete archaeological evidence and colonial-era documentation as would be necessary to detail land use change in other hill regions of Latin America.

The disturbingly close presence of Haiti offers another compelling attribute of the Dominican Republic as a site for the study of the regional phenomenon of hill land use evolution. The D.R. shares Hispaniola, the Caribbean's most mountainous island, with the hemisphere's most tragic example of hill land degradation. Unlike the Dominican Republic, Haiti has a long tradition of hillside peasant agriculture born from its slave/plantation colonial economy and unique revolutionary history. The physical landscape and social causes of soil erosion are similar on both sides of the island's political boundary. Primarily, the shorter period of settlement on the Dominican side of Hispaniola's hill lands accounts for its less degraded condition. Haiti, which occupies the western third of the island, provides a stark picture of what could be in store for the D.R. if it cannot establish more sustainable land use practices for its hill land areas.

Physical Characteristics

With a maximum east-west distance of 390 km. and a maximum north-south distance of 265 km., the D.R. covers 48,442 km.^{2} [18,810 miles^2]. Hilly and mountainous regions dominate the national landscape [figure 1]. At 3,067 meters in elevation, Pico Duarte in the Cordillera Central represents the highest point in the Caribbean. This rugged topography

creates a heterogeneous climatic regime. Within a short span of 50 kms. one finds biomes ranging from arid thorn woodland to wet subtropical forest.

Although the D.R. is the second largest nation in the Caribbean chain, only 20.3% of the land is considered suitable for annual cultivation (Hartshorne et. al., 1981). Steepness of slope presents the most extensive factor of agricultural limitation for the remaining 79.7% of the land. Figure 2 indicates the locations of this research's two, hill land, study areas within regions judged as unsuitable for either annual or perennial (tree crop and pasture) production (O.A.S.,1984).

The History of Hill Land Occupation

Sauer(1966) detailed Columbus' first voyages of discovery and early efforts at Spanish settlement. Initially the aspirations of those early explorers focused on the island of Hispaniola where large populations of Arawak Indian farmers and evidence of gold deposits prompted the establishment of the first European settlements in the " New World". An early census by the Spaniards estimated the aboriginal population of Hispaniola at 1.3 million. This large indigenous population supported itself by a productive and apparently ecologically stable farming system known as "conuco", a vegetatively propagated, polycultural system, based on manioc as the primary staple.[3] The availability of seafood, an important protein supplement, encouraged settlement of coastal zones, but Arawak settlements were sparsely dispersed throughout the mountainous interior as well.

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[3] The aboriginal term "conuco" remains in common use by Dominicans to signify the portion of the farm devoted to the production of annual food crops.

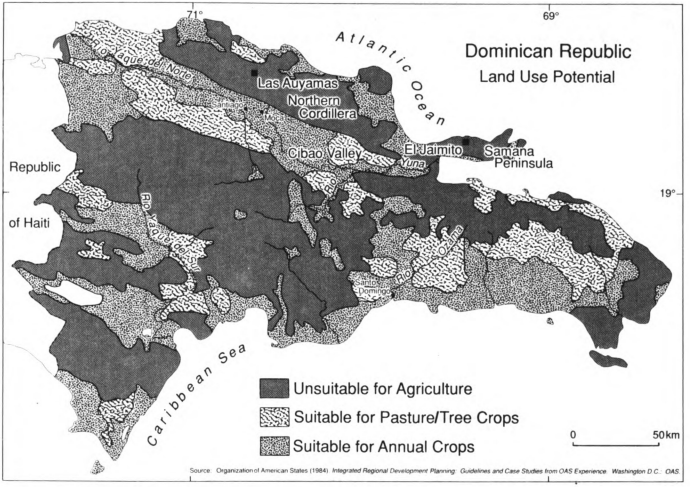

Figure 2 Land Use Potential Map of the Dominican Republic

A combination of military violence, introduced European diseases and the Spaniard's brutal systems of forced labor quickly decimated the Arawak population. Spanish settler numbers diminished as well, when the gold mines proved unproductive, the supply of Arawak labor was depleted, and news of great riches and conquests from the mainland reached the colony.

As a response to dwindling gold production in the 16th century, the Spanish crown promoted sugar production based on the use of African slave labor. By mid-century, slaves and free blacks composed approximately 70% of the total population (San Miguel, 1987). Vargas Lundus (1988: 84) summarizes the colony's economic deterioration following this early sugar boom;

> During the seventeenth century, the Spanish colony suffered a period of decline. The English maritime dominance isolated Hispaniola from Spain and exposed its ports to raids from different hostile powers. The Western part of the island was penetrated by the French and in 1697 Spain, in the treaty of Ryswick, acknowledged French possession of this part. While the sugar industry flourished in the French colony, (Saint Domingue) it deteriorated in the Spanish colony and an exodus of plantation owners and commoners alike led to a drastic reduction of its population- in 1509, 12,000 free Spaniards lived in the colony, in 1730 their number was reduced to 6,000.

With little population pressure or economic incentive to move onto sloping lands, the mountainous areas remained largely uninhabited. Agricultural activity in the foothills was restricted to "hatos", extensive ranching, and "ranchos", farming based on pig raising and subsistence swidden gardens. Extensive cattle rearing served as the mainstay of the feeble 18th century economy. These minimally managed cattle operations

"hatos" relied on their lucrative trade in hides and live cattle with prosperous Saint Domingue (Ricart,1972).

The 19th century was an era of great political and social upheaval. The establishment of the independent Republic of Haiti in 1804 culminated a successful slave revolt in Saint Domingue. By 1822, Haitian troops had conquered and annexed the Spanish portion of Hispaniola [the colony known as Santo Domingo]. The settlers of Santo Domingo vanquished the Haitians in 1844 and the Dominican Republic was born, but military conflict continued to plague the new republic. In the early 1860's, the young nation fought a second war of independence, this time with Spain, which had annexed the country in 1861 with the collusion of certain Dominican elites. Civil wars between rival regional factions which were common throughout the 19th century, eventually culminated in the U.S. invasion and occupation of 1916-1924 (Madruga,1986). Throughout this tumultuous period the mountains provided refuge for those fleeing conflict in the lowlands. The term "monteria" described the rugged existence of these early hill settlers who relied on the hunting of wild pig and swidden gardening for their subsistence (Antonnini, 1968).

Historically, terrenos comuneros, or the collective possession of the land by several owners, acted as the predominant land tenure system. Prior to the revival of the sugar industry, in the late 19th Century, the terrenos communeros system adapted well to the nation's prevailing conditions of low population densities and extensive land use. A modern, capitalist, agricultural economy could not develop in the early years of the republic because of the insecurity of individual land tenure rights. The organization of an effective legal apparatus for the protection of individual claims to the land represented one of the primary objectives of the U.S. occupation. The

U.S. occupation managed to establish civil order, construct basic infrastructure and enforce individual ownership rights to land; in sum, the occupation laid the foundations for the accumulation and investment of capital in the agricultural sector (Crouch, 1981).

Irrigation projects and the creation of large sugar plantations pressured peasant farmers out of the valley bottoms and coastal plains, causing many to migrate to sparsely populated, steeply sloped or arid regions of the country. Population increase, modernization of infrastructure, and strict suppression of social unrest during the Trujillo era (1931-1961), resulted in an overall intensification of agriculture. Extensive ranching was displaced from prime agricultural areas to more isolated, upland regions. Monoculture export plantations and diversified, commercially oriented, latifundia estates "fincas" became prominent features of the landscape. Even peasant farming became increasingly geared toward cash crop production (Antonini,1968; San Miguel,1987)

Antonini (1971) describes the Dominican peasant agriculture of the 1960's. In arid zones, peasants used riverine sites for mixed cash/subsistence farming while subsistence-type, extensive grazing occurred on the slopes. In hill lands with adequate rainfall, farmers planted hollows "hoyas" ,which had deeper soils and greater moisture retention, to high value cash crops, while on the steep slopes, they cultivated slash and burn subsistence plots. The preferential status of cash crops indicated the importance of cash income to peasant farmers, even in marginal and isolated areas, and their already substantial dependance on the market.

The reign of the dictator Rafael Trujillo had important implications for the Dominican Republic's hill lands. Responding to high lumber prices during the World War II era, timber companies owned or backed by the dictator

plundered huge tracts of the pristine upland forests. Peasants, who travelled up the new logging roads to clear slash and burn farms, further accelerated hillside deforestation. Although spontaneous agricultural colonization on to state controlled hill lands did advance in this period, the fear of Trujillo's repressive national guard kept the process in check. The 1981 Country Environmental Profile (Hartshorne et. al., 1981:10) describes the events following the assassination of Trujillo;

> Rights to land, forest, and water were controlled outright by Trujillo or through the guise of quasi-independent companies. After his overthrow in 1961, a wide range of political, economic and social restrictions were removed...In the forested mountainous interior of the Republic, the demise of the dictator precipitated mass invasions of lumber company lands that many considered were owned in part by Trujillo. Standing timber was indiscriminately cut by peasants intent upon establishing their land claims by introducing slash-and-burn farms. Some planners and policy makers have suggested that this indiscriminate cutting of the forests in the early 1960's represented a true peasant revolt against the dictator's inhumane policies.

In 1967, as a result of indiscriminate deforestation, the government ordered the cessation of lumbering activities and a ban on all tree cutting. Despite this prohibition, the nation's forests continue to fall, principally as a result of charcoal production and small-scale, slash-and-burn farming.

Trujillo's policy toward the peasantry was a blend of repressive and paternalistic "pro-peasant" measures (San Miguel,1987). The distribution of land to peasant farmers, often in remote hill land regions, played an important role in the "Trujillato" development policy. These land reform settlements, known as <u>colonias</u>, allowed the dictator to fulfill multiple objectives;

1) Increase state control over sparsely populated territories. [Many colonias were established along the mountainous Haitian frontier as a way to increase border security (Augelli,1962).]
2) Raise agricultural production.
3) Garner political support from land reform beneficiaries without addressing the country's inequitable land tenure structure

The unwillingness of the government to expropriate, and redistribute under-utilized large estates "latifundia" situated on good agricultural land has continued in the post-Trujillo era. Most of the lands distributed by the agrarian reform program continue to come from agriculturally marginal, state owned properties, much of which are located in hill land regions (I.A.D.,1979).

Small-scale farmers are squeezed by the expansion of cattle ranching in the hill areas[4]. Fifty five percent of the country's agricultural land is in pasture and 50% of all beef production comes from hill land regions (Geilfus,1986). When land goes up for sale, large cattle ranchers and wealthy urbanites, who increasingly invest in land and cattle throughout the Dominican highlands, easily outbid small-scale farmers. The low labor requirements of extensive cattle raising and the relatively inexpensive land prices attract urban investors to the hill lands (Hartshorne et. al.,1981). The 1981 census figures provide an indication of the non-intensive use of pastures. Although pasture covers 55% of all agricultural land, beef production only accounts for 9.1% of the total value of agricultural production (Mejia, 1989).

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[4] A land use study in the western half of the D.R., which employed LANDSAT imagery, showed pasture land had increased 42% during the period 1972-1986 (Fournier & Russell,1987).

Typically small farmers are blamed for the hill lands' environmental problems but ranching must assume a major portion of the responsibility. Not only can poorly managed ranching operations directly degrade hill lands by eroding and compacting hillside soils, but additionally, small-scale agriculture's competition with ranching for resources often pressures farmers into unsustainable practices as well (Geilfus,1986).

Hillside farmers have historically practiced a shifting agricultural system that depended on abundant areas of open land. As ranching occupies more and more of the uplands, farmers are pressured into more intensive, ecologically unsustainable, agricultural practices on the restricted areas still available for farming. Similar to the practices of ranchers in the Central American Highlands (Dewalt,1985), the leasing of parcels to land hungry farmers constitutes a common way for large landlords to clear forested property and create pasture. In exchange for access to the land, the farmer assumes the legal risk and labor requirements of clearing the forest and after several harvests, the land is reclaimed by the landlord and converted to pasture. Although it is frequently the peasant farmer who wields the axe, the primary beneficiaries of deforestation are latifundistas (large landowners) and those intermediaries who market the hill lands' agricultural products (Gomez et. al., 1987).

With the lifting of restrictions on freedom of movement for rural populations imposed during the Trujillo dynasty, rural to urban migration increased markedly in the 1960's [Figure 5]. No census has been taken since 1981, but social scientists believe that the pace of rural out-migration has quickened in the last decade (Duarte,1986; Guerrero,1985). Two events that have helped fuel this rural exodus need to be included in this historical overview of hill land occupation.

In September of 1979, Hurricanes David and Frederick buffeted the D.R. in rapid succession. David's heavy rains saturated the soils and when Frederick hit a few days later, extensive and disastrous landslides and flooding ensued. Hillside farmers, who had no tradition of utilizing soil conservation structures, saw entire topsoil horizons washed away in a matter of hours (Hartshorne et. al., 1981). Wind damage to homes and fields was also severe. This natural catastrophe discouraged many campesinos, already frustrated by the hardships of their rural existence, from continuing in agriculture. A decade later, many farmers continued to attribute pest and disease problems among their banana, coffee and avocado crops to the effects of the hurricanes of 1979.

The elimination of the entire pig population of the D.R., during a 1980 eradication program to stop the spread of African swine fever, dealt a second major blow to the hillside agricultural economy. Although peasants claim that their pigs were healthy, government troops slaughtered the pigs without any compensation to the farmers. Pig raising was the primary means of capital accumulation for small farmers. The native pig el puerco criollo was very inexpensive to maintain, its diet consisted of unpalatable crop residues and rotting fruits and vegetables collected by the young children. The elimination of the pigs not only represented an immediate financial loss, it also created a lasting gap in a peasant economy that relies on self-sufficiency.

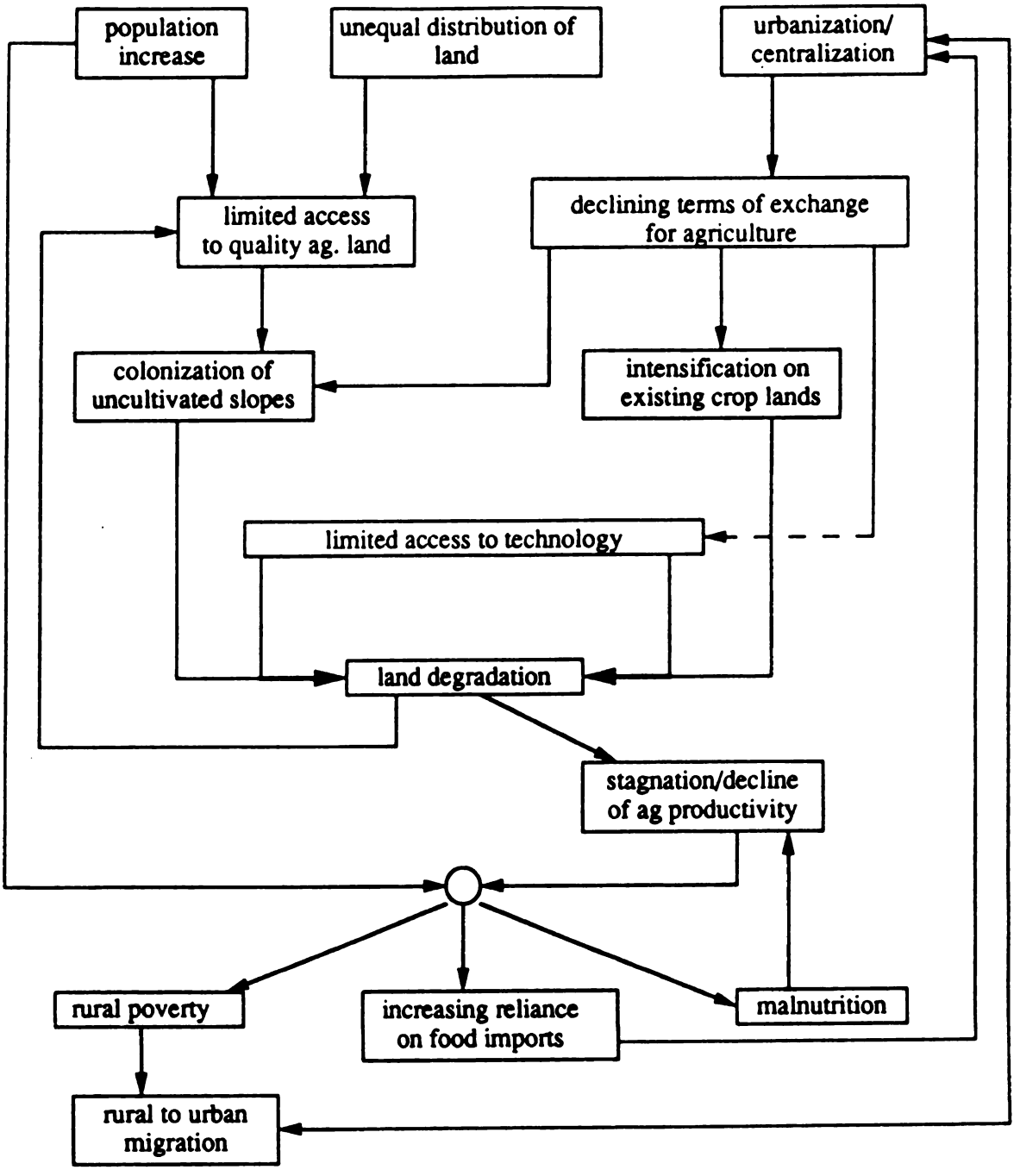

Figure 3 Socio-Economic Causes and Effects of Hill Land Degradation in the Dominican Republic: The Situation of Small Scale Farmers

Contemporary Context

The following discussion will be organized around the flow diagram entitled; Socio-economic causes and effects of hill land degradation in the Dominican Republic: The situation of small-scale farmers [Figure 3].

The Central Role of Small Farmers in Hill Land Use Issues

The 1981 project proposal for the joint U.S.A.I.D.-D.R. funded Natural Resource Management [NARMA] project describes the problems of hill land areas in a dramatic and concise manner:

> The massive destruction of the watershed areas is exhibited throughout the country. Every year millions of tons of the nation's most productive land base are washed away. Hillside areas are denuded and covered with massive scars from landslides, washouts, and deforestation. The colors of the rivers are now bright brown indicating the increased soil loads in the water. Due to the lack of hillside vegetation cover, the unusually heavy rainfall this year has taken on calamitous proportions causing major flooding throughout the country. Sedimentation is filling up the nation's reservoirs. The useful lives of multi-million dollar hydro-electric facilities have already been cut to less than half by siltation...The hillside farmer is at the center of this problem. He is forced by population pressures to cultivate on the only land available: hillside areas which are vulnerable to erosion. The agricultural practices the farmer uses are often the principle cause of erosion which results in lower productivity, a major cause of his poverty...

This passage is informative not only for its description of the D.R.'s environmental problems, but also for what it reveals concerning official attitudes toward hill land campesinos. The hill lands are commonly referred to as "watershed" or "upper watershed" areas; terms that demonstrate a

lowlanders perception of hills and mountains as primarily founts of hydraulic resources rather than places for people to live. In this context, hillside farmers are seen more as a troublesome nuisance rather than recognizing their important contributions to the national economy. Population pressure, in this analysis, forces peasant farmers on to hill lands that should be kept in forest to protect the watershed. Underlying this argument are Malthusian notions that degradation of the environment results from uncontrollable breeding among the poor masses. Little attention is paid to inequitable distribution of resources in government reports and statements on hill land degradation; the focus is on the small farmer and his apparent inability to farm well (Hartshorne,1981).

This passage carries a convenient "blame-the-victim" message commonly found in the popular press. The poor people are to blame, not only for the impoverishment of the environment, but their own poverty as well. This view of hillside farmers as bothersome appendages to economic progress helps justify the lack of government support for hill land communities. An opposing perspective sees hill land campesinos as essentially good land managers who, if provided institutional support, would be the best protectors of the hill lands. (Yunén et. al., 1987; Geilfus,1986a).

There are many in the Dominican Republic who view the peasant farm as an anachronism that will soon give way to large-scale, mechanized agro-enterprises. A study commissioned by the Consejo Promotor de Inversiones de la República Dominicana [Investment Promotion Council] interprets the rural exodus as an indication of societal progress, rather than a symptom of economic failure. The study offers the example of the United States to support their assertion that economic development involves reducing the amount of labor employed in agriculture (Riley et. al., 1989: 136-138). Other

observers point out that the inefficiency of large farms has precipitated many of the nation's agricultural crises of the past, while small farmers consistently have shouldered the bulk of the nation's agricultural needs (Dore Cabral, 1986; Juan del Rosario,1989).

Weak government support for hill land campesinos reveals a lack of appreciation for hillside farming's important contributions to national production and its employment of labor that can not easily be assimilated by other regions or economic sectors of the country. An estimated 43% of the D.R.'s total agricultural production comes from hill land regions (Posner&McPherson,1982). Sugar remains the nation's most important export crop followed by coffee, cacao and tobacco. Farms of under 10 hectares [1 hectare (ha.) =2.47 acres] provide 90% of all coffee, cacao and tobacco harvested (Sanchez Roa,1989). Coffee grows almost entirely in hill regions and a major proportion of the cacao grows there as well. While it is common knowledge that small farmers are an important agent of deforestation, it is less recognized that campesinos have afforested great tracts of hill lands with coffee, cacao, as well as many food bearing, nitrogen fixing, and other useful trees (Geilfus,1989).

Projections indicate that over 55% of the economically active population is either unemployed or underemployed (Gomez et. al.,1987). Rural immigrants overcrowd the cities. Ranching has low labor requirements. The large agro-enterprises that have expanded their base of operation in the lowlands, have become more reliant on mechanization and easily exploited Haitian emigrant labor. In an era of limited employment opportunities the capacity of hill land agriculture to productively employ a significant share of the population should not be overlooked.

Small farmers are neither the culprits nor the innocent victims in the poverty and environmental deterioration that currently afflicts the uplands. Although ranchers and land speculators are other important actors in the evolution of hill land use, this study will focus primarily on the small-scale farmer. Peasant farmers are a central part of the problem, and must be an essential part of any change toward a more socially and environmentally sustainable use of hill land areas.

Socio-economic Causes of Hill Land Degradation

Limited Access to Farm Land:

Peasant farmers are confronted by an increasingly limited access to quality agricultural land and declining terms of exchange for their production. Primarily, access to land for small scale agriculture is limited by the rapid increase in population and a land tenure structure which features control of the majority of land suitable for agriculture by a small group of large landholders.

Population Increase:

Throughout the 20th century the D.R.'s population has grown at an average rate of approximately 3% per year. The first national census in 1920 counted 894,655 inhabitants; projections for 1990 estimate the current population at over 7.1 million (Gomez et. al., 1987). This represents a nearly 8 fold increase over the last 70 years. Despite the apparent self-evident

correlation of population increase and greater competition for land, Gomez et. al. (1987) downplay the importance of population growth in explaining overuse of the Dominican Republic's fragile lands. They point out that although rural families, on average, are larger than urban families, out-migration has caused rural populations to grow at a much slower rate than the national average. During the period 1960-1981, the rural population grew at a pace of little over 1% per year; and during the last decade most observers believe that rural numbers have either remained constant or show a decline (Geilfus, 1989). Gomez et. al. would concur with Campbell (1990) that Malthusian explanations of population-resource imbalances are inadequate without a careful analysis of social structures and institutions;

> Where wealth is polarized, off farm employment opportunities are concentrated in cities and the primary producers in rural areas are denied access to the value added in secondary and tertiary activities based upon their primary output. Then the population-resource imbalance is almost inevitable in the rural sector. .... There is no population problem in many areas we are led to find it. What there is is a problem of equity and entitlement regarding access of the majority to productive resources and economic opportunity.

In isolation, population increase may not have great direct impact on small farmers access to land. However, it is a significant contributory factor in the polarization of land tenure and the uneven, urban-biased form of development; social processes that impinge on small farmers' access to land and other productive resources.

Unequal Distribution of Farm Land

Latin America's agriculture is characterized by the most skewed distribution of farm land in the world; a land tenure structure commonly referred to as the minifundia-latifundia system (Juan del Rosario, 1989). Even by Latin American standards the Dominican Republic represents an extreme case. The 1981 census found that 81.72% of the farms are under 5 has. yet they constitute only 12.18% of the nation's farm land. On the other hand, the 1.83% of the farms that are larger than 50 has. occupy 55.23% of the land [figure 4].

As is typical in Latin America, latifundia dominates the agriculturally rich farm land, irrigated or rainfed valley floors and coastal plains, while much of the minifundia is situated in lands considered unsuitable for farming purposes [Figure 1]. What is perhaps most disturbing about the land tenure situation is that the gap between large and small appears to be widening. Minifundia increased during the period 1970-1981 even though their proportion of farmland diminished [Figure 4].

Those that claim an unequal land tenure system represents a more significant issue than population growth, beg the question of how population increase effects the land tenure structure. The traditional rules of inheritance provide that all children, male and female, receive equal shares of the family land. With the typically large families found in the Dominican countryside, it does not take many generations before parcelization renders individual plots too small to be economically viable. Parcelization often can lead to the sale of uneconomically small plots to large ranchers and urban speculators.

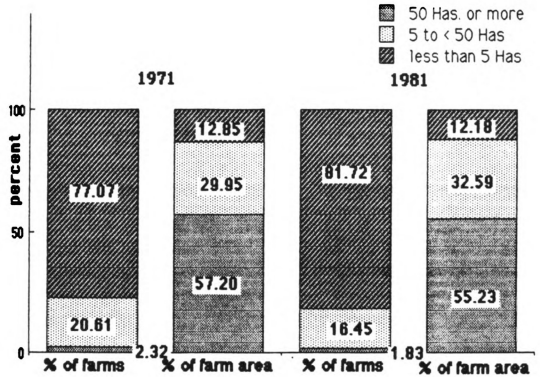

Figure 4 Land Tenure 1971-1981

For all practical purposes, the Dominican Republic has no property tax (Crouch, 1981). The absence of property taxes make speculative land purchases an attractive option in the D.R.'s highly inflationary economy. Furthermore, large land holdings facilitate the acquisition of credit. Wealthy landowners, therefore, are quite willing to pay for available parcels of land at prices that are out of reach for small producers. (Vargas-Lundus, 1988).

This research suggests that hill land emigrants often will hold onto their land, but for many of the poorest farmers, selling their land provides an indispensable source of income for making the transition to an urban existence. In other cases, initially, farming may be considered more desirable than emigration but over time, overuse of the land to compensate for the small size of the farm depletes the soil and eventually leads to the

sale or abandonment of the land. In sum, population growth interacts with inequitable land distribution to restrict small farmers' access to suitable farm land.

Declining Terms of Exchange for Peasant Agriculture

Hillside farmers are more integrated into the market economy than ever; yet, the returns of small-scale farming are poor. Rural household incomes average just over half the average earned in the cities (Juan del Rosario,1989). Rising costs of production, "cheap food in the city" policies, and a decline in agriculture's exchange value for consumer goods suppress rural incomes.

Urbanization/Centralization

Rural to urban migration both describes and explains the problems of hill land areas. Over 30% of the national population currently resides in the Santo Domingo metropolitan area [Distrito Nacional] (Gomez,1987). The concentration of people, as well as economic and political power, in the capitol city and other regional centers was facilitated by the transfer of wealth out of rural areas and into the cities (Juan del Rosario,1989). This process of centralización (Yunén,1985); impoverishes rural areas and therefore stimulates out-migration. In turn, rural out- migration, bolsters the city's dominant position in society; thus completing the urbanization/centralization positive feedback cycle [Figure 5].

Marginalization or center/periphery social analytical frameworks originated in the Latin America literature of the 1960's (Blakie & Brookfield, 1987: 21). At the domestic scale, this analysis critiqued urban-industrial led development and at the international scale, underdevelopment and the dependency of Latin American countries to the industrially developed nations. Blakie and Brookfield quote Stavenhagen to represent and summarize this analytical view;

> The channeling of capital, raw materials, abundant foods, and manual labour coming from the backward zones permits the rapid development of these poles or focal points of growth, and condemns the supplying areas to an increasing stagnation and underdevelopment. (1969:108).

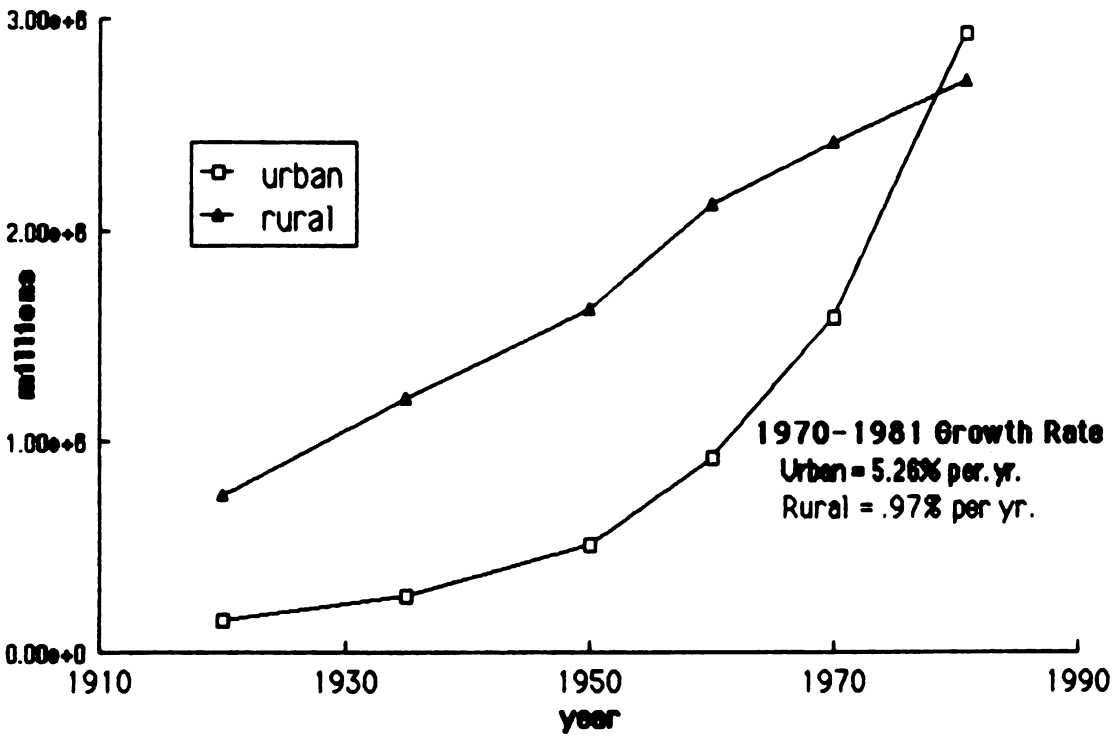

Figure 5 Urban/Rural Population

National Centralization

In the 19th century, the D.R. was comprised of three major socio-economic regions; 1) the East, an area dominated by extensive cattle ranching 2) the South whose primary economic activity was the logging of mahogany, and 3) the North, known as the Cibao, that developed around the peasant production of tobacco (San Miguel,1987). Communication, economic and political links between the regions were weak. In the late 1800's, the sugar industry began to develop along the Caribbean coastal plains adjacent to Santo Domingo. As sugar quickly surpassed tobacco as the primary export commodity, the country's political and economic center of gravity migrated southward (Hoetink,1982).

The U.S. occupation of 1916-1924 greatly advanced Santo Domingo's preeminence. The U.S. saw the capitol city as a logical base for their operations. U.S. efforts to modernize transportation networks served to integrate the island around the hub of Santo Domingo (Crouch,1981; Yunén, 1985). The U.S. transformed the Dominican army into an efficient force of occupation . Soon after the withdrawal of U.S. troops the Dominican military establishment, under the control of Rafael Trujillo, ascended to power . Under Trujillo's rapacious rule a huge proportion of the national economy was brought under the monopolistic control of his inner-circle. In this era, Santo Domingo [then called Ciudad Trujillo] became a dominant pole of economic power and urban in-migration (Duarte,1980). U.S. dependent capitalism flourished during Trujillo's reign and continues to the present as a major component of national economic policy (Madruga,1986). As the principal headquarters of foreign investment, Santo Domingo, in particular, has benefited from this development strategy.

Congruent with the urbanization of the Dominican Republic has been the effort to industrialize the economy and modernize public infrastructure. Agriculture's contribution to total G.N.P. has declined from 25.9% in 1969 to 16.4% in 1988. During the period 1983-1988, gross national production in agriculture declined by .6% even while the total G.N.P. grew 4.2% (Sanchez Roa, 1989). Consistent with trends throughout Latin America, the Dominican Republic's export sector is shifting its reliance on agricultural commodities toward manufactured goods (CEDOPEX,1989).

The current administration, voted into power in 1986, has launched a massive program of publicly financed, urban construction as the centerpiece of its strategy to vitalize the national economy . The treasury's expansion of the money supply largely pays for this "política de construcción ". (Abreu et. al.,1989). This monetary policy creates inflationary pressures that cause great hardship for hill land farmers. To briefly summarize, urban-industrial growth largely has been built at the expense of agricultural development; particularly in the smallholder sector.

The Net of Extraction:

The transfer of resources out of agriculture to finance urbanization and industrialization has been accomplished by a variety of economic means that Rosario (1989) terms the "red de extracción", the extraction net. Traditionally, hillside farmers relied, almost exclusively, on locally available resources; but recently, they have become increasingly tied to the market. Peasants' economic relationships with the market are often more exploitative than complementary. A coffee grower in the Las Auyamas study region

summarized farmers' current predicament; " Vendemos barato. Compramos caro: y lo que compramos es más qué lo qué vendemos " ["We sell cheap. We buy expensive; and what we buy is more than what we sell."] To illustrate; between the 1988 and 1989 harvest, the farmgate price of coffee [a major hill land campesino crop] declined approximately 40% while household consumer costs virtually doubled.

Production costs (fertilizers, pesticides , seeds, etc.) and basic consumer goods (clothes, household items, transportation, etc.) have experienced rapid inflation in the 1980's. Costs of production for 23 principal agricultural commodities increased 668.4% during the period 1983-1988 while their farmgate price increased only 291.2% (Sanchez Roa,1989). Over the period 1973-1984, the prices of maize, pigeon peas, yams, sweet potato and yucca [all basic campesino food crops] declined an average of 59% relative to the price index of industrial goods (Juan del Rosario,1987: Anexo F).

The most important consumer cost for peasant households is food. Unlike their grandparents, hillside farmers buy a substantial proportion of the food they eat. Much of the foods purchased (cooking oil, pasta, rice, beans, chicken) are produced, and or processed, by urban-based agribusiness. These agro-enterprises are much better connected to political and financial institutions than their peasant counterparts and commandeer most of the limited resources invested in agriculture (Crouch,1981).

In the period 1981-1986, producer prices rose 15% less than consumer prices for agricultural goods (Mejia,1989). Since farmers are both producers and consumers that pricing deficit represents a real loss of purchasing power for farmers and an increased share of agriculture's total value coopted by the marketing system. A relatively small group of urban-

based intermediaries [intermediarios] control the marketing of hill land agricultural crops. Truck drivers [camioneros], either hired or independent, travel the hill roads buying in-season crops. In most cases, this produce eventually arrives at the central markets or agro-processing plants of Santo Domingo.

Formal credit for smallholders is inadequate and inconvenient so peasants often prefer to borrow from "intermediarios" at high rates of interest or in exchange for selling their harvest at reduced prices (Moquette,1984). Loans made to farmers are an important way for the camioneros to secure their share of the harvest (Vargas-Lundus, 1988). The large sums of money needed to purchase harvests and advance loans to small farmers limits the entry of competition into the marketing system. Private banks loaned 33.2 million pesos to large coffee exporters for the purchase of the 1982 harvest. In that same year, the government's Banco Agricola provided only 14.2 million pesos to coffee farmers for the maintenance of their plantations (Amigo del Hogar, Feb.1986). In sum, the marketing system, with support from the private banks, preferentially benefits urban "intermediarios" over the needs of small-scale farmers (Juan del Rosario, 1989; Sanchez Roa, 1989).

The charges of excessive profit taking by agricultural intermediarios helped precipitate the 1969 creation of INESPRE, the government's Price Stabilization Institute. INESPRE's policies cater to the concerns of urban consumers by importing cheap foods. This "cheap food in the city" policy places peasant agriculture, which is the primary producer of domestic food staples, at a competitive disadvantage, and encourages hillside farmers' further dependance on purchased food.

Government policies toward hillside farmers' two principal export crops, coffee and cacao, are no more helpful. Traditional exports; sugar, tobacco, coffee and cacao are subject to import tariffs on agricultural inputs and a sizable export tax. Importers pass along the cost of tariffs on agricultural inputs to the farmer/consumer; and exporters lower the farmgate price of the harvest to compensate for money paid out in taxes. Only a very small percentage of that tax money is ever reinvested in the hill land communities which actually produce the coffee and cacao.

International Centralization:

The current era has seen a greater integration of the D.R. into the global economy. The Dominican government, with the "encouragement" of the International Monetary Fund (I.M.F.) has pursued an export-led development strategy to promote growth and earn foreign exchange to pay off the D.R.'s substantial foreign debt. Three areas of the export economy have been singled out for particular attention; tourism, non-traditional agricultural exports and free trade zone (zona franca) industries.

All three of these economic sectors are considered non-traditional exports and their promotion represents a government commitment to diversify the export economy. Export diversification is a national priority due to the country's dependance on the depressed and highly volatile international markets for their four traditional commodities. The Dominican government has enacted a series of laws and programs to promote non-traditional exports including, exemptions from tariffs on imported capital inputs, various exemptions on export taxes, subsidized credit as well and other financial incentives (Riley et. al.,1989; Carabello, 1985)

A prerequisite for the success of any export-led policy is local currency devaluation. In 1984 the Dominican peso was on a par with the U.S. dollar; however, by 1988 the official rate was 6.28 pesos for $1 U.S.. Devaluations stimulate foreign investment and tourism, and provide exporters more local currency for a given amount of exports. The economic restructuring agreements made with the I.M.F., which include currency devaluations and cutbacks on government subsidies for consumer goods, cause an important share of current inflationary pressures.

Tourism and Non-Traditional Agricultural Exports

The promotion of tourism and non-traditional agricultural exports would seem to offer promising new markets for food producers. However, the demand for high quality fruits and vegetables in the tourist industry has been supplied almost entirely by imports and well-capitalized agricultural enterprises. Peasant farmers seem to have little success breaking into this specialty market . Moreover, tourism drives up land values, making it difficult for local campesinos to buy farmland (O'Ferral,1990). A similar situation exists in the market for non-traditional ag-exports. Trans-national agribusinesses dominate the production of blemish-free fruits and winter vegetables in demand on the lucrative North American and European markets (Carabello,1985). Some hillside farmers do benefit from a minor market for traditional campesino crops such as yautía [Colocasia esculenta or C. antiquorom, common names: coco yam or taro] and yams [Cissampelos species], exported primarily to Puerto Rico and the urban centers of Hispanic population in the United States, (CEDOPEX, 1989).

Non-traditional ag-enterprises compete with peasants for land resources even more than tourism. Recent competition between campesinos and ranchers for land in the hill regions appears in part due to the export incentives offered to beef producers. The quantity of beef exports increased 74.3% in the period 1985-1988 (CEDOPEX, 1987 & 1989). However, beef exports still represent a small proportion of total sales; the rapidly expanding, urban, middle-class market consumes the majority of beef produced. The share of beef in the value of total agricultural production has increased from 6.4% to 9.1% from 1980-1987 (Mejia, 1989).

Due to the collapse of the world sugar market the government is converting their plantations to other uses. Advocates of land reform saw this as an opportunity to relieve some of the land pressures in hill regions by distributing these state-owned flatlands to small farmers. According to government documentation, of the 526,084 tareas [16 tareas=1 hectare] now available for diversification only 12,334 tareas will be made available to the Instituto Agrario Dominicano [the agrarian reform agency] (ONAPLAN, 1989). The majority of these former sugar lands will be cultivated by large-scale, ag-export enterprises and the remainder developed by the tourism industry.

Zona Franca Industries

The zona franca industries (z.f.i.'s) represent the most dynamic sector of the export economy. In 1981, while traditional exports comprised 75.15% of total exports, zona francas constituted a mere 3%. The situation has now been completely reversed so that in 1988 the zona francas had a 36.44% share of total exports while traditional exports dropped to 22.89% [figure 6].

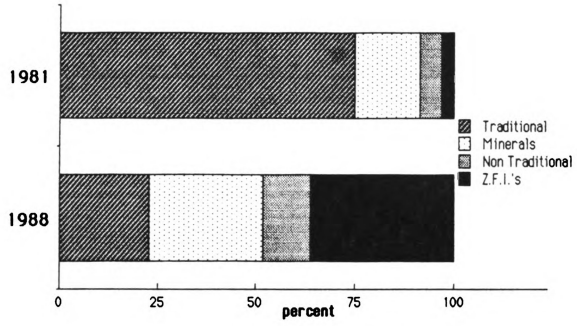

Figure 6 Export Share 1981 & 1988

Free trade zones cater primarily to foreign companies that wish to take advantage of low wages and generous tax incentives to set up their assembly operations in the D.R.. The principal benefit to the host country is the generation of employment.

Despite the considerable investment made in supportive government services for the zonas , spinoff effects to other sectors of the national economy, and agriculture in particular, are minor. Z.F.I.'s obtain only 4% of their primary material inputs from within the country (Listin Diario, July1989). Labor constitutes the most important production cost for the z.f.i.'s and a majority of the work force are rural emigrants. Laborers work under grueling and often dangerous conditions to earn less in a 44 hour

work week than what a minimum wage job in the U.S. pays for an 8 hr. day (De Chiara, 1988).

As the z.f.i.'s gain economic strength their political power also grows. The many free trade zones located throughout the Caribbean Basin vigorously compete with each other for the limited pool of corporate leasees. In order to keep z.f.i. production costs down and maintain their position as the largest z.f.i. sector in the Caribbean, the managers of the Dominican zonas clamor for additional rounds of devaluations (Hoy, Nov. 1989). The z.f.i.'s place constant pressure on the government to institute fiscal policies that will keep wages low, as well as provide social services and inexpensive food in the urban areas where the z.f.i employees live and work. Devaluations which help drive inflation, cheap food policies and the preferential provision of social services in the cities, all serve to marginalize rural hill land regions. In turn, rural emigrants form an abundant supply of easily exploitable labor for the zona franca industries (Duarte,1986).

In summation, the D.R. has moved toward the increasing concentration of power into the hands of trans-national corporations, global financial institutions (e.g. World Bank and the I.M.F.) and an internationally sophisticated, Dominican elite that benefits from this international centralization process (Croes,1985). Not only have hill land campesinos been hurt by the inflation that has accompanied an export oriented development strategy, they have had to compete with the three privileged sectors of the economy (tourism, non-traditional ag-exports, and z.f.i.'s) for government services as well as land, labor and scarce investment resources (Sanchez Roa.1989).

Limited Access to Technology

By itself, expansion and intensification of agriculture does not necessarily imply the degradation of hill lands. Despite commonly accepted land use potential classifications for steeply sloped areas [Figure 2], hill lands are not inherently incapable of supporting agriculture. Hill lands are subject to deterioration only under specific types of use and specific intensity of usage. Even very steep slopes can support intensive agricultural systems if farmers use appropriate techniques (Denevan, 1989). Pre-Columbian, Andean, terrace systems and traditional hillside farming in the Guatemalan Highlands offer just two examples of successful land use adaptations to hill land environments (Treacy,1989; Wilken, 1987).

When the early settlers began to farm the Dominican hill areas, shifting agriculture provided an efficient way to exploit the natural fertility accumulated in the forest canopy and soil organic matter. These peasants used traditional swidden systems to obtain good yields with little or no purchased inputs. Given the low population densities, shifting agriculture was an efficient and ecologically sustainable, farming method (Raintree & Warner, 1987). However, given contemporary land pressures and greater financial needs, the agricultural experience of their predecessors has limited relevance to current challenges faced by hillside farmers.

Inadequate or inappropriate responses to modern land pressures create many of the problems of hillside farming in the Dominican Republic. The rapid pace of social and environmental change has outstripped the slower processes of indigenous adaptation and diffusion of appropriate technologies. Without new techniques or resources, hill land farmers simply intensify their use of traditional farming methods to meet their immediate

needs (Geilfus,1986a; Santos,1981). To increase short-term production, farmers reduce fallow times and replace polycultures, which provide more complete ground cover, with clean row monocultures. Soil nutrients are harvested, leached and eroded from fields more quickly than they are replaced or regenerated. This extractive mining of the soil causes a steady decline in the fertility of the land.

A farming tradition that comes from a flat lowland experience and the more recent agricultural history of a shifting agriculture system that exploited the natural fertility of the land has left hillside farmers ill-prepared to manage a system that requires available soil nutrients to be carefully conserved. Synthetic agro-inputs [fertilizers, herbicides and pesticides] can be a short-term substitute for management expertise. However, the declining terms of exchange for peasant agriculture make it a risky financial proposition to purchase adequate amounts of chemicals to compensate for the reduced soil fertility as well as greater weed and pest problems associated with reduced fallows (Sanchez,1976).

The marginal situation of hillside farmers within the current development paradigm limits access to sufficient credit for chemical inputs or the labor costs of establishing soil conservation structures. Even if money were available for the implementation of soil conservation engineering or hillside agro-forestry systems, the national research and extension infrastructure to develop and introduce techniques adapted to local needs are largely absent.

Government and non-government agencies have spent millions on specific conservation projects but they have been hampered by a top-down management style that failed to balance the short-term financial needs of farmers with the long-term public concern for watershed protection

(Geilfus,1986a). In the current agricultural development strategy, government credit, policy, research and extension gears toward " high tech" large-scale agribusiness. Policy makers view hillside farmers more as a problem than a worthy investment; therefore they pay little attention to these agriculturalists' special needs.

Land Degradation

The landslides, washouts and gully erosion described in the NARMA project proposal are not highly evident in the Dominican hill regions. In many cases degraded landscapes appear verdant and productive. Only a well trained observer would recognize the proliferation of weedy species adapted to nutrient poor soils that often provide the only visible evidence of degradation.

Blakie and Brookfield (1987: 6-7) point out that deforestation, for example, does not necessarily constitute land degradation in the social sense. Farmers perceive a cleared field as a land improvement although a wildlife biologist may not. The authors define degradation as; "... a reduction in the capability of land to satisfy a particular use". As land use is the focus of this study and local land users are usually the best assessors of local land degradation; a utilitarian definition of degradation like that of Blakie and Brookfield is appropriate. To summarize the socio-economic causes of hill land degradation as outlined in Figure 3; expansion of the area under cultivation and intensification of existing crop lands without an appropriate management technology leads to declining capability of the hill lands to satisfy agricultural uses.

Socio-economic Effects of Hill Land Degradation

Hill land degradation causes decline of per-unit area yields and in some cases the complete abandonment of the land for agricultural purposes. Degradation, therefore, exacerbates the problem of limited access to agricultural land that originally spurred the hill land colonization process. Apart from a few protected park areas that continue to be invaded by peasant farmers and charcoal makers, the Dominican Republic's agricultural frontier is virtually exhausted. With no virgin territory available, agriculturists must return to lands that have yet to recover from previous exploitation.

Hill land peasants farm similar amounts of area but the land's productivity has steadily declined. Excluding cattle, national agricultural production declined 2% in the period 1983-1988. Although the figures are not indicated by topographic regions, the production of principal hillside farm crops; coffee [Coffea arabica], cacao [Theobroma cacao], maize [Zea mays], banana [Musa sapientum], pigeon pea [Cajanus cajan], sweet potato [Ipomoea], cassava [Manihot esculenta], yams, coco yam and pumpkin squash [Cucurbita moschata], have declined 31.6% over the years 1977-1988 (Sanchez Roa,1989: 13,21). While agricultural production stagnates or declines, population continues to grow. Rates of rural fecundity have declined considerably over the last two decades, but rural woman still have an average of 5 children (Gomez et. al.,1987:4). On the local level, the inability of agricultural production to keep pace with population growth has meant increasing poverty and malnutrition; while on the national scale the diminished supply of food from hill land farmers has contributed to the increasing deficit of domestic food supplies.

Poverty

The declining returns to land and labor due to land degradation compound the negative effects of declining terms of exchange on peasant incomes. Nationally, the number of households under the poverty line increased from 23.3% in 1976-1977 to 27.4% in 1985. While distressing, these figures fail to take into account the full impact of inflationary pressures during the 1980's on the poorest strata of Dominican society (Gomez et. al.,1987:5). Furthermore, we should recall that generally, Latin America's hill areas have a proportionally greater concentration of people in absolute poverty and are notoriously underserved by government social services which can help ameliorate the effects of low incomes.

Malnutrition

Today's hillside farmers are less self-sufficient than in the past. As hill land areas become further integrated into the national monetary economy, community based networks of food and labor exchange break down (I.A.D., 1981). On the peasant farm, the pressures to survive in this modern, cash-dominated and inflationary economy tend to displace subsistence production with market production . The limited credit and technical assistance made available to small farmers target cash crops, which further reinforces monetarization trends .

The decline in soil fertility intensifies farmers' tendencies to devote less land for household food needs. The conucos produce less and the range of food crops that will grow on these degraded soils decreases. Hillside farmers, therefore, become more dependant on <u>la pulperia</u> [the rural store]

to meet their food needs, and the declining terms of exchange for peasant cash crops, reduces their ability to purchase the food they previously provided for themselves. The poor nutritional quality of many purchased foods compounds the problem of the inadequate quantities that peasants can afford to buy. The typical peasant diet increasingly substitutes natural foods like beans and fruit juice with industrially processed foods of lower nutritional value such as pastas and sodas.

Children with bloated stomachs, an indication of digestion tract parasites and protein deficiency, are a common sight in the Dominican hills. A 1981 study found that 43.8% of all rural children under 5 years of age suffer from malnourishment (Gomez,1987). Malnutrition among adults is less visibly obvious but poor diets reduce the energy level of farmers, which further contributes to declines in agricultural productivity (Smith et. al., 1986).

Increasing National Reliance on Food Imports

Over half of all nationally grown food crops destined for the domestic market are cultivated in the hill lands (Posner & McPherson,1982). Throughout the 1980's, the faltering production of basic hill land staples accounts in part for the rapid decline in national per-capita food production (Mejia,1989). Declining terms of exchange for non-export agriculture explains much of the growing deficit between per-capita food needs and food production; but hill land degradation plays an important, if unmeasured, role.

As recently as 20 years ago the D.R. was self sufficient in the production of food stuffs, but the value of agricultural imports increased

more than 50% in the decade 1976-1985 (Mejia,1989). The growing reliance on food imports has meant a loss of scarce foreign exchange for the national government and a loss of food market share for hillside farmers. Approximately half of the foreign exchange earned by agricultural exports leaves the country to purchase food imports (Mejia,1989). As more and more of the national diet is composed of imported foods processed and packaged by urban agro-industries, urbanization is re-enforced and food farmers in the hills become more marginal to the national food economy.

Need for Present Study

Practical Implications

The literature review has attempted to portray two basic and conflicting interpretations of the small farmer's role in land use and degradation of hill areas;

1) Small-scale farming is anachronistic, and is to blame for the degradation of upper watershed regions.
2) Small-scale farmers are victimized by structural processes that push them to use hill lands in an exploitative manner just to survive.

The first perspective is under-represented in the review of the literature because it reflects actual government and financial sector policies, rather than a well-published academic argument.

Whether the hillside farmer is seen as culpable or victimized, all observers seem to accept that degradation of the hill land environment presents a serious and ongoing problem and that small-scale farming plays a

major role in this problem. The study will not join the debate on who or what is primarily responsible for hill land degradation, but instead examines how small farmer land use adapts to deteriorating conditions in the hill lands.

Farmers are neither self-destructive nor mere pawns of some greater macro socio-economic process. Denevan (1983) cautions geographers to ask why a particular adaptation is chosen rather than make overly deterministic causal statements. For example, the general statement that; "land pressure causes farmers to reduce fallows" does not consider why that particular adaptive strategy was chosen over others, such as emigration or other methods of agricultural intensification. This study assumes that farmers make rational decisions within the range of accessible land management choices.

Hillside farmers face considerable environmental and socio-economic difficulties, yet many Dominican peasants continue to live and farm in the hill lands. A greater understanding of the various ways peasants actually adapt to degraded hillside soils will help to develop more sustainable land management techniques for the future.

Methodological Importance

It appears that studies of land use change typically are made at a regional scale too large to carefully analyze decision making at the farm level. The landscape studies of Sauer (1981), or in the D.R. literature, Antonnini (1968) look at general regional changes over major periods of time but the pixel of analysis never resolves to the individual farm level. Those land use change studies that are more quantitative tend to focus on

particular environmental processes like soil erosion (Stocking,1987; Antonnini et. al.,1975) or deforestation (Fournier & Russell,1987; Echavarria,1990).

This study will attempt to quantify land use change at the farm system level. With the current concern for sustainable agriculture and sustainable development, has come the recognition that problems require analysis in an integrated, holistic fashion (Bebbington & Carney,1990). By using the farm system as both the pixel and object of research and integrating farmer decision making in the analysis, the author expects that a more detailed, synthetic explanation of broader regional changes in land use will be found.

Research Methods, Results and Discussion

Statement of Purpose

This thesis examines the process of human adaptation to rapidly changing social and physical conditions in the hill lands of the Dominican Republic. Brookfield (1964) asserts that process studies, with their concomitant need to inquire into human organization and motivation, can only be managed at relatively large scales [small study areas] of analysis. Heeding Brookfield's admonition, the author carried out field work in two, small, rural territories; but with a view toward understanding broader, regional issues. Objectives of the study are to:

1) Analyze hillside farmers adaptation to declining land productivity

2) Propose a model of land use evolution in the Dominican hill regions

3) Demonstrate how this model of change is modified by historical events that are specific to particular locations, or macro events that differentially effect hill areas at different stages in the land use evolution process; i.e., draw out the distinction between historical and evolutionary explanations of land use change

4) Advocate the study of regional land use change as an important tool for developing sustainable systems of land management

Methodology

Yunén (1985) writes that spatial elements can be studied "sincronicamente" and "diacronicamente". Diachronic analysis is used to explain the evolution and presence of the actual space. Synchronic analysis verifies or disproves the diachronic analysis. Data for this study's "diachronic analysis" [i.e. the proposed land use evolution model] include; oral histories, published histories, census information and historical airphotos. Published reports, contemporary airphotos, survey results and field observation were used for the "synchronic" test of the land use model. The author collected most of this data during three months of field work between September-December of 1989.

Comparative method

The study compares the land use evolution of two hill land"secciones" [a sección is the smallest administrative unit in rural areas] to determine commonalities and particularities of their past and present land use.

Lowland peasant farmers colonized Las Auyamas and El Jaimito at two distinct periods of the 20th century. The author selected study areas with generally similar ecological characteristics to minimize the importance of the physical environment in explaining their land use differences, thereby focusing on the evolutionary/historical aspects of land use pattern formation. A comparative method had several advantages;

1) The use of more than one study area improves the reliability of general statements about the D.R.'s hill lands.

2) As a foreign researcher, a comparative method allows the social scientist to judge the relative importance of a particular phenomenon by domestic standards; e.g., how poor is a "poor" farmer, or how steep of a slope is a "steep" slope. U.S. "agri-cultural" standards have little relevance in a Dominican context.

3) Historical/evolutionary processes are the focus of this study. By selecting study areas that have been under cultivation for different periods of time, it was possible to hypothesize about temporal explanations for land use differences between the two study areas.

Secondary sources

The understanding of the regional and historical context for field work was primarily obtained at the library of the Centro de Estudios Urbanos y Regionales [C.E.U.R.] and the general library of the C.E.U.R. host institution La Universidad Católica Madre y Maestra [U.C.M.M.] located in Santiago. Apart from scholarly studies, the various national censuses and other government reports, maps housed in the C.E.U.R. Cartographic Center were used extensively.

Airphoto interpretation

Land use maps of the two secciones [hereafter referred to as sections] for the years 1959, 1968, and 1983 were obtained from stereoscopic airphoto interpretation and ground truthing.[5] The scale of the airphotos ranged from approximately 1:56,000 for the '59 photos to 1:20,000 for the 1968 photo sets and 1:41,000 for the 1983 sets. While accurate interpretations of land use at the farm parcel level was possible for the 1968 photos, the coarse resolution of the 1959 photo demanded a less detailed mapping procedure. The completed land use maps were then digitized on the "Erdas" G.I.S. system to determine the areal proportions of each land use type within each section.

Survey

The author developed a questionnaire with the advice and guidance of colleagues at C.E.U.R. [refer to Annex 1 for the survey instrument]. A pretest with local farmers and editorial contributions from research assistant Pedro Mencia helped further refine the questionnaire. Two local residents, Sr. Mencia and Pedro de la Cruz, [one for each section's survey] helped administer the survey and interpret farmer responses, but most importantly to introduce the foreign author to the hospitable but reasonably cautious campesinos. We addressed the questionnaire to farmers who owned or otherwise had personal rights to the land they farmed. Although the

[5] Airphoto coverage was not available for El Jaimito 1959.

household member with principal responsibility for farm management decisions was asked to be the primary respondent; interviews took place in the farmers' homes, and participation from visiting friends, relatives and other household members was common and encouraged. Only 3 of the 61 principal farm decision makers surveyed were women, so group interviews helped elicit the full dynamics of the farm household. Furthermore, questionnaire responses tend to be more reliable when the informant is in a group setting (Chambers,1985).

Administration of the questionnaire lasted approximately an hour. Due to the numerous questions and the wide range of topics, the author used a guided interview style of questioning; not all questions were necessarily used for all persons surveyed. The guided interview approach often elicits information not directly solicited by the formal questionnaire. This approach presents two important disadvantages; 1) the same questionnaire is not rigorously duplicated for each person surveyed, and 2) sample sizes among the individual questions in the questionnaire may vary, both of which present problems for satisfying certain requirements of formal statistical analysis. (Casley & Kumar, 1988).

On the positive side, a guided interview provokes a more relaxed atmosphere during the survey sessions than a formal, closed question-response format. An otherwise well constructed survey will produce inaccurate results if informants do not provide reliable answers. For campesinos who have a long experience with government repression, the author decided that an open-ended interview would be less reminiscent of the agricultural census surveys in which campesinos are notorious for providing inaccurate information. The vast majority of respondents

appeared more than eager to tell their side of the story and seemed to appreciate the fact that someone cared to listen.

Sampling Strategy: The study employed a stratified random sampling procedure to select surveyed households. Las Auyamas, for example, is comprised of 13 parajes [parishes]; the percentage of the total amount of interviews in the section scheduled for any particular paraje was equivalent to the paraje household population as a proportion of the household population for the entire seccion.[6] Once the number of households to be selected for each paraje was determined, the author randomly selected participant households for the survey. A more informal stratification strategy, was to select farm households both near to, and far from local roads; with the proportions based on a field estimated average of house to road placement throughout the section. The stratification procedure insured complete spatial coverage of the section and a sampling distribution that was proportionate to the population of the study area.

The study surveyed 35 farmers in El Jaimito, 7% of the total number of households recorded in the '81 census; and 26 farmers in Las Auyamas, 5.2% of the '81 census total. Las Auyamas, predominantly a coffee growing region, had a smaller sample because of its relative uniformity of land use. Small-scale coffee cultivation has been well studied; therefore survey data from Las Auyamas could be supplemented by the published Dominican literature on coffee production.

Time restrictions limited the number of questionnaires administered. Sample sizes in the two study areas were insufficient for formal statistical

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[6] Household population data were obtained from the 1981 census.

tests within the range of statistical confidence commonly accepted in the social sciences. To partially compensate for the small size of the sample, the author took great efforts to reduce non-sampling error.

Non-sampling error, although more difficult to quantify, is at least as important as sampling error in effecting survey reliability (Casley & Kumar,1988). Major sources of non-sampling error include; poorly understood questions, misinterpretation of answers, errors in recording answers, and errors of coding and data entry. The author designed, administered and interpreted the survey, thus eliminating the variation and misconceptions that occur when such tasks are shared among different individuals. The Dominican research assistants, local area residents, helped clarify any miscommunication between the author and the survey respondents during the actual interview. Furthermore, the author taped and reviewed all interviews to verify the accuracy of responses collected at the time of the interview.

Discussion with Key Informants

Apart from the structured survey, the author solicited interviews with agricultural extension agents, government officials in the various agriculture related ministries and low level crop marketers. The most important informants and councillors were colleagues at C.E.U.R., a multi-disciplinary research unit which integrates the skills of geographers, economists, agronomists, cartographers, ecologists and members of other disciplines for applied research on national problems. The patient and good natured counsel from the members of C.E.U.R. greatly advanced the author's understanding of Dominican society, culture and geography.

The "Uso del Suelo" Project

I had the good fortune to arrive at C.E.U.R. [September of 1989] when the Center was operationalizing a nationwide study of land use and food production. "El Uso del Suelo y Producción de Alimentos en La República Dominicana" is a collaborative project with the Center for Research and Application in Remote Sensing [CARTEL] located at the University of Sherbrooke (Quebec) Canada and funded by the International Development Research Center of Canada [I.D.R.C.]. The "Uso del Suelo" project addresses the inter-related problems of: 1) the inability of domestic food production to meet internal demand; and 2) the diminishing productive capacity [degradation] of the agricultural soil base; particularly in the small farm sector, traditionally, the major food supplier for the domestic market. Project objectives include: 1) determining the nation's potential for food production; and 2) establishing the inter-relationships among various rural socio-economic sectors and between rural and urban areas of the country (C.E.U.R., 1989).

The C.E.U.R. project selected a sample of 24 sections to represent the range of natural ecotypes and land use systems found in the D.R.. Las Auyamas and El Jaimito represent two of the twenty sections selected to represent areas of predominantly small farm "campesino" types of production (C.E.U.R.,1989a). Project members designed the research instruments and sampling strategy for the project to provide statistically reliable results at the national level. Although the "Uso del Suelo" methodology was not structured to accommodate comparative analysis between sampled sections, this thesis serves as a project case study of precisely that kind of a comparative research strategy. The "Uso del Suelo"

project is concerned with land use change; 1958, 1968, 1983 airphoto interpretation based land use maps are to be made for all 24 sample sections. However, primary goals of the study are not to establish land use relationships over time but across spatial and socio-economic sectors. By utilizing a comparative research design and explicitly focusing on the evolutionary/historical dimensions of land use, this thesis should complement the broader research objectives of the "Uso del Suelo" project.

Case Studies

Las Auyamas and El Jaimito are located in the Northwestern region of the country known as the Cibao, a region articulated by the Cibao valley, the nation's most important zone of non-sugar crop production. Bounded by the Cordillera Central to the South and the Cordillera Septitrenional to the North, the valley extends from the Haitian frontier to the Bay of Samaná [Figure 2].

The Cibao valley's long history of small farm, tobacco operations helped foster a large, freeholding peasant class in the region. Unlike the sugar industry's highly centralized development, intense competition among the various nations bidding for the harvest suppressed centralization of tobacco cultivation. Production was controlled by a large number of small-scale farmers who benefited from the competition among a large pool of buyers (San Miguel,1988; Yunén,1985).

Until the 20th century, the mountainous rim of the Cibao valley remained sparsely populated. The combined forces of lowland drought, economic depression, minifundia parcelization, expansion of large-scale agro-enterprise and land speculation have displaced many peasants from the

valley floor. These former lowland farmers and their descendants gradually infiltrated to the most remote areas of the upper Cibao watershed.

Due to the long standing presence of the "Plan Sierra" integrated rural development project, settlement of the Cordillera Central region has been the subject of considerable academic study (Santos and Adames,1987; Rocheleau, 1983). The Cordillera Septitrenional and the Samaná Highlands, on the other hand, have been virtually overlooked by academia. In order to partially fill this research gap, "Uso del Suelo" project coordinators Rafael Yunén and Pedro Juan del Rosario suggested that field work for this thesis be conducted in these less-investigated regions of the Dominican Republic.

Physical Geography

Las Auyamas

Located on the northern flank of the Cordillera Septitrenional [the Northern Mountains] the section covers an area of approximately 23 km.^{2}. Elevations within the section range from 400 m. along the Yasica river valley, which forms the Northeastern section border, to a high point of 984 m. on the southern border which abuts the central ridge of the Cordillera. Although the mountains are low the terrain is quite dissected, local reliefs reach up to 500 m. with slopes moderate to steep [30-75% slopes common throughout the section]. The Pedro Garcia river system, which runs through the center of the section, has year round stream flow.

Limestone parent material with intercalated stratas of shale form well drained, Eutropept soils, which are highly saturated in mineral bases

(O.A.S.,1967; S.I.E.D.R.A. program, 1980). Apart from an acidic red soil found in the paraje of Los Rincones, pH typically range between 7.2-7.4 . Coffee, the major crop of the region, grows best in slightly acidic soils pH 6-6.5. The alkalinity of the Las Auyamas soils limits the assimilation of several soil nutrients essential to the health of coffee bushes. Fertilizers, although rarely applied on the section's coffee plantations, typically use a calcium base that only exacerbates the problem of excessive alkalinity (Hiciano, 1989). Slopes are considered too steep for agriculture and land use potential maps classify the area as suitable only for forestry [Figure 2].

Exposure to the northeasterly tradewinds creates abundant orographic precipitation throughout the region (Hartshorne et. al.,1981). Las Auyamas has a subtropical moist forest climate, with rainfall exceeding potential evapotranspiration by approximately 60%. Las Auyamas receives year round rains with an annual average of approximately 1900 mm.. Annual precipitation varied from 1,293 mm. to 2,933 mm. during the 1972-1983 period. The spring rainy season peaks in April-May with the greatest rains occurring during October-December. Elevation moderates the tropical temperatures. Daytime highs in the hot months of late summer average less than 29° C. [upper 80's F.]; during the coldest months of January-February average daytime highs drop to 22°-24° C. with nighttime lows cooling off, on average, to the 14°-15° C. range ("La Cumbre Experimental Station",1989).

El Jaimito

Occupying an area of approximately 45 km.^{2}, the section sets upon a karst plateau along the central spine of the Samaná Peninsula, (O.A.S.,1984). Section elevations range from a maximum of 500 m., on the plateau's

southern ridge, to 100 m. in El Jaimito's northern limits. The majority of the section lies at elevations between 300 to 400 meters. The pockmarked, karst topography characterizes the region. Instead of dissected river valleys the landscape is divided into numerous "valles cerrados" [closed valleys]. Although slopes can be as steep as those of Las Auyamas, slope lengths are much shorter. As is characteristic of karstic regions, surface drainage is erratic; and despite abundant rainfall, El Jaimito contains no year round streams.

Well drained calcareous parent material has created the nutrient rich, mildly alkaline, Eutropept soils which predominate the section (S.I.E.D.R.A. program, 1980). However, considerable variation in local soil types, from deep red clays to shallow organic soils, make section-wide agronomic recommendations problematic (Fria, 1989). Unimproved pasture and bush fallow shifting agriculture constitute the predominant land uses of the region. Slope is considered the limiting factor for the area's agricultural potential. The 1977 O.A.S. survey categorized the section as class VII or suitable only for forestry [Figure 2].

The Samaná Peninsula is one of the wettest regions of the country. Both El Jaimito and Las Auyamas fall within the subtropical wet forest life zone. The nearest weather station, located in the Samaná Bay port city of Sanchez, reports an average annual rainfall of 2046 mm. (Oficina Nacional de Meteorología). The maritime influence moderates seasonal and annual fluctuations in temperature and precipitation. Average maximum daytime temperatures in El Jaimito vary between 28° and 31° C. all year round[7].

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[7] calculated from Sanchez temperature data based on a .5° C. drop in temperature per every 100 m. in elevation (Wilson,1976).

Comparative summary: Las Auyamas and El Jaimito receive abundant rainfall and possess naturally fertile, although relatively shallow, soils. On the basis of their steep terrain, land use potential surveys classified both areas as unsuitable for agriculture. El Jaimito receives more, and more consistent rainfall but excessive drainage makes seasonal water shortages more acute than in Las Auyamas. The higher elevations of Las Auyamas make it better suited for coffee production, but warmer year-round temperatures in El Jaimito permit the cultivation of hot weather perennials such as rubber trees [Castilla elastica] and coconut [Cocos nucifera]. The shorter slopes and vertical drainage of El Jaimito soils would tend to reduce soil erodibility, but that advantage is partially offset by higher rainfall levels.

In general, El Jaimito and Las Auyamas have similar agroecological constraints and potentials for agricultural production. However, lower elevations, a wetter, warmer climate and the karstic geology of El Jaimito constitute important distinctive agroecological characteristics that may account for some of the land use differences between the study areas. While not discounting the importance of these ecological contrasts, the study argues that evolutionary/historical factors played a much greater role in forming contemporary land use patterns. As discussed below, during the period of early settlement, the two sections' farming systems and crop mixes displayed remarkable similarities, suggesting that current land use more reflects transitory conditions rather than inherent physical differences.

History

The history of hill land settlement in the Cordillera Septitrenional and the Samaná highlands has yet to be written. To reconstruct past settlement and land use systems in Las Auyamas and El Jaimito previous to the years of airphoto documentation, the following discussion draws from indirect published evidence, survey results and oral accounts of early settlers from the two study areas.

Las Auyamas

Of the 26 households surveyed in Las Auyamas 11 had family histories dating back to the period 1902-1920, and only 4 families had arrived in the area later than 1935. The old people of Las Auyamas recall that they, or their parents, were attracted to the area by reports of ample rainfall, good soils and open land. Judging from prevailing accounts of hill land settlement in the Dominican Republic, one would not anticipate such an early date of settlement for a region located in the heart of the Cordillera Septitrenional. Apart from a few communities in the Cordillera Central, descendants of those who fled from the Haitian invasion (Antonini et. al., 1975), the hill lands are commonly perceived as having been essentially unsettled before the era of Trujillo.

The explanation of hill land settlement presented in the literature review appears inadequate for the Las Auyamas case [Figure 3]. Land pressures at the turn of the century were quite moderate. Less than 900,000 Dominicans lived in the country at the time of the 1920 census [18.5 persons per km.^{2}.].

Early settlers came from the rural areas surrounding Santiago, a city sometimes referred to as the capitol of the Cibao. The residents of Las Auyamas speak of a "gran sequilla " a major drought in the valley and Cordillera Central foothills at the turn of the century which caused people to head for the Northern mountains in search of rainfed land. Rising land prices in the Santiago region and "La miséria", a time of great hardship in the lowlands, were frequently mentioned also as motivations to head for la loma [the hills].

According to San Miguel (1988), the 1920's were an extremely difficult period for farmers in the Santiago area: the tobacco industry was in a state of competitive decline, furthermore the U.S. occupying forces were requiring peasants to work on road building projects and pay heavy taxes to finance modernization of national infrastructure. A 1923 announcement from the Santiago City Council reported that the majority of the area's peasantry were abandoning their homes "looking for other places where they can get their sustenance." (San Miguel, 1988: 279).

If the only reason to emigrate was to escape drought and financial persecution there were numerous reception areas for Santiago's peasants. The transportation history of the Cibao provides some clues as to why the Santiago peasants chose the Las Auyamas area, in particular, as a good relocation site. The section lies just off a major mule train route that connected the central market of the Cibao, Santiago, and the region's principal port city, Puerto Plata. Although a train link was established in 1897 that used a less steep route through the Altamira pass east of Las Auyamas (Hoetink,1982), the shorter, but more rugged route that passed close to Las Auyamas remained an important transportation path in the pre-automobile era (San Miguel,1988: 273). It appears likely that the

muleteers who carried tobacco from Santiago to Puerto Plata also carried stories to the Santiago peasants of the rich lands that lay along their routes. In turn, the mule train paths would have provided the lowland peasants' access to this remote highland area.

Dominican histories commonly claim that hill land settlement was insignificant prior to the mid-1930's (Hartshorne et. al.,1981); however, at the time of the 1935 census, population density in Las Auyamas, 38.4 persons/ km^2, already exceeded the national average of 30.5 persons/ km^2. Another well accepted interpretation of hill land settlement history hypothesizes that lowland out-migration is caused by social forces that involuntarily displace peasants from the higher quality farm areas in the lowlands. The evidence from the Las Auyamas case is somewhat to the contrary, and indicates that pull factors were as least as important as push factors in explaining settlement of the region.

Rising land prices and burdensome taxation in the Santiago area helped motivate Las Auyamas settlers to leave the valley; but evidence from the historical record supports the view that the perceived superior agroecology of the highlands probably carried more weight in the decision to migrate. In 1918 a member of the Santiago city council called for the opening of new paths to Las Auyamas' neighboring section Pedro Garcia[8] in order that; "poor families from the lowlands would migrate to that 'rich section' and the agricultural goods produced by them could easily be brought to the city." The councilman went further "and devised a colonization plan that included spreading propaganda among the peasants that worked in poor

[8] Pedro Garcia bordered Las Auyamas on two sides; in the next census Las Auyamas will be a section in the newly formed municipio of Pedro Garcia.

soils, calling their attention on the fertility of Pedro Garcia's soils..." (San Miguel, 1988:300).

Land use potential maps invariably classify steeply sloped lands as unsuitable for farming, but peasant farmers throughout Latin America's history have perceived many hill land areas as rich in agricultural resources. At least at this early stage of the D.R.'s agricultural development, hill land migration by lowland peasant farmers was more a positive adaptation to new opportunities than a desperate act of a displaced population (San Miguel,1988: 300).

> the migration of peasants to the highlands allowed them to engage in new economic activities. This was the case of coffee production, that though suffering from low prices during the 1930's, began to recover slowly during World War II and boomed thereafter.

Despite the commercially oriented tobacco farming background of the original settlers, and the fertile, newly cultivated soils which provided an ample surplus, early peasant production in Las Auyamas was primarily subsistence oriented. Peasants would have preferred greater integration with the commercial economy, but continually they were frustrated by an undeveloped marketing structure. Farmers traveled all night by mule train over treacherous trails to arrive at the Santiago market by morning; where, despite the considerable efforts to grow and transport their crops, Las Auyamas farmers received only a pittance for their harvests. At this time, the Cibao was still a highly rural society and the relatively small non-farmer population paid low prices for agricultural goods made available in town markets.

The picture of Las Auyamas life during this early period of settlement describes a vibrant, if monetarily impoverished, community. "*Habia una abundáncia pero poco dinero*" was a typical summation of the era. The conucos were highly productive; upland rice, plantains, maize, beans and a wide assortment of tree and root crops flourished. Every household had at least one milk cow and a pack horse, plus the usual assortment of pigs, goats,turkeys and chickens. Although families typically had more than 10 children to feed, subsistence surplus would rot for lack of a market. The sale of garlic, tobacco and peanuts (all easily stored and transported, high value to weight crops) provided the family's minimal cash needs.

In a cash-poor economy, non-monetary exchanges of goods and labor represented the most typical form of economic transaction. For more isolated areas of the section, wide spacing between individual households inhibited the development of community solidarity. In general, however, community cooperation such as *juntas de vecinos* [work parties] formed an indispensable part of peasant life.

By the early 1940's, settlers had cleared virtually all of the virgin forest and farmers noticed a marginal drop in soil fertility. As yields from the conucos declined, farmers cut back on cultivating nutrient-demanding food and cash crop annuals (peanuts, tobacco, rice, etc.), and increased the proportion of land devoted to less soil demanding perennials such as coffee and pastures. When coffee prices boomed in the post-World War II period, Las Auyamas farmers were ready to make a major change in their farming system.

Coffee prices increased more than 7 fold in the period 1940-1953 before quickly dropping to more modest levels by the end of the decade

(San Miguel,1988: 145). In many ways, coffee was a perfect cash crop for Las Auyamas at that juncture in the section's history since:

1) Las Auyamas farmers had more than sufficient food production coming from their conuco's to satisfy subsistence needs but an increasingly monetarized economy necessitated additional sources of income. Hillside farmers wanted to participate more fully in the cash economy and the high coffee prices of the early 1950's allowed them a viable way to do so.
2) Coffee already comprised a part of the farm system, and farmers were familiar with its cultivation requirements.
3) The faltering production of tobacco and peanuts on the already depleted hillside soils necessitated a new cash crop.
4) Coffee thrives in highland environments; and once dried, is easily transported to lowland markets.
5) A second generation of Las Auyamas farmers came of age at a time when old cropping patterns had become obsolete and this new market opportunity arose. The need for farming system change is not a sufficient condition for a change to actually take place. A rural community also needs a young, ambitious and innovative group of farmers to make the needed changes in a well-entrenched system. [This theme will be addressed later in the discussion.]

Summary: Standard histories describe the Dominican Highlands as sparsely populated during the early 1900's, unless one assumes that these historical accounts are completely erroneous; it appears that the Las Auyamas/Pedro Garcia area was one of the earliest sites in the more rugged hill regions to experience intensive settlement. Agriculture, although poorly remunerated, was highly productive for at least the first 35-40 years of farming in the section. The gradual exhaustion of the soil's natural fertility and a 1950's boom in the coffee market set the stage for the transition from a subsistence to a market-based economy.

El Jaimito

If Las Auyamas is one of the earliest sites of hill land settlement, then El Jaimito represents one of the last areas in the Dominican Highlands to be opened for State-sanctioned colonization. Historically, the Samaná Peninsula was one of the most marginal areas of the Cibao. In the mid- 1950's, well after peasants had begun to clear the upland forests of the Cordilleras Central and Septitrenional, the Trujillo regime implemented a colonization program in the unexploited hill lands of Samaná.

Despite its traditionally marginal status, Samaná has a long and interesting history. When a group of Samaná natives attacked a Columbus-led reconnaissance mission, it marked the first armed conflict between Native Americans and Europeans. Ever since that 1493 battle, Samaná has been the scene of a multitude of international disputes. At various times France, England, Haiti, the United States, Spain and Germany have attempted to lay claim, either by force or negotiation, to the Peninsula (Demorizi,1973). A 1853 report by Sir R.H. Schomburgk, British foreign officer and close friend of Alexander von Humboldt, explains why the Peninsula was such a coveted prize (In Demorizi,1973: 304-309);

> The soil of Samaná is highly productive which is shown in the gigantic trees which still cover the hills that extend towards the seashore. The sides of the mountains have been only partially cleared, and cultivation has only commenced its inroad on the great primeval forest. The mahogany is an article of spontaneous growth, and constitutes the greatest export. There are still a number of these trees to be seen in the mountain forests promising employment and profit for years to come... The present inhabitants are satisfied with cultivating yams, batatas, Indian corn, and fruits, principally oranges, mangos, alligator-pears, coconuts,etc. The luxuriant appearance of the fruit trees struck me forcibly during my visit... The fertile soil is fit for

> the cultivation of all tropical productions; its spacious bays and anchoring places offer a shelter to the navies of the world; and its creeks afford facilities for the erection of arsenals and docks, while the adjacent forests yield the requisite woods for naval architecture; still its chief importance does not consist in these advantages, alone,but in its geographical position, forming, as it does, one of the principal keys to the isthmus of Central America, and to the adjacent Gulf of Mexico.

"Although nature has done so much for this tongue of land", Schomburghk continued, "man inhabits it but sparingly." Samaná was to remain a national backwater area until well into the 20th century. San Miguel (1988:85-86) picks up the story where Schomburghk left it;

> Samaná was an outlier from the rest of the Cibao. Best known for the potential of its excellent bay, Samaná had little economic significance up to the late nineteenth century. The lack of internal communication means, added to an accidental terrain-close forests, abrupt hills and swampy valleys--hindered the integration of Samaná into the mainstream of the Cibao economy... The construction of the La Vega-Sanchez railroad contributed to activate the economy of the province. Peasants from the Cibao Central as well as immigrants from the Caribbean came to work in the construction of the railroad... In spite of all this, in 1920 Samaná still was scarcely populated.

The La Vega-Sanchez railroad, the nation's first, was built in the 1880's to ship agricultural goods from the Cibao valley through the newly-built port of Sanchez[9]. The young town boomed during the early 20th century, but the advent of the automobile and the construction of highways to serve the port of Santo Domingo soon made the Sanchez rail link irrelevant; and by the 1940's, Sanchez was a pale shadow of its former glory (Olivo et. al.,1986).

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[9] Sanchez, located one kilometer south of El Jaimito's southwestern limit, is the principal market center for El Jaimito residents.

The small population that lived on the Peninsula in the first half of the 20th century resided almost exclusively along the coastal plain and in the port cities. The few farmers with a family history that precedes the establishment of the colonia, describe the hill lands as a sparsely inhabited jungle. By 1940 the mahogony had been logged and the "Samanenses" [descendants of the early inhabitants of Samaná] had little reason to leave the marine resources and rich flat lands of the coastal plain to settle the rugged hills.

El Jaimito comprises a little less than half of a large colonia located on Samaná's karst plateau. Angela Bueno, an employee of the colonia, patiently explained the rather complicated procedure for receiving rights to land in the colonia:

Land tenure rights are granted in a gradual step-by-step manner. Prospective colonos [members of the colonia] must first find unoccupied land to clear and farm[10]. After a few years, if the farmers can prove their good citizenship and have maintained their parcels in tidy, working condition, the parcels are recorded and farmers receive a provisional title. At this stage the farmer is considered an "occupante", but do not enjoy the full privileges of a colono. For example, if the land reform agency implements a bean production campaign, occupantes are required to plant beans; a colono, on the other hand, can choose to participate in the campaign or not. After additional years the occupante can ask for a review of petition to be granted the more complete rights of a colono, which includes the right to pass along the parcela to one's heirs. The final step is to have the plot surveyed; and after another review, the State grants the colono private title

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[10] An administrator directly allotted parcels in the early stages of the colonia.

to the land. Legally, a colono cannot sell their parcel until they receive private title; but in practice, an active land market in untitled parcels has always flourished.

The period of usufruct tenure typically lasts more than 20 years. During that time the colonia has the power to arbitrate disputes among colonos and to a degree, control the agricultural production of the parcel. In return, the colonos and occupantes benefit from loans and other forms of production assistance specifically targeted for land reform settlements. Over the years, farmers in El Jaimito have received free coconut, rubber and cacao trees as a result of various campaigns to promote their cultivation. In many ways, agrarian reform beneficiaries have greater access to government services than independent peasant farmers (Crouch,1981).

The vast majority of the people living in El Jaimito are recently transplanted Cibaeños [Cibao valley natives]. Only 5 of the families surveyed were Samanenses, and only 3 of the households had members of the family who had arrived in Samaná prior to the establishment of the colonia. Twenty three families arrived in the period 1956-1968, and only 4 families in the survey arrived after 1970. Of the 35 households surveyed, 27 were new arrivals to the area, while the majority of immigrants came from the Moca region just east of Santiago [Figure 1].

The model of lowland emigration presented in the literature review fits the El Jaimito case more closely than the migration history of Las Auyamas [Figure 3]. Frequently mentioned reasons for leaving the valley include;

1) The scarcity of land forced farmers to sharecrop in order to gain access to land

2) Too poor to afford the valley's expensive farm land
3) Pasture lands and coffee plantations had occupied available farm areas,and no land remained for conuco
4) Parcelization of inherited minifundia plots had left farmers with uneconomically small parcels.
5) Their small plots had been overworked and the soils exhausted

An examination of the census data supports the view that land pressures were particularly acute in the Moca region and quite plausibly precipitated out-migration. The area of the Cibao valley centered around Moca is famed for its rich, deep soils and among the most densely populated rural regions in the country. Peasants with little or no land depend on access to the under-utilized farm lands typically present on larger farms. Census figures suggest that during the great influx of Moca peasants to El Jaimito, 1955-1970, practically every inch of Moca's farm land was in use.

In 1950, the municipio[11] of Moca had 85% of its farm land in production, leaving 15% in forest or in other non-production land use; as compared to the national average of 74.4% of the farm land in active production and 24.6% in non-production land cover. By 1971, 99.4% of Moca's farmland was in production, while nationally the average was 87.6%. Twelve of the 14.4 percent increase in Moca's cultivated farm area [1950-1971] came from the expansion of pasture lands; so the region's agricultural growth probably created few new employment opportunities for poor and/or landless peasants (Censo Nacional Agropecuario, 1950 & 1971).

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[11] A municipio is the next largest rural administrative unit above the section level. The municipio is the smallest administrative unit for which the census provides a breakdown of land use

In the municipio of Samaná, on the other hand, Only 56.2% of the farm land was actively farmed in 1950. Although the farming intensity increased dramatically in the 1950-1971 period, less than 85% of the farmland was in production by 1971[12].

The description of rural life during the early period of the colonia is remarkably similar to that of Las Auyamas during the pre-coffee boom era. Again the El Jaimito farmers spoke of the remarkable productivity of the land " la abundancia"; but also complained of poor prices and limited markets for their agricultural surplus. "We would travel all night in mud up to our knees just to earn a couple of pesos in the Sanchez market", the farmers recalled. As in Las Auyamas, community support and barter was vital to the peasant economy.

Most of the new settlers could not handle the hardships and isolation that confronted them in this thickly forested, hill land environment. Those settlers who were more resilient and resourceful, remained and acquired the untitled parcels from those who had left. With a bit of craft, some enterprising colonos circumvented colonia rules which prohibited the accumulation of large landholdings, and became local latifundistas in their own right.

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[12] The tendency for peasant farmers to migrate from fully occupied areas to less utilized regions of the national territory has been documented and analyzed in the African context by Olson (1989).

Comparative Summary

Push factors were much more important in the settlement process of El Jaimito than for Las Auyamas. However, the fertility of the Samaná highlands was an attractive force for valley peasants. The vast unoccupied hill lands once available to Cibaeño peasants did not exist by the 1950's. However, the cities offered much greater economic opportunity for rural migrants than ever had existed in the past. Moca emigrants recall that something of a Moca exodus occurred when news got back to the community of fertile lands, free for the taking in El Jaimito. Just as the physical characteristics of Las Auyamas and El Jaimito parallel, so too cultural characteristics. Most of the farmers surveyed in El Jaimito were born less than 50 kms. east of the residents of Las Auyamas' home region of Santiago, in fact 3 households surveyed in El Jaimito had migrated from the Las Auyamas/Pedro Garcia area. Neither environmental or cultural differences appear significant enough to account for the wide disparities in the two sections' current land use; the remainder of the thesis focuses on the evolutionary dimension in order to explain these differences.

Land Use Change

Land use change is the product of both evolutionary and historical processes. By "evolutionary processes" the study refers to diachronically continuous phenomenon such as; natural population increase, or soil depletion in circumstances where farmers fail to replace leached, eroded and harvested soil nutrients. This study assumes that human land use, like natural biological systems, evolves in a causal/logical sequence. In fact, this

study uses a classic model from the science of ecology to help illustrate the evolutionary aspects of land use in the Dominican hill lands.

After a disturbance, such as a fire or a hurricane, forests pass through a regular sequence of biological regeneration . Post-disturbance recovery begins with a period of low net annual primary production(i.e. the annual increase in biomass of an ecosystem). Net annual primary production (n.p.p.) rapidly increases as early successional species take root. Once rapid growing early successional species are photosynthetically mature, the system reaches a n.p.p. peak. Following this "adolescent" apex in the successional process, the biological community begins to invest less energy in fast growing leaf, small branch and root-tip growth and allocates more photosynthate to slower growing, woody structures. Finally, the system enters a mature climax stage where n.p.p. is stable at a level of productivity somewhat below the system's "adolescent" phase maximum (Reiner,1983) [figure 7].

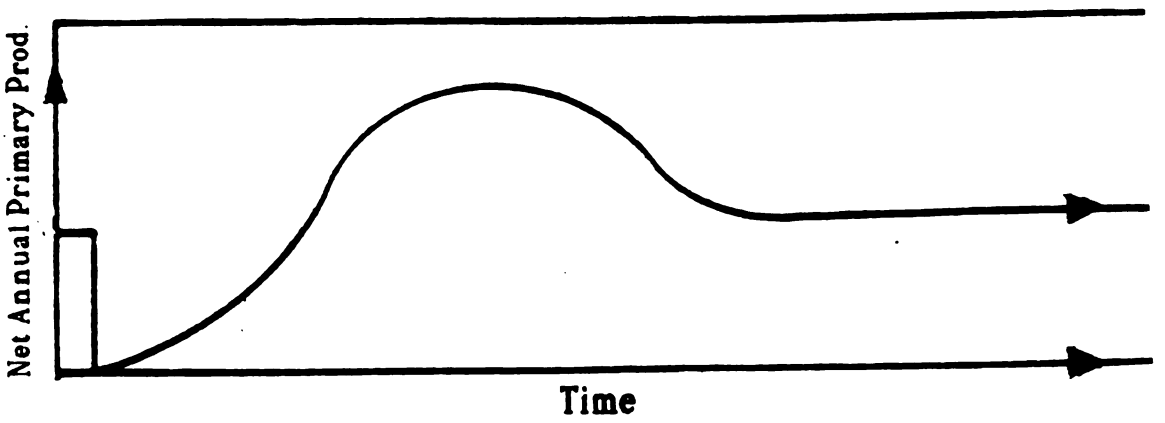

Figure 7 Post Disturbance Succession

Land use change in the Dominican hill lands closely parallels the sequence of forest regeneration described above. In Las Auyamas, for example, agricultural production rapidly increased as peasants cleared the

forest [a human induced ecological disturbance] to establish their hillside farms. Initially, the newly cultivated soils produced bumper harvests; but as the fertility of hillside soils deteriorated, farmers changed cropping patterns from an emphasis on quick turn-over, high nutrient-demanding, annuals to more resilient, less soil-depleting, perennials.

Coffee is a less remunerative per-hectare cash crop than the tobacco which it replaced, and the transition from upland rice to banana represents a decline in the nutritional quality of the region's primary food crop (INCAP-ICNND, 1961). Bananas do not provide the same nutritional yields and coffee does not provide the same economic yields as the annual crops they replaced, but they are much more reliable producers in the environmentally degraded conditions which presently exist. Las Auyamas farmers, for example, frequently cited coffee's ability to produce during drought conditions as a reason not to replace it with cash crops that currently are more profitable.

Land use in Las Auyamas has changed from primary forest to small-scale subsistence; and, as we will show, from a fairly healthy and balanced market-subsistence agricultural economy in the 50's and 60's to an ecologically stable but economically unproductive reliance on coffee in the 1980's. The pattern of rapid but unsustainable agricultural growth, succeeded by a stable but not highly productive farm system, has notable similarities to ecology's model of post-disturbance succession.

Evolutionary explanations have a compelling theoretical elegance, but an over-reliance on evolutionary explanations can lead to the dead end of environmental determinism. Evolution-type hypotheses can provide a basic framework for understanding land use change, but discrete historical events are the key to understanding why land managers make a particular land use

decision at any given point in time. For example, monetarization of the economy and soil degradation, both evolutionary-type processes, pressured Las Auyamas farmers to seek a change in their land use system. Both coffee and cattle production were established parts of the Las Auyamas farm system and either production system might have adapted to the degraded agroecological conditions of the time. In the 1950's, the decision to expand coffee plantations rather than cattle pastures largely was due to an unprecedented rise in the price of coffee. At a very similar juncture in El Jaimito's land use evolution, the different historical conditions which prevailed in the 1980's led to a different land use response. A healthy market for beef, combined with land speculation fueled by the development of a nearby tourist area, largely explains the increase of pasture lands.

A Note on Methodology

This section of the thesis will use airphotos to measure land use change in the two sections and survey data in order to understand why those changes occurred. C.E.U.R. cartographer Freekye Olivo, with assistance from the author, interpreted airphotos to produce the 1959, 1968, and 1983 Las Auyamas land use maps. The 1968 El Jaimito map is entirely the work of Sr. Olivo, while the 1983 El Jaimito map is the sole responsibility of the author.

Airphotos optically distort the true planimetric proportions of the actual landscape (Avery & Berlin,1985). Since we composed the land use maps directly from the airphotos [each photo with its own particular distortions] the areal shapes of same-section maps differ slightly. The lack of perfect uniformity should not effect basic, proportional comparisons of

land use between maps of different years, but the maps' non-uniformities do prevent the use of computerized G.I.S. overlay systems. With the use of color transparencies, the author developed a hand-held overlay technique for analyzing the patterns of land use change in specific subregions.

To understand land use change in any particular area one needs to know that region's demographic history. The author used survey responses and the 1935, 1950, 1970 and 1981 population censuses to estimate population change in the two "secciones". Since El Jaimito was not defined as a "seccion" until the 1981 census, the author calculated its pre-1981 population by employing census figures available for the "seccion" of Las Terrenas, now a municipio containing the "seccion" of El Jaimito.

Another extrapolation from the census data was necessary in the case of Las Auyamas. The 1960 census reported a 280% increase in the seccion's population from the figure reported in 1950. The author judged that this huge population increase was non-credible, particularly in view of the survey results on the migrational history and population change of the area. The author, therefore, constructed a projection from the 1950 census figure based on population growth rates during the 1950-1960 period in the surrounding "secciones" [Figure 8].

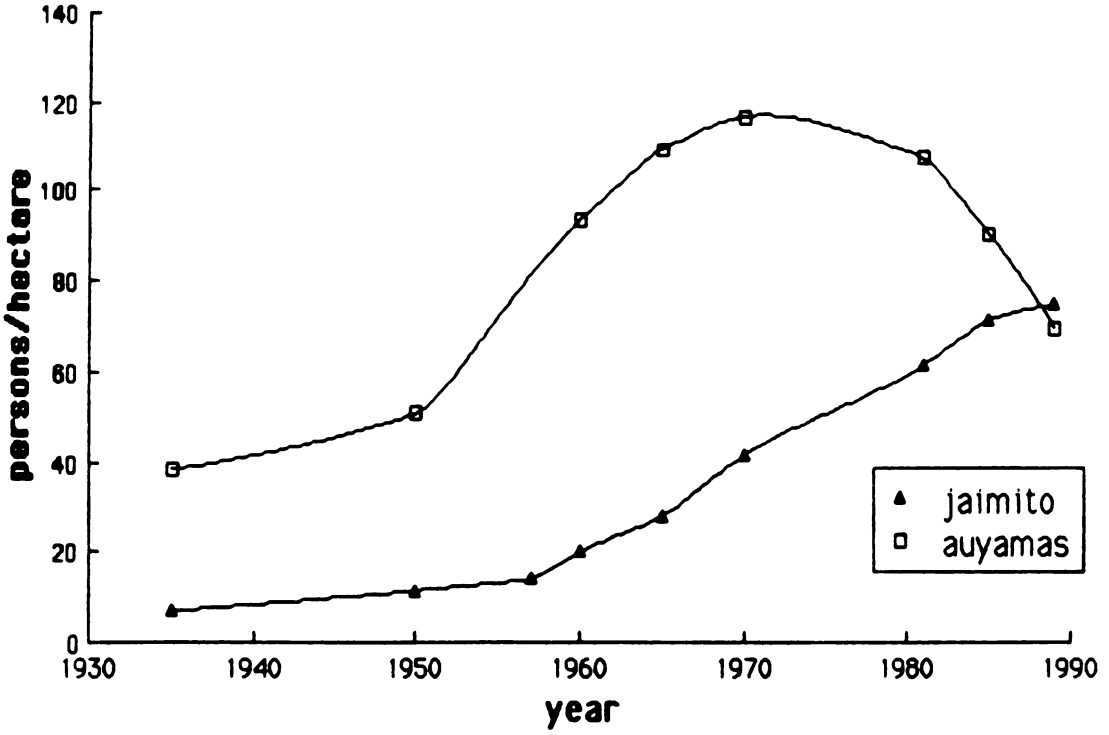

Figure 8: Population Change in Las Auyamas and El Jaimito

Las Auyamas

1959:

The 1959 map [Figure 9] can be seen as an amalgam of the history and the future of Las Auyamas land use. The still forested, Centralwestern region,which is the most rugged and isolated area of the section, represents the pre-settlement era. The Northwestern half of the section displays a diversified land use/ land cover pattern which reflects the shifting agriculture, mixed farming system that prevailed throughout the first 35 to

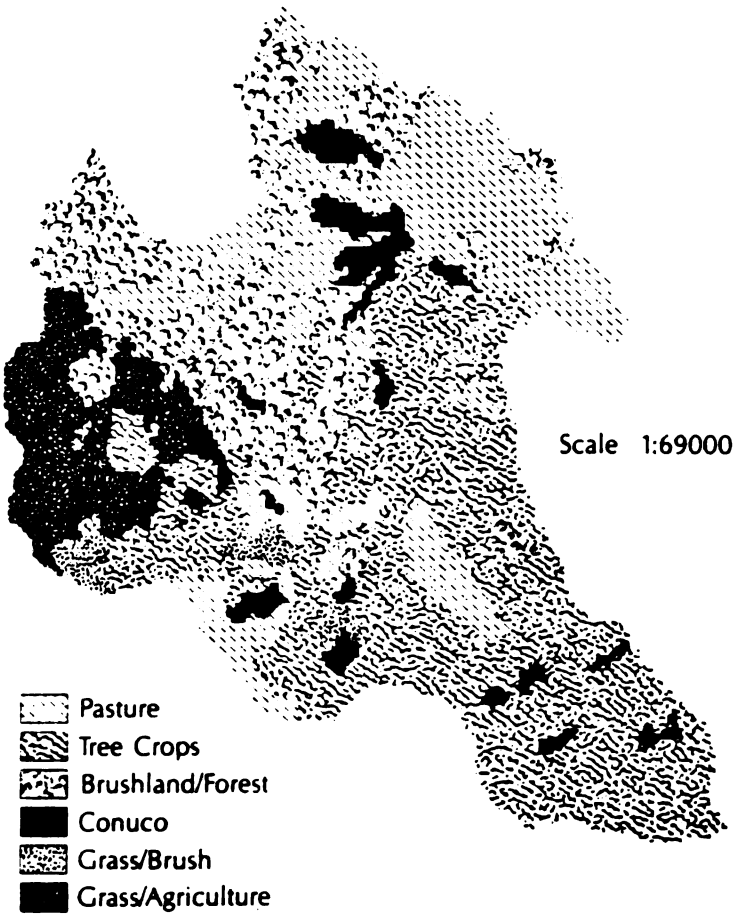

Figure 9 1959 Las Auyamas Land Use Map

40 years of Las Auyamas settlement. In the more accessible Southeastern half of the section, coffee plantations, which would eventually disperse throughout the region, already dominated the zone.

Three aspects of 1959 land use particularly interested the author;

1) The prevalence of coffee plantations so soon after the late 1940's early 1950's coffee price boom
2) The large amount of land in pasture
3) The small portion of the land devoted to conuco production.

Coffee: Although coffee prices had rebounded from their 1940 low, it was not until 1947 that coffee prices had returned to their pre-1930 levels. Of the 16 farmers questioned, 13 identified dates between 1945 and 1960 as the period when the planting of coffee began to accelerate. Despite a common perception of Dominican peasantry as conservative and non-entrepreneurial land managers, Las Auyamas farmers responded quickly to the new market incentives; by 1959, coffee had covered 40% of the section[13].

Pasture: Given the recent increase of cattle production in the section and the long-term national trend toward pasture expansion, the author assumed that in 1959, areas in pasture would cover a relatively small proportion of the section. The 1959-1983 airphoto time series indicates that the location of pasture areas within the section has changed considerably over time. Pasture has increased markedly in some parajes, while others have

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[13] Over 90% of the Las Auyamas area classified as "tree crop" is planted to coffee; the remaining 'tree crop" area is comprised of small cacao groves.

experienced a net decrease; but overall, pastures occupied a larger area in 1959 than 1983.

In 1959, pastures occupied 22% of the section, and if we assume that half of the grass/brush was used as unimproved pasture, the proportion is 26%[14]. An examination of the 1950 census data for the neighboring, highland municipio of Altamira suggests that prior to the 1950's coffee boom pasture may have been the most important land use in Las Auyamas. Local farmers explain that degradation of pasture lands has led to their widespread abandonment. The airphoto evidence appears to corroborate the non-sustainabilty of the area's traditional, extensively managed form of cattle production.

Unlike many areas of the tropics which have predominantly acidic soils [e.g. the Amazon Basin], the mildly alkaline soils of Las Auyamas provide an excellent growth medium for pasture grasses. Soil compaction and weed invasion, which result more from improper management than any environmental limitation, present the major problems with cattle grazing in the region. Soil compaction leaves the hillsides vulnerable to soil erosion and land slips. The tendency of farmers to use the steepest slopes for pastures while planting coffee in more protected hollows and depressions increases these pastures' susceptibility to erosional processes. Local farmers claim that old pastures tend to dry out quickly during periods of low rainfall. The poor moisture retention of old pastures probably results from erosion of soil organic matter and compaction of soil pore space.

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[14] Grass/brush areas usually represent lands in the fallow stage of a short-cycle, swidden agricultural system; these areas are commonly used as unimproved pasture.

Typically, weed invasions of pastures occur when ranchers allow livestock to selectively graze a pasture. If permitted, grazing animals will eat only the nutritious succulent forbs; those noxious weeds which were passed over by grazing livestock will then proliferate. Eventually the nutritious grasses are grazed out and the weedy species completely cover the field; at that point, the farmer has little choice but to abandon the pasture or change its land use (Vandermeer, 1990).

Conuco: Of the 26 farmers questioned, 24 claimed that conucos currently occupy less land than in the past. Based on the survey results, the author expected to find a greater proportion of conuco land use in the section than the 7.5 % actually documented by the 1959 airphotos. The two farmers who disagreed with their neighbors pointed out that the conucos of the past, although more numerous, were much smaller than current food plots[15]. A government extension agronomist for the region explained that to compensate for poor yields, contemporary conucos occupy more space than the small, highly productive parcels of the past (Hiciano, 1989).

The traditional coffee cultivation techniques used by Las Auyamas farmers also help explain the limited area devoted solely to food crop production. The native variety of coffee, la café typica, grows under shade. Farmers plant guama [Mimosa inga, a nitrogen fixing tree] as the principal shade tree, but they intermittently plant food crop trees as well. Coffee bushes are established under plantain and banana groves to shade the

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15 Due to the small scale of the 1959 airphoto set, the map may under-represent the true area in conucos, as some of the smaller conucos may have gone undetected. For comparative purposes with the 1968 & 1983 maps, as shown in Figure 12, the study estimates that 15% of the land in grass/ag was occupied by conuco with the remainder in grass/brush

seedlings while the guama matures. As the plantation [cafetal] matures, the low growing crops, which are planted in the sunny gaps of the cafetal, and later, banana and plantain gradually become shaded out. In summary, the young cafetales, which existed at this early stage of coffee cultivation, likely provided a large share of household food needs.

1968:

In the 1959-1968 period, the land under production expanded rapidly at the expense of forest and brush cover. In 1959, brush or forest covered 22.5% of the section but by 1968, only 6.6% of the study area remained uncleared. The large Centralwestern forest had been entirely removed by 1968 and planted, primarily, to cafetales. Coffee prices remained constant throughout 1959-1968 at a level well below the price received in the early 1950's. Given stagnant market conditions, it is not surprising that coffee lands increased only 11% over the 9 year period.

Much of the 1959 pasture lands already had degraded to grass/brush; however, new pasture lands appeared, principally, in areas with good motorized vehicle access[16]. The trend toward pasture expansion along major roadways continues to the present. Local farmers explain that urban based rancher/speculators will pay premium prices for grass lands with good automobile access. Overall, pasture land use declined from 22% of the total section to 14.7% while grass/brush increased from 8.2% to 19.8% of the land area.

Conuco land use practically doubled during these 9 years, from 7.5% to 14.7%. An approximately 25% increase in population would explain some of

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[16] Note the new pasture areas along the ridge road which forms the Southern border of Las Auyamas

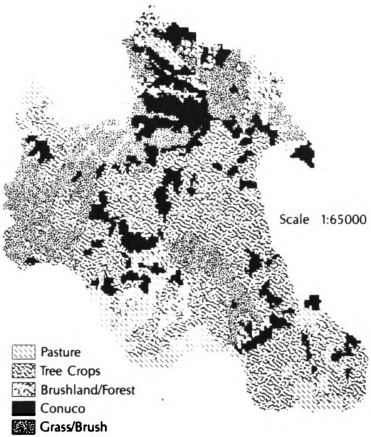


Figure 10 1968 Las Auyamas Land Use Map

this expansion of food production areas [Figure 8]. Better detection of small conuco parcels with the 1968, 1:20,000, airphoto set could account for another share of the mapped increase; but probably, adaptation to declining soil fertility caused most of this increase.

The agronomist for the region mentioned 1960 as a turning point in the history of local land use, a time when farmers began to experience significant negative effects from their exploitative, non-sustainable, farming practices (Hiciano, 1989). If farmers decided that they wanted to continue providing the bulk of household needs from their conucos, they needed to expand the conuco's area to compensate for its poor yields. The technology to intensify food crop production was largely limited to the purchase of agro-chemicals. Even at the time of field work for this study, farmers applied very little synthetic fertilizers on their conuco plots and probably used purchased agro-inputs even less in 1968.

1983:

Three historical events combined with the evolutionary process of land degradation to significantly shape the demographic and land use situation of Las Auyamas during 1968-1983;

1) The ban on tree cutting enacted in 1967
2) Construction of the Santiago- Altamira-Puerto Plata highway completed in the late 1960's
3) Construction of the Santiago Free Trade Zone " Zona Franca" in 1976

The 1967 tree cutting prohibition was designed to halt rapacious logging practices and slash and burn agriculture, neither of which were very important in post-1968 Las Auyamas. However, the law also banned the

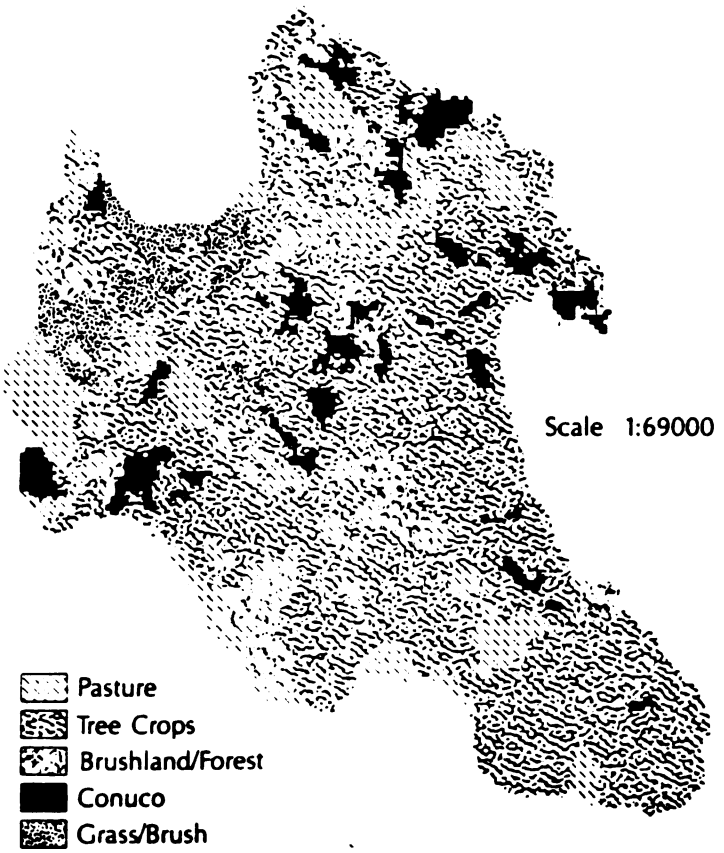
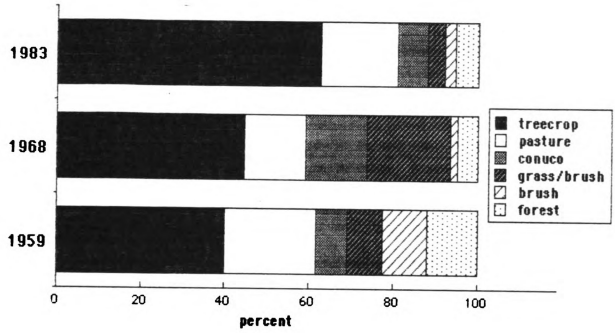


Figure 11 1983 Las Auyamas Land Use Map



Year	Treecrop	Pasture	Conuco	Grass/Brush	Brush	Forest
1959	39.8%	22%	7.5%	8.2%	10.7%	11.8%
1968	44.3%	14.7%	14.7%	19.8%	1.9%	4.7%
1983	62.5%	18.3%	7.4%	3.9%	2.6%	5.4%

Figure 12 Las Auyamas Land Use Change 1959-1983

cutting of coffee bushes without the permission of responsible government officials. Numerous patterns of land use change occur in Las Auyamas [e.g. grass/brush to coffee or conuco to pasture], but once a farmer plants a parcel to coffee, the land use change process usually is complete. The peasant economy survived by adapting to new constraints and opportunities, but the 1967 ban locked most farmers into a rigid coffee production system.

Prior to construction of the Altamira highway, the Santiago-Pedro Garcia-Puerto Plata highway provided the only direct paved route for travel between the Central Cibao Valley and the Atlantic Coastal Plain (D.G.E., 1945). Practically all of the heavy Santiago- North Coast traffic flow rerouted along the modern Altamira highway. Meanwhile, the Pedro Garcia highway, the main transportation artery for Las Auyamas, deteriorated rapidly. As a consequence of the sudden obsolescence of the Pedro Garcia highway, the local Las Auyamas transportation network degenerated as well.

The Santiago Zona Franca is one of the oldest and largest free trade zones in the country, and many Las Auyamas residents single out the construction of "La Zona" as the historical milestone which marks the beginning of a major and ongoing exodus from the region. Despite the heavy out-migration dating back to the early 1970's, throughout the 1968-1983 period, populations in Las Auyamas matched or exceeded average national population densities. The 1983 map provides evidence of both intensification and extensification of land use which parallel the demographic conditions of relatively high population densities and a significant flow of out-migration.

Intensification: From 1968 to 1983, the overall expansion of land in active production and the dispersion of coffee plantations to virtually all

regions of the section represent the two most apparent land use changes. By 1983, farmers had converted most of the 19.8% of the section formerly covered by grass/brush into more active land uses [conuco, cafetal, and pasture]; most of these grass/brush areas became coffee plantations. Cafetales spread over 62.5% of the Las Auyamas land surface, a 41% increase over the 15 year period. Pasture lands tended to expand onto old conuco grounds even as many old pastures reverted back to grass/brush[17]; overall, pasture areas showed a moderate increase.

Disintensification: Pasture lands increased from 14.7% to 18.3% from 1968 to 1983; but if farmers used a half of the grass/brush land for livestock production [as unimproved pasture] the proportion of land used for grazing purposes actually declined from 24.5% to 20.2%. Small-scale farmers historically grazed their livestock on unutilized grass/brush lands. As "loose lands" converted to cafetales and pastures, peasants could not provide feed for the family milk cow and the traditional, broad assemblage of small livestock, typically found on traditional farmsteads. Although 12 of 23 farmers believed that pasture lands have increased; 20 of the 22 farmers surveyed, claimed that previous livestock numbers exceeded current levels[18].

If, as the study suggests, conuco lands expanded as a response to declining soil productivity and population increase; why then did conuco

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[17] Note the changes in the Northcentral region between the 1968 and 1983 maps.

[18] Some of those surveyed qualified their answer by saying that the beef cattle herd in the section has grown over the years; but overall numbers of livestock have generally declined. The 1980 pig extermination campaign was an additional factor in the decline of small livestock in the section.

lands contract over the 1968-1983 time span? The population had decreased just 13% and soil conditions had significantly worsened, yet conuco areas had diminished to half of their 1968 extent. The author concludes that the abandonment of conuco lands during this period reflects farmers' increasing frustration with food crop production.

Although conucos are typically much smaller than cafetales, food crops require more labor per hectare than maintainance of a coffee plantation. Even if the section's total population decline was not great, the heavy out-migration of young adults placed a high premium on household labor. Farmers grew tired of investing considerable amounts of time and energy on food gardening when their conucos frequently failed to produce sufficient quantities of food to compensate for their efforts. Farmers calculated that they could buy rice, corn and other subsidized staples with their coffee earnings, rather than contend with the difficulties of growing their own food.

Despite the expansion of area under productive land use during the 1968-1983 period, the author estimates that total agricultural production either stagnated or declined. With less land in conuco and lower yields, food production in the section plummeted; if we accept that livestock production also decreased, then coffee production represented the only dynamic sector of the economy . A growing dependance on a one crop cash economy would be worrisome in and of itself but the declining productivity of the cafetales underscores the deterioration of the Las Auyamas agricultural system.

Optimally, coffee bushes should be replaced every 10-15 years; after that period of time productivity begins to decline (Sanchez Roa, 1989). The average mean age of Las Auyamas cafetales at the time of the 1989 survey was 29 years and the mode 35 years [n-21/26]. Even if no replanting

occurred over the last 6 years, these figures indicate that the cafetales of 1983 had outlasted their productive prime. Two major factors account for the neglect of cafetal maintenance and their subsequent decline in yields; 1) the poor terms of exchange for coffee growers inhibited capital reinvestment, and 2) young adult out-migration created labor shortages for routine cafetal upkeep.

Summary: Although the area of Las Auyamas under cultivation increased during the 1959-1983 period; overall, the intensity of agricultural production decreased. The depopulation of Las Auyamas during the 1980's appears quite understandable given the degradation of the soils, the deterioration of the transportation network and macro-economic forces that favored urban-industrial development.

El Jaimito

Pre-1968:

Had there been 1959 airphoto coverage, it would have shown an area covered by dense, broadleaf forest, broken intermittently by slash and burn farms. Early settlers recall that, "the forest was so thick that the daytime was dark and not even a mule could pass through". This description of Samaná's "evergreen hardwood" forest was echoed, albeit in greater scientific detail, by biogeographer William Durland (1922: 212-213);

> Collectively ... [evergreen hardwood forests] ... are rich in thick stemmed lianas and epiphytes and contain a wealth of aerial roots which descend vertically and unbranched through the air from the tree crowns. The temperature and moisture conditions are more or

> less uniform throughout the year, extending the actual growing period of the species within this type over the entire twelve months. It is here, as would be expected, that the most luxuriant forest growth of the republic is found. Within these forests there is displayed a dense mass of foliage from the ground up to the tops of the tallest trees, beneath which there is scarcely any direct sunlight and through which it is exceedingly hard to make one's way.[19]

Typically, newly arrived peasants cleared conucos many times larger than the 1989 norm.[20] Unlike early settlers of Las Auyamas who planted small conucos sufficient to meet their subsistence needs, El Jaimito's colonizer's planted conuco's that produced much more than peasant households could either consume or market. Farmers planted large conucos for two distinctly different reasons;

1) To maintain land tenure rights in the colonia the parcelas had to be actively worked. The clearing of a conuco was the first step in establishing more permanent agricultural land uses, such as tree crops or pastures, which required less effort to maintain.

2) Farmers planted large conucos with the unrealistic hope "la illusión" that they could sell the surplus. In reality, a great portion of their production rotted, or was fed to the pigs. In contrast to the difficult task of clearing and weeding the short-cycle bush fallows that predominated the Cibao Valley, Cibaeño colonizers could clear large tracts of forest with relative ease; and once opened, these freshly cultivated lands experienced very few weed and pest problems. New immigrants, who possessed little or no land in the valley, behaved like "kids in a candy factory" when presented with El

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[19] Durland mapped the Las Auyamas forest as belonging to the same "evergreen hardwood" type described above

[20] Settler's recall clearing conucos of up to 50 tareas (over 3 hectares). 1989 survey results found a mean average conuco size of 1 hectare and a modal size of .6 hectares.

Jaimito's wide expanse of fertile forest land. Unfortunately, it appears that colonizers squandered much of the forest's accumulated fertility during a time of weak market demand for their agricultural bounty.

1968:

Despite steady in-migration over the previous decade, the section's population was sparse; roughly equivalent to 1935 population levels in Las Auyamas [under 40 persons/km.^{2}]. Areas of active cultivation concentrated in the section's Southwestern quarter, the area nearest to the city of Sanchez, and the Northcentral region, the zone most proximate to the Atlantic Coast fishing village of Las Terrenas. A rough unpaved road, connecting Sanchez and Las Terrenas, served as El Jaimito's main transportation artery. Although on the airphoto, clouds cover much of the land bordering this road, by 1968, settlers had established farms all along this route.

Land use: Forests continued to extend throughout 44.8% of El Jaimito, while active farm land [conuco, treecrop and pasture] occupied just 17.3% of the section.[21] Although grass/brush covered 19.4% of the area, no improved pastures existed.[22] The absence of improved pasture contrasts sharply with the regional landscape that would prevail just 20 years later. Conucos covered a modest 4.5% of the section; but a more representative figure of swidden agriculture's importance is obtained by combining the land areas

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[21] All proportions calculated from the 86% of the section not obscured by cloud cover.

[22] Improved pastures are distinguished from non-improved pasture lands by the presence of fences and the abscence of brush

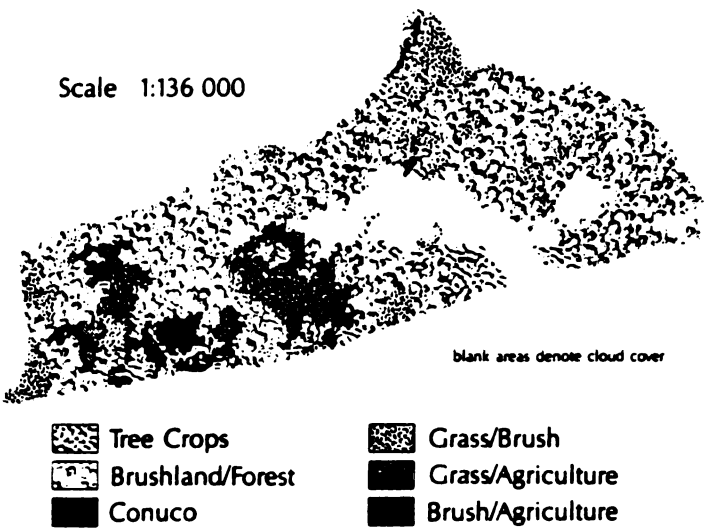

Figure 13 1968 El Jaimito Land Use Map

classified as conuco, grass/brush, grass/ag., and brush/ag..[23] Areas of shifting agriculture occupied 24.7% of the section and approximately two thirds of the land not in brush or forest [Figure 13].

1983:

El Jaimito's landscape changed dramatically during the 1968-1983 period. Areas of forest and brush, which in 1968 extended throughout 63.3% of the section, only covered 11.1% of the 1983 area. By the late 1970's, just 20 years after initiation of State-sponsored colonization, virtually none of the region's original forest remained.[24] Grass/brush, became the predominant land cover, occupying 32.6% of the study area; followed by tree crops, whose area expanded 236% over the 15 year period, to comprise 30.4% of the region. Settlers began to establish improved pastures [portreros] in the mid 1970's and by 1983, they occupied 17.6% of the land. Although conucos constituted only 8.8% of the section, their expansion more than kept pace with population growth.[25]

Deforestation: The extent of forest conversion during this short period appears to be non-proportional to the section's relatively small population. In 1983, the population density reached approximately 67 persons/km.^{2}, a

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[23] Grass/ag. are areas of short-cycle, grass fallow, shifting agriculture, while brush/ag. are areas of medium-cycle, bush fallow agriculture. For comparative purposes with the 1983 map, Figure 15 calculated that 25% of the land in grass/ag. and brush/ag. were in conuco with the remaining 75% occupied by grass/brush and brush respectively.

[24] Apart from a few isolated remnants of primary forest, the afforested 7.4% of the section was secondary regrowth.

[25] From 1968-1983, the population grew approximately 90%; while conuco areas increased 97%

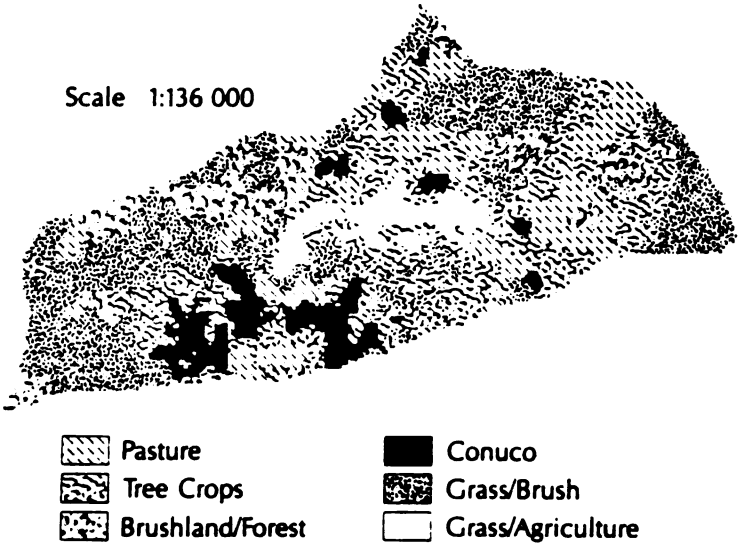
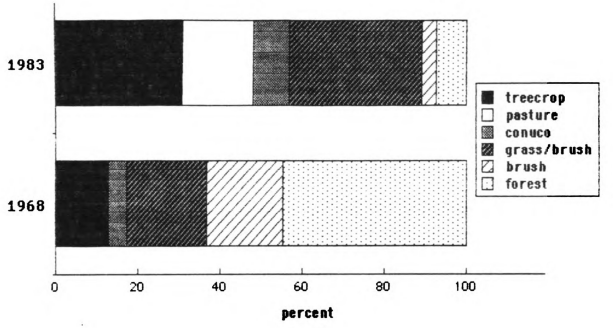


Figure 14 1983 El Jaimito Land Use Map



Year	Treecrop	Pasture	Conuco	Grass/Brush	Brush	Forest
1968	12.9%	0%	4.5%	19.4%	18.5%	44.8%
1983	30.4%	17.6%	8.8%	32.2%	3.7%	7.4%

Figure 15 El Jaimito Land Use Change 1968-1983

level well below that of Las Auyamas circa 1959; however, the areas in forest and brush were less than half that of 1959 Las Auyamas. The colonia's regulations, which rewarded settlers for establishing "propiedad" [i.e. land uses that demonstrate long-term improvement of the land] explains much of this rapid deforestation, as well as the marked increase of tree crop and pasture lands.

The vast expanse of grass/brush suggests that farmer's cleared the forest, often without any immediate use in mind, apart from maintaining claim over their parcelas.[26] During a time when a ban on tree cutting was supposedly in effect, it is ironic that the State presided over and, through its land reform policies, actually encouraged the massive deforestation of El Jaimito.

In defense of colonia administrators, the State expended considerable effort to promote soil conserving tree crops for the area. The colonia helped provide credit for coffee cultivation, and distributed cacao, caucho [rubber tree] and coconut seedlings to resident farmers.[27] The remarkable increase of the area in tree crops indicates the great potential of government supported, agroforestry campaigns.

Food production: In contrast to Las Auyamas, where cafetales and pastures dominated areas with decent motorized vehicle access; conuco and "grass/ag." remained important land uses in El Jaimito's Central region, the

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[26] Charcoal production, which with the growth of urban demand for fuel was becoming an important commercial activity in the region, could also account for an important share of the deforestation.

[27] Unfortunately, coconut trees, which produce poorly in this upland environment, now cover a large proportion of El Jaimito. The trees serve little purpose other than establishing propiedad

area of the section best served by the local road network.[28] The prevalence of food production in this commercially strategic area reflects its importance in the cash economy. In the 1970's, yams [ñame] and coco yams [yautía], as well as a variety of tree crops, supplanted tobacco as the section's primary cash crops. Unlike Las Auyamas, El Jaimito's soils could still support commercial food production at a time when urban demand had made it a profitable activity.

Comparative Summary:

Over the 1968-1983 period, El Jaimito's agricultural area more than doubled; but unlike what occurred in Las Auyamas over this same time frame, production intensified. In 1983, the conditions of land use in the two study areas differed remarkably; while Las Auyamas was saddled with a one crop economy, agriculture in El Jaimito displayed a well balanced and diversified structure. El Jaimito's conucos produced an abundant diversity of both subsistence and commercial crops; but the Las Auyamas' conucos provided a meager harvest of mainly cassava, banana and those few other crops that could tolerate the region's depleted soils. While Las Auyamas residents left in droves, in El Jaimito, immigrants continued to arrive .

Only by studying the land use evolution of these two areas, could an observer note the parallels of El Jaimito's land use change pattern to that of Las Auyamas. The author finds a close similarity between the robust, diversified agricultural system found in Las Auyamas during the 1950's to

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[28] By 1977, improvements of the Sanchez-Las Terrenas road made the route passable for most cars and trucks; and by the end of the decade, Santo Domingo-based camioneros regularly visited the area .

the situation of El Jaimito's farm economy of the 1980's. At these two different points in history, both areas appeared to have arrived at the same "adolescent apex" in their land use evolution. A comparative analysis of contemporary land use should help reveal whether the study regions' dissimilar landscapes actually reflect a common evolutionary process, observed at two different stages in its development.

Contemporary Socio-Economic Conditions and Land Use

Las Auyamas

In the 1980's, out-migration became the preeminent social process while coffee production continued as the section's dominant land use. Out-migration and coffee production mutually reinforce one another; labor shortages resulting from emigration encourage farmers to emphasize non-intensive coffee cultivation over more labor demanding land uses, in turn, the marginal profits and low labor requirements of extensive coffee production encourages out-migration.

Annual fluctuations of the international coffee market greatly effect the socio-economic status and migrational patterns of Las Auyamas. In the late 1970's, despite construction of the Santiago zona franca and ongoing declines of agricultural productivity, the high price of coffee apparently suppressed, or ar least delayed, out-migration. With the decline of coffee prices in the 1980's, emigration became a more attractive strategy of economic survival. A mean average of survey responses places 1979-1980

as the year when the current wave of out-migration commenced [n-21/26], with 15 of 17 informants identifying the years 1982-1989, as the era of maximum out-migration.[29]

Ironically, a brief rebound in coffee prices during the mid 1980's derailed a program that might have broken the degenerative spiral of dependance on coffee production and population decline. In 1983, the government formulated a program to diversify production in regions predominantly devoted to coffee cultivation. The potential benefits of incorporating additional cash tree crops into the farm system include;

* Allowing a more even allocation of labor throughout the growing season
* Reducing the total cost to the farmer of a price decline in any one crop
* Minimizing the damage from crop-specific pests and diseases

When coffee prices increased 45% over the 1983-1986 period, the government judged that the short-term gains of increased export tax revenue outweighed the long-term benefits of an initially costly, diversification process (Hiciano, 1989). Although after 1986, coffee prices quickly declined to more modest levels, the government did not attempt to revive the diversification program.

National policy makers value the established cafetales as providers of foreign exchange and upper-watershed protection. Although nationally, average coffee yields declined 40% over the 1980-1989 period; the government obtains the economic and ecologic benefits from old cafetales at little or no cost, and apparently, considers cafetal renovation a low priority investment (Hiciano, 1989). Old plantations require an expensive rehabilitation effort, but the government's small loans barely cover farmer's

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[29] Based on survey results, the section's net population declined at least 35% from the level reported in the 1981 census.

living expenses during the pre-harvest season, much less major capital reinvestment (Sanchez Roa, 1989). In Las Auyamas, lack of government support does not restrict itself to coffee production; the section has no secondary school, paved road, health clinic, police post, telephone or electrical service.

In 1989, Las Auyamas farmers faced several serious threats to their coffee-based agricultural system. In July of 1989, the International Coffee Organization [I.C.O.], the cartel which controls the world coffee market, failed to reach agreement on export quotas. Failing to reach an accord among producer nations, the I.C.O. deregulated the market, and coffee prices quickly fell to their lowest levels since the mid-1970's (Hernández,1989).

The drop in coffee prices came at a difficult time for Las Auyamas coffee farmers [cafecultores], who had endured a year of high inflation. The study's itemization of basic consumer goods revealed that as of November 1989, household consumer costs had doubled since autumn of 1988. Farmers typically accumulate considerable debt by the start of the October-December coffee harvest; in 1989, the costs of high inflation made this debt load particularly heavy. With the sharp drop in prices, many cafecultores expressed concern as to whether the harvest would cover their debts, much less generate savings for the off-season. Interviewees fought off pessimism with hopes for better prices next year, but as long as these farmers depend heavily on the vagaries of the international market, it is difficult to understand how they could plan rationally for the future.

The economic vulnerability of a one crop economy eventually may seem inconsequential when compared with a coffee monoculture's biological vulnerability. In the late 1980's, a fungal disease of coffee bushes ["La Roya"] rapidly spread throughout many of the D.R.'s coffee growing zones.

While in Las Auyamas, the current extent of the infestation appears limited, the disease threatens the region's future of coffee production.

Aside from La Roya and swings in the economy, cafetal productivity continued its steady decline. Most of the section's cafetales were planted during a 1948-1960 boom in coffee cultivation, and many plantations have not undergone major renovations since then. Not only has the labor shortage, caused by out-migration, hampered coffee replanting efforts; cafecultores can not keep up with routine annual maintainance, such as replacement of shade trees, and the bi-annual weeding and brushing operation " la limpieza." Sixteen of 23 farmers reported steady declines in coffee yields and 4 farmers claimed their production trends were irregular. The 3 cafecultores who experienced increases in productivity, recently had renovated their cafetales. Although conuco production, as commonly practiced, degrades fragile hillside soils, traditional coffee production appears sustainable if farm households can supply the necessary labor.

Summary: The declining intensity of land use, which commenced in the 1968-1983 period, accelerated in the post-1983 era. Essentially, the areal proportions of the various land uses in the section remained unchanged from their situation in 1983; however, the stabilization of agricultural production, predicted by the study's land use evolution model, failed to materialize [Figure 7].

El Jaimito

Contemporary socio-economic circumstances in El Jaimito appear much more promising than Las Auyamas. The rapidly growing popularity of the Las Terrenas tourist zone has brought money and jobs to the area. To serve the booming tourist trade, the government recently completed construction of the newly paved, Sanchez-Las Terrenas highway, which greatly improved mobility and market access for local residents. High food prices and the government's promotion of non-traditional food exports have created new market opportunities for El Jaimito's farmers who, unlike their Las Auyamas counterparts, continued to farm lands capable of producing food crops on a commercial scale as well as supplying a major share of household needs. The 1989 decline in coffee prices and a serious problem with La Roya, partially cloud the generally bright economic picture, but the region's diversified economy enables most peasant households to endure the shortfall in coffee earnings without undue hardship.

By 1989, pastures had become the section's primary land use. Three socio-economic forces helped propel the recent expansion of pasture lands;

1) A real estate boom precipitated by the growth of tourism
2) The relative strength of beef production in the national agricultural economy
3) The increasing polarization between large and small landholders

Urban Dominicans and foreign tourists, attracted by the recreational and investment qualities of the region, bought up lands along the Sanchez-Las Terrenas highway. Investors, interested in building vacation homes or holding the land for investment purposes, prefer the neat appearance and

low maintenance of grass lands. Small herds of cattle graze these properties to keep the grass down and deter land invasions by peasant farmers; but typically, landlords are unconcerned with maximizing livestock productivity. Frequently, local peasants with lands close to the highway, even some that do not own grazing animals, plant portions of their property to pasture in order to increase its real estate value. More serious ranchers, on the other hand, have bought large tracts of relatively inexpensive land in those areas not desired by the tourism-related real estate market.

The region's economic progress does not benefit all residents equally. Those farmers fortunate enough to own land along the highway witnessed a property increase of 25 to 100 times its 1980 price, but for those with little land or money, the inflated land market further restricted their access to farm land. Local peasants, who capitalized on the new economic opportunities in the region, have expanded their landholdings at the expense of those farmers who possess few resources, or perhaps, lack great entrepreneurial skill. One informant summarized the change in land tenure structure by saying, " *Hay más gente ahora, pero la cantidad de tierra ha llegada a más pocas personas. Más con mucha y más con nada*."[30]

For many middle class peasants, cattle serve as the primary means of capital savings. Typically, these farmers retain their cattle as long as possible, rather than sell them when ready for market. Small holders cannot afford the expense of purchasing cattle nor the land required to pasture them, and therefore restrict their farming activities to conuco and tree crop production.

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30 "There are more people now, but most of the land has been acquired by an even smaller group of landholders. There are more people with lots of land, and at the same time, more people with none."

Overall, the situation for poor and or landless peasants has worsened, at least in relative terms, during the post-1983 period. Small-scale farmers can not afford the expensive lands which border the roads; ranchers outbid them for the less expensive lands in more remote areas and virtually no colonia lands remain unworked or unclaimed. Traditionally, large landowners used landless campesinos to clear areas of their properties covered by brush or forest. As the area of unutilized brush and forest lands rapidly disappears, the many poor peasants who gain access to conuco sites in this manner were working themselves out of a job.

In those regions of the section where land prices are highest, the expansion of grass lands has almost entirely displaced small-scale mixed farming. In the Northcentral region, the author had a difficult time encountering an adequate number of farmers to complete the survey sample. As land speculation and ranching continues to increase, the future of small-scale farming in the section becomes more tenuous. Some of the poorest interviewees complained that, while cattle in the regions graze more than adequate areas of pasture, they cannot obtain sufficient conuco land to feed their families.

Summary: In the post-1983 period, small-scale farmers, responding to market forces, increased commercial food crop and non-coffee, tree crop production. Overall, the increase of pasture lands represented the section's most significant land use change. The model predicts an eventual disintensification of land use in El Jaimito, but the evidence presented suggests a mix of both intensification and extensification [Figure 7]. The following discussion reviews the evidence from the El Jaimito and Las

Auyamas case studies to test the land use evolution model's utility for explaining and/or predicting land use change in hill land areas of the D.R..

Discussion

To this point, the study's comparative analysis has treated land use change in El Jaimito and Las Auyamas as two separate phenomena, which share certain communalities, but also display characteristics unique to each location. In the following discussion, this research treats the two study areas as separate stages in the development of one phenomenon, the hill land colonization process. Instead of a more traditional, geographical approach of restricting regional comparative analyses to aspects of location and spatial distribution; this study expands its research agenda to include analysis of the comparative, temporal location of the two study areas along a common land-use-evolution continuum.

Contemporary land use configurations are not simply a reflection of current resource attributes and recent resource use decisions; in large part, they result from the region's history of human events and physical processes. Although each region has its own unique land use genealogy, this study proposes that all Dominican hill land use systems pass through similar evolutionary stages; beginning with the initial colonization process and culminating with adaptations to the land's declining capability for human use.

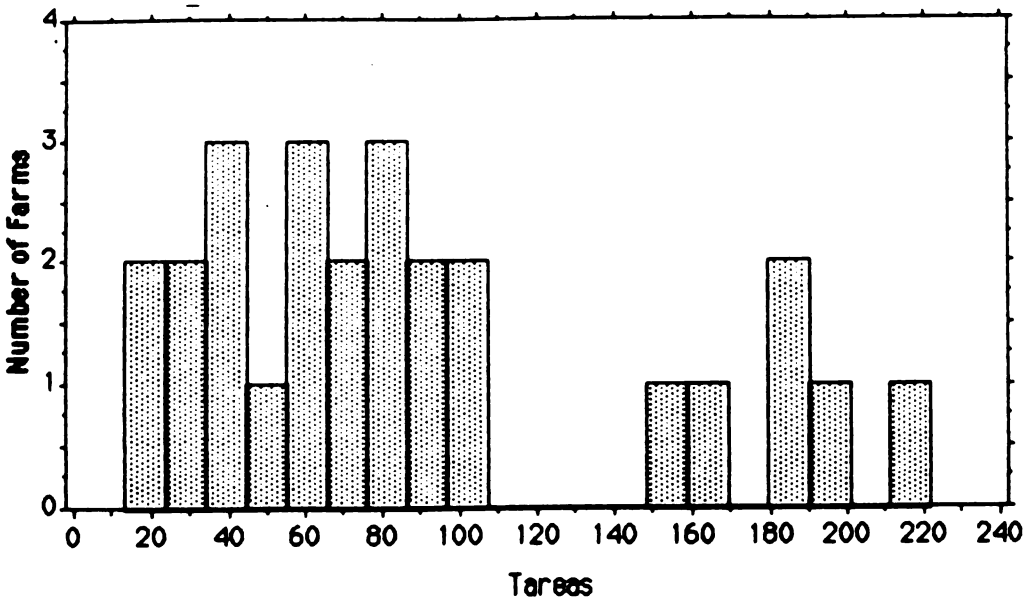

Figure 16a Las Auyamas Land Tenure Structure

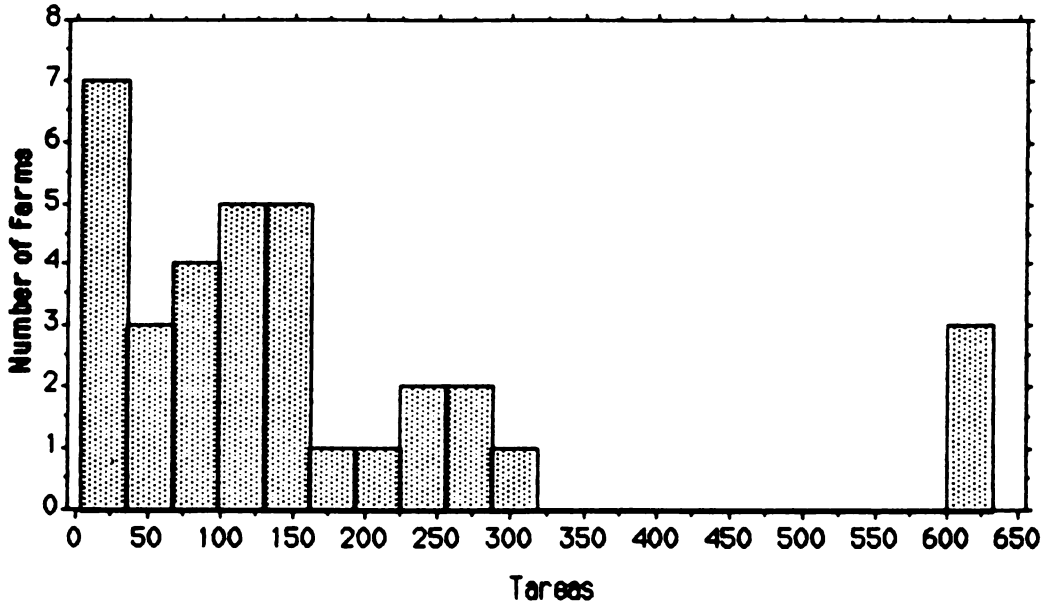

Figure 16b El Jaimito Land Tenure Structure

Table 1 Property Profile

Table 1a

Land Area Sample Size	Surveyed property area/Section area
Las Auyamas n=26	. 6.1%
El Jaimito n=35	. 7.6%

Table 1b

Property Profile	Avg. Property Size	Avg. # of Parcels	Avg. Parcel Size
Las Auyamas n=26	88.3 tas.	3.1	28.7 tas.
El Jaimito n=35	160.1 tas.	2.2	72.6 tas.

Table 1c

Principal Land Buyers	Auyamas n=22	Jaimito n=27
Small-scale Farmers	31.8%	3.7%
Local Latifundistas	13.6%	25.9%
Urban Speculators	22.7%	22.2%
Foreign Buyers	0%	22.2%
" Now; almost no one"	31.8%	25.9%

Table 1d

Land Availability	Auy. n	Las Auyamas	Jaim n	El Jaimito
Avg. minimum price for land	n=20	288 pesos/ta.	n=14	768 pesos/ta.
Avg. maximum price for land	n=22	443 pesos/ta.	n=14	3715 pesos/ta.
Sharecrop land is available	n=9	45%	n=18	28%
Sharecrop land is not available	"	55%	"	72%

Table 1 Property Profile [Continued]

Table 1e

Land Tenure	Las Ruyamas n=26	El Jaimito n=35
Own	71.5%	74.4%
Family	10.3%	23%
Sharecrop	18.2%	2%
Rent	0%	.6%

Table 1f

Emmigrants Sell/Leave Their Land?	Ruyamas n=25	Jaimito n=18
They leave their land	28%	*
The majority leave their land	36%	33.3%
Some leave it; others sell	8%	11.1%
They sell their land	12%	*
The majority sell their land	36%	55.6%

Property Profile

With every passing generation, family properties subdivide; the smaller average size and greater parcelization of the Las Auyamas properties reflect the section's longer history of land use [Table 1b]. Las Auyamas' highly subdivided land tenure system clearly supports the study's evolution-based argument, however El Jaimito's more polarized land tenure structure appears to contradict the thesis.[31] Despite national trends which suggest that over time, land tenure becomes further polarized, El Jaimito's younger land tenure system displays a wider disparity between large and small peasant landholdings [Figures 16a & 16b].

The author suggests that if land tenure polarization is conceived as a problem stemming from competition for land rather than the mere passage of time, the greater polarization of peasant holdings in El Jaimito supports, rather than contradicts, the evolution-based argument. During the current "adolescent" stage in El Jaimito's land use evolution, competition for farm land is more intense than in Las Auyamas, which is experiencing a period of decline and abandonment. Additionally, El Jaimito's current history of tourism-related land speculation, and the boom in the beef cattle market, compound the more intrinsic, "evolution-based" land pressures. In contrast to El Jaimito, where local latifundistas, urban speculators and foreign buyers dominate the land market, Las Auyamas' lower land prices allow peasants

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[31] The survey exclusively sampled local farmers; no foreign or urban-based, absentee landowners were included in the sample.

a greater opportunity to purchase lands [Tables 1c & 1d].[32]

Apart from outright purchase of land, sharecropping allows cash-poor farmers access to land. Eighteen percent of the land sampled in Las Auyamas was sharecropped, and in 27% of the farms surveyed, sharecropped parcels formed at least a part of the farm operation; as opposed to 2% of the land and 14% of the farms in El Jaimito [Table 1e]. The author sampled the smallest landholders among the 86% of El Jaimito farmers who did not sharecrop and found that 72% of these minifundistas, could not find land available to sharecrop in their local areas [Table 1d].

The vast majority of Las Auyamas emigrants reside in nearby Santiago, where they may continue to manage their cafetales, either by returning to the mountains during the harvest season or sharecropping their plantation. The pronounced tendency for Las Auyamas emigrants to hold on to their hill land farms increases the availability of sharecrop land and helps suppress the accumulation of property by wealthier landowners [Table1f].[33] Although small property sizes and unproductive farmlands create hardships for the local peasantry, the relatively inactive and non-competitive land market of Las Auyamas appears to have suppressed the landholding polarization process. On the other hand, the intense competition for land in El Jaimito has acted to further separate those who can and can not participate in the land market.

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[32] The high percentage of respondents in both sections who reported that demand for land is virtually non-existent, reflects speculation's distorting effect on the land market. With further peso devaluations anticipated and inflation on the rise, many potential land sellers are holding out for expected higher prices. Even at the lower prices of Las Auyamas, land remains beyond the financial reach of most small-scale farmers.

[33] The current high rate of absenteeism among Las Auyamas landowners contributes to the deteriorating condition of the section's cafetales.

Table 2 Demographic Profile

Table 2a:

Family Profile	Las Auyamas n=26	El Jaimito n=35
Avg. family size	5.2 children	8.1 Children
Avg. age of male head of home	55.4 years	50.3 years
Avg. age of female head of home	49.8 years	44.7

Table 2b:

Children's Residence	Las Auyamas	El Jaimito
Parents' home	41.2%	51.3%
In the nearby area	10.7%	18.6%
The city	45%	25.3%
A distant rural area	2.3%	4.5%
Abroad	.8%	.4%

Table 2c:

Will local youth stay to farm?	Yes	No	Some will stay
Las Auyamas n=22	0%	72.7%	27.3%
El Jaimito n=23	39.1%	34.8%	26.1%

Demographic Profile

The older average ages of the Las Auyamas heads of household and quite possibly the smaller family size,[34] reflects the heavy out-migration of the young adult population and more generally, the depressed economic condition of the section [Table 2a]. The adult children leave their home region with greater frequency than their counterparts in El Jaimito [Table 2b]. In the depressed economic conditions of Las Auyamas, the youth's disaffection with agriculture has become particularly acute; however, in both sections, many young people consider farming a low status, dead-end occupation and aspire to non-agricultural employment. "*La juventud no quiere trabajar con machete*" and " *La juventud quiere manos limpios*" were the typical summations offered by senior members of the communities for young people's reluctance to engage in farm labor.[35] Judging from the author's field experience, a Las Auyamas farmer only slightly overstated his community's employment situation when he remarked " *De cada cien hay solamente tres o cuatro viejos todavia trabajando*"[36]

For peasant households which have to adapt to declining productivity and poor terms of exchange for their farm operation, out-migration and/or obtaining non-farm sources of income represent important forms of economic survival. In Las Auyamas, the lack of alternative employment

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34 Large family size may be discouraged if peasant parents realize that their children will leave the farm for the city as soon as they reach a working age.

35 " The youth do not like machete work " " The youth want to keep their hands clean". Both remarks disparagingly imply that the young people of today will not work hard for a living. Young adults respond that they are quite willing to work, if they receive proper compensation for their labors.

36 "Out of every one hundred people [in the community] only three or four old people are still working [in agriculture]".

opportunities, particularly during coffee's non-harvest season, encourages many residents to emigrate. In El Jaimito, on the other hand, a relatively dynamic and diversified regional economy better supports the local population, and in particular, young adults. In 69% of El Jaimito's peasant homes, at least one member of the family has a job which provides a non-farm source of income [n- 35]; and in 24% of El Jaimito homes, non-farm income represent the primary cash source [n-34].[37] In contrast, only 46% of Las Auyamas' peasant households obtain a non-farm source of income [n-26], and non-farm income provides the primary cash source for the household in only one of twenty six homes.

Similar to circumstances in the late 1940's, when declines in soil fertility made tobacco and peanut cultivation a non-viable, commercial enterprise, the contemporary situation of high food prices, low cafetal productivity and coffee market instability demands a transformation of the current Las Auyamas land use system. However, unlike the situation in the 40's, a large and disproportionate number of the most dynamic sectors of the population, young adults and middle class peasants, already have migrated out of the section. The aging population neither possesses the energy nor the ambition to reshape the agricultural economy of the region; or in the words of one farmer " *La tierra está cansada y tambien yo*".[38]

A significant share of El Jaimito's young adults farm or work as agricultural day laborers;[39] but despite the relatively greater optimism

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[37] Non-farm sources of income include; agricultural day labor, operating a pulperia or working as a petty intermediario. For peasants in El Jaimito, producing charcoal or working in the tourism industry provide additional employment opportunities.

[38] " The land is tired and so am I".

[39] El Jaimito's larger share of family land primarily represents young adult children working undivided family properties [Table 1e].

among residents about the willingness of local young people to continue in agriculture, access to farming careers for the area's younger population has become increasingly restricted [Table 2c]. Traditionally, conucos, with their short production cycle and high labor to land input ratio, provided the initial base for building a more diversified farm system. However, interviewees report that in recent times only farmers with relatively large expanses of "propiedad" [tree crop plantations and/or cattle] appear to be "making ends meet". Despite high food prices, the inflated costs of production and the greater suceptibility of annuals to catastrophic crop failure causes commercial food farming to remain a relatively high-risk enterprise. Particularly, young and still not firmly established farmers lack the resources to absorb a major shortfall in harvest profits.

Although food farming and establishing "propiedad" always has entailed great effort, contemporary young farmers face new and formidable challenges to building a stable future in agriculture, including;

* In the contemporary situation of greater dependence on a cash based economy and high inflation, the needs for a year-round cash supply have increased. The highly seasonal nature of farm income pressures young parents, with small children and limited savings, to work wage paying jobs rather than develop their own farm operations.

* The scarcity of land pushes aspiring young farmers to clear their conucos in the most remote and/or steeply sloped areas of the section. The isolation of these conucos increases between-parcel and home-to-parcel travel time, as well as raising the cost and risk of crop damage for transporting the harvest to market.

* Unlike the early years of swidden agriculture, farmers require considerable quantities of purchased fertilizers and herbicides to insure a

good harvest; the tendency for young farmers to have access only to the steepest or most degraded slopes exacerbates the problems of declining soil fertility and escalating input costs.[40]

Land Use

Table 3a represents the study's attempt to assess the changes in farmland use from 1983 to 1989 among the peasant sector of the land using population. The author only included non-brush and forested lands to estimate the various proportions of agricultural land uses on the actively farmed land of 1983. Grass/brush, for the purposes of comparison with the survey, was classified as "fallow". The author calculated the " '89 " columns by dividing the total areas of each land use, as reported by the interviewees, by the total property area surveyed. The "Use/Farm" column records the average proportion of each land use, thereby providing equal weight to each farm surveyed, regardless of property size.

A comparison of the '89 column with the Use/Farm column suggests that large farms tend to have a relatively greater proportion of their land area occupied by pasture and fallow lands, while small-scale farmers devote a relatively greater proportion of their farms to conuco and, to a more marginal extent, tree crops. To compare the 1983 land use map with the 1989 survey results, the study needs to account for the survey's sample bias of excluding absentee landlords. Based on field observation, the author assumed that improved and unimproved pastures, and to a lesser degree, tree crops, comprised the primary usage of properties held by absentee landlords. This assumption implies that the '89 column would particularly

[40] The price of a sack of fertilizer has increased 375% from the Fall of 1987 to the Fall of 1989.

Table 3 Land Use Profile

Table 3a:

Land Use	Ruy. '83	Ruy.'89	Ruy. Use/Farm	Jaim '83	Jaim '89	Jaim Use/Farm
treecrop	68%	74.8%	76.2%	34.2%	33%	37.7%
pasture	19.9%	15.8%	9.4%	19.7%	31.1%	17.3%
conuco	8%	8.7%	14.5%	9.9%	10.8%	26.9%
fallow	4.2%	.8%	0%	36.2%	25.1%	18.1%

Table 3b:

'89 vs. '79	Ruy. n	Ruy. >	Ruy. <	Ruy. =	Jaim. n	Jaim. >	Jaim. <	Jaim. =
conuco	n=12	3	7	2	n=27	6	20	1
pasture	n=0	*	*	*	n=16	13	3	0
treecrop	n=16	3	4	9	n=25	11	10	4

Table 3c:

Proportion of Farms With...	Treecrop	Pasture	Conuco	Fallow
Las Ruyamas n=26	100%	26.9%	88.5%	11.5%
El Jaimito n=35	77.1%	62.9%	88.6%	62.9%

under-represent pasture lands and over-represent conuco area, with a more modest over-representation of tree crop lands and under-estimation of fallow lands.

Given the study's assumptions, it appears that peasant land use in Las Auyamas remained reasonably stable during the 1983-1989 period, with perhaps a small decline in conuco and fallow area and a moderate increase in pastures. In El Jaimito, pasture area on peasant farms increased markedly with modest declines in conuco and fallow lands. In both sections, the proportion of peasant lands covered by tree crop plantations appears relatively unchanged. Table 3b shows the changes in land use made by sampled farmers on their own properties between 1979-1989. Although the sample sizes are small, the results support the study's interpretation of section-wide change during the 1983-1989 time frame.[41]

Summary: Las Auyamas and El Jaimito have similar physical characteristics, their populations share common cultural origins and in 1989, population densities were generally equivalent as well; but despite the close congruence of these key variables, peasant land use systems in the two sections widely differed. Las Auyamas peasants relied almost exclusively on coffee production to garner their subsistence. Only a small number of relatively prosperous peasants possess pasture, and given the minute proportion of fallow lands and the low level of inputs, the conuco grounds appear greatly overtaxed.

El Jaimito's peasant land use system, on the other hand, displays a well balanced structure. Instead of a reliance on one perennial crop,

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[41] The author neglected to collect data on changes in pasture area for Las Auyamas; only 7 of 26 farms surveyed had pasture lands.

peasants cultivate a wide variety of commercially valuable trees; the majority of farmers own at least some pasture lands, and the fallow to conuco ratio indicates a relatively viable, swidden-agriculture system. To understand why the two sections display such a wide disparity in peasant land use, the study analyzes the various components of the peasant land use system: tree crop, livestock, and food crop production.

Tree Crops

When Cibao valley colonizers migrated to the hills of El Jaimito, they brought with them coffee seedlings from their home region. Coffee, as a traditional Cibaeño crop, always formed a part of the colonia's polycultural farm sytems, but it was not until the 1970's, when the colonia provided support for coffee cultivation, that coffee production gained commercial importance. Despite El Jaimito's serious problem with La Roya and Las Auyamas' more suitable climate for coffee production, El Jaimito's younger cafetales out-produce those of Las Auyamas [Table 4a]. However, the poor prices received by El Jaimito farmers economically negates the greater productivity of their cafetales. Perhaps due to Samaná's great distance from the major coffee export warehouses of Santiago and Santo Domingo or the perceived inferior quality of coffee grown at low elevations, coffee buyers pay El Jaimito's farmers approximately 80% of the price offered in Las Auyamas. Local coffee prices dropped so low in 1989, that many farmers in El Jaimito decided not to harvest their cafetales.[42]

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[42] Table 4a used 1988 figures in those cases where farmers did not harvest their 1989 crop.

Table 4 Tree Crops Profile

Table 4a:

Cafetal Profile	Auy. n	Las Auyamas	Jaim. n	El Jaimito
Average age	n=21	29.1 years	n=16	14.3 years
Average Productivity	n=23	37 lbs./ta.	23	47lbs/ta.

Table 4b:

Soil Quality By Parcel	Las Auyamas n=17	El Jaimito n=21
Good	8.3%	32.4%
Average	43.7%	28.9%
Poor	28.8%	23.4%
A mix of soil qualities	19.2%	15.3%

Table 4c:

Primary Source of Farm Labor	Las Auyamas n=26	El Jaimito n=32
The family	69.2%	75%
Wage laborers	23.1%	18.8%
Equal parts family/wage	7.7%	6.2%

Table 4d:

Availability of Wage Labor	Las Auyamas n=20	El Jaimito n=19
Easily obtained	30%	78.9%
Nether easy nor difficult	10%	21.1%
Difficult to obtain	60%	0%

Table 4e:

Food Trees on the Farm	Las Auyamas n=25	El Jaimito n=34
None	0%	5.9%
1 to 3 varieties	68%	11.8%
4 or more varieties	32%	82.4%

Unlike their counterparts in Las Auyamas who appear paralyzed by the enormity of the coffee production problem, at the time of field work the younger, more energetic and more optimistic farmers of El Jaimito were wasting no time in converting diseased or unprofitable cafetales to, principally, pastures and/or cacao plantations.[43] Apart from the age and psychological makeup of the farmers themselves, three key factors help explain why El Jaimito peasants have a greater capacity for making a major transformation in their farm system, as demanded by the current crisis in coffee production;

1) The section's less degraded soils support a more diversified farming system [Table 4b]. El Jaimito farmers typically have more than one income generating agricultural operation, therefore during replacement of any one aspect of the operation, farm income continues. Furthermore, more fertile soils allow a greater range of alternative land uses; Las Auyamas farmers recognize that coffee represents one of the few crops that will consistently produce on their degraded soils, and are apprehensive about replacing their cafetales with alternative land uses.

2) In most peasant households, family labor handles the majority of farm operations [Table 4c], but major land use changes require more workers than a typical peasant family could supply on its own . While in El Jaimito,the availability of wage labor appears adequate, young adult out-migration in Las Auyamas, has created a shortage of agricultural workers [Table 4d].

3) Government enforcement of the tree-cutting ban, which deterred clearing

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[43] Although the market for cacao is more volatile than coffee, cacao can be harvested up to three times a year, and the trees have a longer productive life span and greater disease resistance than coffee bushes.

of unproductive cafetales in Las Auyamas, appears quite lax in El Jaimito. All cafecultores can obtain legal permission to clear La Roya infested cafetales, but El Jamito's farmers clear unprofitable, but healthy, plantations as well, and apparently, with little concern over possible legal retribution.[44]

After coffee and cacao, "caucho" and "cana" represent the two most important commercial perennials of El Jaimito. The Las Terrenas tourist industry highly values cana palm tree fronds for construction of thatched roofs. Because of current high prices for latex and continuous income provided by year-round tappings, local peasants valued caucho plantations above all other land uses.

Peasants cultivate a wide range of food producing perennials which are used primarily for subsistence purposes. Dispersed throughout the cafetales, cacaotales, pastures and conucos grow orange, coconut, grapefruit, avocado, breadfruit and a wide variety of other tropical, food bearing trees. As was true of the recently planted cafetales of Las Auyamas,[45] these relatively young, intercropped, perennials provide a substantial proportion of the household diet [Table 4e].

Livestock Production

Apart from livestock's important contribution to an otherwise protein-poor diet, farm animals symbolize wealth and financial security to the

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[44] The author speculates that the government has greater confidence in the potential of El Jaimito's agriculture for non-coffee crop production; and therefore, does not strictly enforce the tree cutting ban for the section's coffee growers.

[45] See discussion of 1958 Las Auyamas land use map.

Table 5 Livestock Profile

Table 5a:

There was/is more livestock...	Las Ruyamas n=22	El Jaimito n=29
When I arrived/was a child	90.9%	10.3%
Now	9.1%	17.2%
More cattle but overall, less livestock	*	72.4%

Table 5b:

Proportion of Farms With...	Pigs	Goats	Cattle	Mules	Poultry
Las Ruyamas n=26	35%	3.8%	23.1%	38.5%	88.5%
El Jaimito n=35	11.4%	20%	31.4%	42.9%	85.7%

Table 5c:

Cattle Production	Las Ruyamas n=26	El Jaimito n=35
Number of pasture owners	7	22
Number of cattle owners	6	11
Total number of cattle	32	80
Average herd size	5.3 animals per herd	7.3 animals per herd
Total area in pasture	361 tareas	1638 tareas
Pasture area per cow	11.3 tareas/animal	20.5 tareas/animal

Table 5d:

Meat Consumption	Las Ruyamas n=24	El Jaimito n=31
In good times we eat meat...	2.9 times per week	4.8 times per week
In bad times we eat meat...	1.1 times per week	2.2 times per week

Table 5e:

El Jaimito Cattle Prod. '79-'89	Increased	Decreased
Pasture area n=16	13	3
Numbers of cattle n=17	8	9

Dominican peasant. The number and type of livestock owned as well as the consumption of animal protein provide one of the best indices of a peasant household's economic status. Given the significance of livestock production on the traditional, diversified, small-scale farm, the practically universal perception, in both sections, that livestock numbers have decreased since the period of early settlement, suggests an overall loss of resilience in the peasant farm system [Table 5a].[46]

Unlike the situation with tree crops and annual food crops, the current status of small- farm livestock production in the two sections is quite similar [Table 5b]. At the time of field work, the quantity and variety of farm animals in no way reflected the great number and diversity of livestock that peasants raised on early-settlement era farmsteads. With the current high prices for milk, peasant families greatly value dairy cows; but the family milk cow, once a standard feature of practically every farmyard, now, rarely forms a part of the household economy. The vast majority of farmers continue to maintain a flock of poultry,[47] but only a minority have the service of a mule or pack horse; goats and pigs, once ubiquitous, have become relatively scarce as well.

Although the livestock situation in the two study areas share numerous communalities, several notable differences do exist. Most small-scale farmers lack the money to purchase cattle, nor possess enough property to pasture them; for the less well-off farmers, small farm animals provide a viable livestock production alternative. The greater incidence of

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[46] El Jaimito farmers distinguished between cattle and other livestock. 72.4% of the sample considered that cattle production had increased, but overall numbers of livestock had decreased

[47] Typically, these "poultry" flocks consisted of greater than 85% chickens , with turkeys and guinea hens comprising the remainder

pig husbandry in Las Auyamas and goat raising in El Jaimito reflects these section's relative availability of non-actively used land. The highly subdivided and fully occupied farm lands of Las Auyamas, provide few browsing areas for goats, which are difficult to manage and potentially quite destructive; pigs, however, remain confined in small dooryard pens, which suits the region's tight use of its agricultural space.[48]

Unlike the now eradicated "puerco criollo", which demanded little medical care and fattened on a diet of kitchen and agricultural wastes, the new "puerco gringo" requires grain supplements and more expensive vetinary attention. The relatively high incidence of pig husbandry in Las Auyamas, in spite of unfavorable terms of credit and increasing production costs, demonstrates the determination of some Las Auyamas farmers to reduce their dependance on coffee production.

Considering the great differences in pasture area and pasture ownership for the two sections [Tables 3a & 3c], the disparity in cattle owning farmers appears quite small. Only 11 of the 22 El Jaimito farmers with areas of pasture actually owned cattle, as opposed to 6 cattle owners among the 7 farmers who maintained pastures in Las Auyamas [Table 5c]. The El Jaimito cattle average 20.5 tareas of pasture per animal, while each Las Auyamas cow subsisted on an average of 11.3 tareas per animal; however, a small sampling of opinion indicated that the more productive pastures of El Jaimito will support a cow in good health with just 4-15 tareas, while Las Auyamas interviewees claimed that, to properly fatten a steer in their region, requires at least 20-40 tareas of pasture. While cattle owners

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[48] Although the two section's had similar population densities, the large proportion of Las Auyamas covered by cafetales, many of them owned by absentee landlords, creates a land shortage for all other agricultural uses.

of Las Auyamas attempted to maximize the use of their limited areas of pasture and perhaps, overgrazed their lands, pasture lands in El Jaimito have as much a speculative as a productive purpose.

Apart from land speculation and colonia land tenure procedures, which implicitly support pasture expansion, the great number of El Jaimito farmers with unutilized or under-utilized pastures reflect the local perception of cattle production as a secure and sustainable activity. Pasture degradation has not arisen as a serious problem; but the experience of Las Auyamas would suggest, that as pastures age and stocking rates increase, ranching may not persist as a stable and attractive activity in the future.

On small farms, raising poultry represents the most important animal husbandry activity. Poultry efficiently convert plant nutrients to animal protein and their small size, low cost and rapid rates of reproduction make them well adapted for peasant farming systems. Among the Dominican peasantry, poultry provide the least expensive and most widely consumed source of meat.

The mean flock size, for those 23 Las Auyamas farms with poultry, averaged 13.4 birds per farmstead; and to help support that relatively large flock, 11 of those 23 poultry owners cultivated maize for chicken feed.[49] Maize production rapidly degrades hillside soils[50] ; for farmers to devote a significant share of their depleted conucos to provide only a fraction of the annual feed requirements of their poultry, indicates the value Las Auyamas

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[49] El Jaimito flock size averaged 12.3 birds, but 2 of the largest property owners in the survey owned 37% of the poultry recorded in the sample . To get a sense of the average flock of a small-scale farmer, the mean average, when calculated without these two exceptionally large flocks becomes 7.2 birds per flock.

[50] Apart from intercropping beans between the rows of maize, which provides some soil protection, farmers use little or no soil conservation measures. Typically, maize rows run up and down the slope.

peasants place on their flocks.[51] Unlike the majority of El Jaimito farmers who produce a wide range of food crops and can afford to buy meat on a regular basis, Las Auyamas farmers subsist primarily on a monotonous, low-protein diet of rice, boiled banana and yucca [Table 5d]. The meat and eggs from their poultry provide variety and nutrition to their diet, and farmers will sacrifice a great deal to maintain a viable, sustainable, flock size. Confronted with the low productivity of their subsistence-providing conucos and the low profitability of their income-generating cafetales, Las Auyamas farmers were intent upon preserving what remained of their livestock production system.

Livestock ownership among the sample population declined dramatically over the 1979-1989 period. In both sections, the pig population, a victim of the 1980 eradication campaign, suffered the greatest losses. El Jaimito's goat herd declined rapidly as well, with increasing population densities and the rising value of conuco production, goats became a greater nuisance. The tendency of El Jaimito peasants to concentrate their homesteads along the Sanchez-Las Terrenas highway created a powerful vector for the rapid spread of deadly poultry diseases; highway traffic takes a regular toll on the poultry population as well. In both sections, and particularly in those <u>parajes</u> most closely accessible to major, lowland, urban areas, poultry thievery has become a serious deterrent to production[52] [a geographical fact, which makes the author less than enthusiastic about the

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[51] Currently, Dominican peasants do not eat maize; feeding a relatively high-protein content grain, like maize, to fatten poultry is an inefficient way to produce protein for human consumption.

[52] The city of Santiago, in the case of Las Auyamas; and the Las Terrenas tourist complex,in the case of El Jaimito.

increasing integration of the Dominican hill lands with modern, urban society].

Cattle ownership in El Jaimito provided the one notable exception to the general decrease in livestock numbers over the decade. Despite consistent increases in pasture area among the El Jaimito sample, the number of farms that increased their cattle herd was approximately equal to those farms which experienced declines [Table 5e]. These mixed results appear to display yet another manifestation of the section's ongoing polarization of peasant society.[53]

Generally, the middle to upper strata of peasant society have maintained or increased their livestock operations; while the smaller-scale farmers have experienced the greatest declines. When the author asked small-scale farmers why they did not own more animals, most provided a long list of reasons including the high costs of feed, difficulty in obtaining credit, increasing disease problems and the need to use expensive vaccines, thievery, limited access to grazing land, etc., but many simply stated " *Vamos abajo*" ["We are going downhill"] or " *Ahora la situación está más crítica*" [Our situation has become more critical]. If livestock production provides a good index of economic integrity, than declines in livestock numbers indicate that the always fragile existence of the poor majority has become even more precarious.

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[53] Refer to the discussions on El Jaimito's land tenure structure.

Table 6 Conuco Profile

Table 6a:

Destination of Conuco Prod.	Las Ruyamas n=23	El Jaimito n=31
Subsistence for the home	95.7%	25.8%
Primarily for the market	4.4%	64.5%
Primarily for the home	0%	9.7%

Table 6b:

Desire to Increase Food Production	Las Ruyamas n=26	El Jaimito n=28
"I don't want to increase"	19.2%	7.1%
"I don't have the resources to increase"	11.5%	0%
"I would increase commercial production"	3.8%	7.1%
"I would increase subsistence production"	53.8%	46.4%
"I would increase for both home & market"	11.5%	39.3%

Table 6c:

Number of Crops per Conuco	1 or 2	3 or 4	5 or more
Las Ruyamas n=23	30.4%	39.1%	30.4%
El Jaimito n=31	19.4%	29%	51.6%

Table 6d:

Conuco Productivity Trends	Las Ruyamas n=12	El Jaimito n=20
Increasing	8.3%	5%
Decreasing	83.3%	65%
No consistent trend	8.3%	30%

Table 6e:

There was/is more conuco...	Las Ruyamas n=26	El Jaimito n=35
When I arrived/ was a child	92.3%	74.2%
Now	3.8%	25.8%
Same now as it was before	3.8%	0%

Table 6 Conuco Profile [Continued]

Table 6f:

Conuco Area Changes '79-'89	Las Auyamas n=12	El Jaimito n=27
Increased	25%	22.2%
Decreased	58.3%	74.1%
The same	16.7%	3.7%

Table 6g:

Conuco Profile	Las Auyamas n=26	El Jaimito n=35
Avg. share of property in conuco	14.6%	26.9%
Avg. area of conuco(s)	7.6 tareas per farm	16.3 tareas per farm

Table 6h:

Conuco Intensity	Avg. n	Las Auyamas	Jaim n	El Jaimito
Avg. # of years conuco worked	n=14	3 years	n=22	2.1 years
Avg. # of years conuco fallowed	n=19	1.2 years	n=26	3.1 years
Years worked/Years fallowed	n=13	1.82	n=20	.57

Table 6i:

Destination of Conuco Prod.	Las Auyamas n=23	El Jaimito n=31
Subsistence for the home	95.7%	25.8%
Primarily for the market	4.4%	64.5%
Primarily for the home	0%	9.7%

Table 6j:

Ag.Chemical Use on Farms w/Conuco	Las Auyamas n=23	El Jaimito n=31
Synthetic Fertilizer Use	21.7%	61.3%
Herbicide Use	0%	58.1%
Fertilizer & Herbicide Use	0%	45.1%

Conuco Production and Food Consumption

Before selecting El Jaimito as a research site for this comparative study, the author visited the area. Initially, he assumed that El Jaimito had experienced a longer period of agricultural occupation than Las Auyamas. Apart from the Samaná region's long history, this assumption was based on field observations of the section's complex, conuco polycultures, which closely resemble peasant, hillside farms found in those areas of the Caribbean with a long tradition of hillside agriculture. Unlike the monocultures or simple polycultures found among Las Auyamas conucos, El Jaimito's food gardens were richly diverse. During the course of subsequent field work, the author discovered that the greater diversity of the El Jaimito conucos demonstrated a less degraded condition of the farm land, as opposed to differences in farmers' cultural traditions. Of the surveyed El Jaimito conucos, two of the finest examples of traditional Caribbean food gardening belonged to brothers who had immigrated from Las Auyamas.

In winter of 1990, the author spoke with a Canadian geographer and member of the "Uso del Suelo" project team, who had recently visited the two study areas. This colleague discussed his initial impressions of the two sections and remarked over the relative prosperity among the El Jaimito peasantry. Without a long-term evolutionary perspective, a rapid assessment may fail to question the sustainability of currently profitable land uses. This thesis interprets the present, relatively optimistic, situation of El Jaimito's peasantry as a transient stage in a larger evolutionary process, which if allowed to continue unimpeded, promises a limited future for small-scale agriculture.

If in a peasant society, livestock indicate wealth and financial security, than conucos represent subsistence and survivability. Even as peasant agriculture becomes further integrated to the global, market economy, subsistenc food production plays a vital role in providing vigor and stability to rural communities. A viable, local capacity for food production provides insulation from the negative impacts of perturbations on the national and international markets.

The majority of the peasant, household budget is spent on food purchases. If farm families provide a substantial share of their diet from home production, a larger proportion of the profits earned from the commercial aspects of the farm operation becomes available for satisfying needs other than basic subsistence. For example, small-scale farmers in El Jaimito, generally, raise less meat-producing animals than their Las Auyamas counterparts;[54] but since they spend a smaller share of their food budget on basic staples, they can afford to eat meat more often. [Tables 6a & 5d].[55]

Declining conuco production and out-migration interact in a positive feedback cycle which undermines the entire hill land, peasant economy. Not only may reduced opportunities for conuco farming help precipitate young adult out-migration, the shortage of agricultural labor which results from out-migration, in turn, reduces the viability of labor-intensive conuco farming. The survey questioned farmers regarding their willingness to take commercial advantage of current high food prices or at least, reduce their dependence on expensive purchased foods [Table 6b]. Las Auyamas

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[54] Since peasants lack refrigeration, beef cattle have a primarily commercial purpose.

[55] Rice, beans and cooking oil comprise the great majority of food purchased. Meat constitutes another major food cost, but peasants consider it a luxury item.

peasants, in explaining their reluctance to engage in commercial food farming, noted that this enterprise requires a strenuous, year-round labor commitment, which would not be possible given current deficiencies in the agricultural work force.

Probably a more significant deterrent than the shortage of labor, the depleted condition of their land, has discouraged many Las Auyamas farmers from making a serious attempt to increase food production. The range and types of crops grown on a conuco indicate its soil quality. Table 6c shows that El Jaimito conucos on average produce a much greater array of crops.[56] Conuco diversity provides a more varied, and typically, more balanced diet, as well as more consistent year-round production.[57] Table 6c actually under-represents the disparity in conuco fertility between the study areas because it does not indicate the types of crops grown. Yucca and sweet potato tolerate nitrogen poor soils, and will grow on soils where most other crops fail; 6 of the 7 conucos in the Las Auyamas sample with two or less crops grew yucca, or yucca and sweet potato. In contrast, 5 of the 6 El Jaimito conucos with 2 or less crops grew yautía, or yautía and plantain, both commercially important crops that require fertile soils.[58] In El Jaimito, yam cultivation represents a major commercial activity; but since the degraded soils of Las Auyamas will not support yam cultivation, only one farmer in the sample cultivated yams.

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[56] In some cases farmers would have more than one conuco; Figure 21c does not distinguish among individual parcels belonging to the same farmer.

[57] The most common annual, food crops in the two sections are; yucca [cassava], yautía, yam, maize, beans, sweet potato, plantain, pigeon pea, and auyama [pumpkin squash]. Peasants usually plant banana, which represents the principal " home grown" staple for both regions, in non-conuco areas of the property.

[58] Yautía has a greater protein to weight content than either yucca or sweet potato (INCAP-ICNND, 1961).

For both study areas; conuco productivity [Table 6d], food crop production [Tables 6e & 6f] and the area of land available for fallow [Figure 12 & Table 3a], have declined. Given the overall downward trends for non-perennial, food crop agriculture, it becomes understandable that peasants in the region with a shorter history of land use [El Jaimito] would:

1) have a greater proportion of their farms occupied by conuco [Table 6g]
2) fallow their conucos with greater frequency [Table 6h], and;
3) have a greater capacity for commercial food crop production [Table 6i].

Nutrition: If conuco and livestock production have declined one might predict that the level of nutrition would decline also; 21 of 23 informants in Las Auyamas and 25 of 27 in El Jaimito agreed that the nutritional status of their respective communities have deteriorated significantly from the standards that prevailed during the 1950's and 1960's. It follows, from the study's evolutionary perspective, that residents from the region of more recent settlement would be better nourished; as evidenced by the El Jaimito sample population's greater consumption of meat, as well as the section's higher productivity and variety of food bearing trees and conuco crops [Tables 5d, 4e & 6b].

Sustainability: Although all food production indicators appear to point downward, the few differences in opinion among the interviewees disclosed several central issues regarding the sustainability of conuco agriculture. Among the El Jaimito sample, 25.8% judged that the section's current expanse of conuco area had never been greater [Table 6e]. Interviewees, who held this minority opinion, assessed that although conuco production currently plays a less important role in the region's more diversified,

agricultural economy, population growth and the expansion of commercial food farming have led to a continuing rise in conuco production. Farmers, who disagreed with this minority opinion, responded that even if the land area occupied by conucos may have marginally expanded, the decline in yields more than offsets the increase of area. Those who insisted that conuco production had risen, claimed that the increased use of synthetic fertilizers has compensated for the loss of organic soil fertility.

Although, the use of purchased fertilizers has become commonplace in El Jaimito and particularly, for conuco farming, fallow rotations continue to form an indispensable component of the food production system. After a conuco has completed its active production cycle, farmers often convert it to pastures or tree crop plantations. Over time, this land use sequence significantly reduces the availability of land for the conuco/fallow rotation.

In both sections, the majority of farmers confirm that, due to declining land availability, frequency of fallow has decreased from the 2 years of cultivation/ 4 years of fallow rotation, which apparently was standard practice at the time of early settlement. Table 6f supports the preceding interpretation, but 4 of the 12 El Jaimito farmers surveyed asserted that fallow periods have increased, and 4 of 7 Las Auyamas farmers reported that fallow times have either increased or remained constant. These informants observed that as soils become depleted they require a longer period of fallow recuperation before they restore their capacity to produce an economically viable harvest. More than calendar age, the height of colonizing vegetation indicates whether land has fallowed sufficiently. Poor and or landless peasants often feel compelled to clear inadequately fallowed land; and frequently, their efforts are rewarded with an almost complete failure of the harvest.

The peasants of El Jaimito have encountered a conuco production dilemma, which in Las Auyamas, first became serious during the early 1960's; how to adapt to the combined effects of declining soil fertility and the reduced availability of fallow. Peasants utilize four primary options to cope with this situation, they may:

1) Reduce the period of fallow, which maintains production for the short-term, but undermines the land's long-term agricultural capacity. Those interviewees who suggest that fallow time is on the increase, provide an indication of the biological limitations of this option.

2) Convert conuco land to more soil conserving, perennial, land uses; namely pasture or tree crop production. Farmers in both sections have used this strategy, which in large measure, accounts for the current shortage of fallow area. In Las Auyamas, the process has reached its ultimate conclusion. Some farmers in El Jaimito reported that in the last five years, there appears to be a further shift away from conuco production toward tree crops and pastures.

3) Cultivate crops that tolerate less fertile soils.

4) Increase their use of synthetic agrochemicals in order to substitute for the recuperative effects of the fallow.

Agricultural Technology: The advancement of agricultural technology has allowed farmers world-wide to reduce or eliminate fallows without sacrificing yields. Soil conservation engineering and irrigation has enabled traditional, hillside farmers to engage in highly productive, permanent agriculture. In more industrialized societies, synthetic agro-chemicals represent the key tool for maintaining yields on annually cultivated fields.

In the two study areas, however, farming technology has progressed remarkably little; farmers rely on the same machete, pick and shovel that their grandfathers used to farm their conucos. The author observed no substantial soil conservation structures or irrigation works in either section. Synthetic fertilizers have been available since the 1950's; but due to their high cost, peasants tend to restrict their use to conuco production.[59] The exceedingly poor condition of the soils and the non-commercial purposes of their conucos, probably explain why Las Auyamas farmers use agrochemicals so sparingly. Rather than take the chance of wasting expensive fertilizers on an unproductive conuco, they resort to the cultivation of less soil demanding crops, most importantly, yucca. In marked contrast to Las Auyamas, the majority of sampled conuco farmers in El Jaimito applied synthetic fertilizers or herbicides [Table 6j].

Agrochemical use in El Jaimito has steadily increased over the last ten years. In the past, farmers used fire as an effective tool to clear bush fallows. With shorter fallow time, tenacious grasses have colonized the fallow cycle, and increasingly, farmers turn to herbicides to effect their removal. El Jaimito's increasing reliance on agro-chemicals represents a general trend away from self-reliance and toward a greater dependance on the market, a trend that has disturbingly close parallels with the process which has impoverished Las Auyamas.

The decline in conuco production has diminished the independence and self-sufficiency of the Las Auyamas peasant economy, the increase of commercial conuco farming threatens to do the same in El Jaimito. Typically, small-scale peasants rely on loans to finance the cost of seed, agrochemicals,

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[59] Steep slopes and the lack of soil conservation efforts cause considerable run-off, which reduces the effectiveness of fertilizer applications.

labor and other inputs required to grow food on a commercial basis. Normally, the terms of credit dictate the crop to be grown as well as its method of cultivation. The traditional, polyculture, conuco provides a good vegetative, ground cover which helps protect fragile, hillside soils and spreads the risk of crop-specific pest or disease damage among a variety of cultivars. However, peasants who " *trabaja con el banco*"[60] cultivate their cash crops in monocultures in order to maximize yields and insure that every ounce of financed agrochemical is applied exclusively on the crop for which the loan was intended. The pressure to repay crop loans leads to a heavy reliance on synthetic agro-chemicals to protect these vulnerable monocultures from catastrophic crop failure.

The case of yam production illustrates how commercial food farming draws peasants into a greater dependance on agrochemicals,credit and the vagaries of the market. At the time of fieldwork, yams commanded a high market price and credit for its cultivation was readily available from both intermediarios and the government's Banco Agricola. Due to the relatively high production cost of yam and its great commercial value, peasants sell practically all of their harvest. Although yam represents a major cash crop for the region, it comprises a very minor portion of the household diet. Like coffee production, yam cultivation represents an almost purely commercial activity; but while coffee bushes conserve the soil, traditional yam cultivation causes tremendous soil erosion (Wilson, 1976).

While credit is available, prices remain high and soils respond to fertilization,yam cultivation provides peasants a lucrative opportunity.

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60 " Work with the bank"

However if prices decline, agrochemical costs increase or soils become excessively depleted, the edifice collapses.

Summary: Horticulture [conuco] constitutes a vital element for sustaining the total, hill land, farm system. The decline in the availability and productivity of land for food farming causes hill land peasants to increasingly rely on an inflationary market for; 1) food purchases to supplement subsistence needs, and/or 2) agro-input purchases to maximize production on those few areas which remain available for horticulture. Furthermore, restricted access to suitable conuco lands, and increasing costs of production, have discouraged many young adults from pursuing a career in farming. The exodus of young adults from hill lands represents a loss of vital social energy. A study of land use history reveals that the ability to adapt to change is essential for maintaining a healthy, hill land, peasant economy. If the peasant community loses its young people, becomes over-reliant on the market and strapped by excessive debt, it has a diminished capacity to endure difficult periods of transition, and successfully respond to socio-economic and agro-ecologic change.

Conclusion

This thesis proposes that the Dominican hill lands experience similar phases of land use. While affirming the universality of hill land use evolution, the study recognizes that; 1) local, historical events [e.g. the construction of a highway, a pest infestation etc.], and 2) more macro-phenomena [e.g. high food costs, international trade policies etc.] which may

differentially effect local regions depending on their stage in the evolutionary cycle, will alter the specifics of each hill land area's unique land use chronology. The study provides evidence that the two study area's substantial differences in contemporary land use result, in large part, from their distinct terms of agricultural occupation. In this conclusion, the study offers a broader theoretical perspective on the changes in land use detailed in the body of the thesis.

Land Use Evolution in the Dominican Hill Lands

During the early settlement phase, colonizing farmers employ flatland farming systems, which are poorly adapted to hill land environments. Despite ecologically abusive methods of cultivation; abundant land, fertile soils and the energetic enthusiasm of a pioneering generation foster productive and self-reliant farming communities. Population growth and the further integration of hill land communities with the broader cash economy, magnify the social pressures for agricultural production. Farmers, who have little or no tradition of hillside agriculture, lack the technical skills and resources to meet these increased demands without over-exploiting their soil resource.

The combination of social demands for increased production and declining soil productivity creates a rapidly changing socio-ecologic context for making appropriate land use adaptations. The study rejects the stereotype of an inflexible peasantry; the small-scale farmers of the two study areas have demonstrated remarkable flexibility in responding to new challenges. However, the rapidity of economic and environmental change

overwhelms the slower process of adaptation and development of more intensive, yet sustainable agricultural systems.

While open lands remain available, farmers merely expand their area under cultivation to achieve greater production.[61] As available land becomes fully occupied, farmers resort to shortening their length of fallow; and/or more recently, increasing their use of agro-chemicals. Reduction of fallow without additional inputs or new techniques results in declining yields; and over-reliance on agro-chemicals creates market dependencies which most peasants can not sustainably support. Hill land peasants, who must operate on the margins of the political economy; require a high-yielding agriculture which:

1) Conserves the fertility of the land base.
2) Primarily utilizes locally available resources.

The successful, Third World examples of hillside agriculture have taken traditional farmers many generations of experimentation and adaptation to perfect. Since Dominican hill land peasants lack the skills or resources to develop more intensive, sustainable land use systems at a pace sufficient to match socio-ecologic changes, they must depend on alternative adaptive strategies, including:

1) Replacement of crops which demand fertile soils with other cultivars that tolerate degraded soils [e.g. replace plantain with yucca]
2) Conversion to less intensive uses [e.g. conuco to pastures or improved pastures to extensive tree crop production]

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[61] Long-time residents of the two study areas recall that property sizes increased when more market-based economics supplanted the colonizer's original, subsistence-based system.

3) Obtaining additional off-farm sources of income[62]
4) Enduring the declines in their standard of living
5) Emigration.[63]

The study's findings contradict a popular conception of Dominican hill land peasants as reckless exploiters of the landscape. Although they have failed to develop a high yielding and sustainable agricultural system, hillside farmers have made a series of strategic retreats from more intensive forms of agricultural exploitation to land uses better adapted to the reduced fertility of their land. Over time, the process of land use evolution has changed from being propelled almost solely by the social needs of the farmer and the market to a system that increasingly, is driven by the ecological needs of a diminished soil resource.

As farmers move away from labor-intensive, land-conserving conuco production, toward less labor-intensive, land-utilizing, pasture and extensive tree crop production; the per-hectare capacity of the hill lands to provide local nutritional needs and employment declines. Eventually, Dominican hillside farmers establish ecologically-sustainable, farming systems; but the low yielding systems that emerge from the "strategic retreat" method of agricultural adaptation do not sustain large populations. The old cafetales of Las Auyamas provide excellent soil protection for the mountainous landscape, but as the section's massive exodus suggests, they fail to support the average peasant household. The expansion of pasture lands in El Jaimito, temporarily, may represent an ecologically benign form of development, but it certainly carries a high social cost for the region's poor majority.

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[62] Interviewees of both study areas most frequently identified employment as the most acute need of their communities.

[63] Many peasant households employ all five of these strategies.

Recommendations

If we return to the metaphor of forest succession, it becomes clear that the challenge for hillside farmers and development practitioners lies in developing a farming system that mimics the sustainability of the mature, climax forest without completely sacrificing the productivity of the younger stages of succession. By combining useful, woody and non-woody species in temporal and spatial patterns that optimize beneficial crop interactions, agroforestry represents a promising approach for bridging the gap between sustainability and productivity. "Agroforestry" is the label applied to this relatively new science, but the techniques that this new discipline researches and advocates have their basis in traditional farming systems. Dominican hill land peasants incorporate agroforestry principles throughout much of their farm operations; therefore, an agroforestry approach to improve these farms would build on a strong base of indigenous knowledge.

The ability of young cafetales to produce a wide array of tree crops and fiber products should serve as an excellent model for an agroforestry-based development program. For example, Las Auyamas cafetales once yielded ample quantities of banana, avocado, orange, breadfruit, mango and many other useful perennial crops, as byproducts of the coffee production system. The loss of these trees to disease, old age and excessive shade represents an important decline in subsistence capacity, as well as a loss of potential income.[64] The national government, in its efforts to maintain coffee export earnings, provides credit for coffee cultivation; but little

[64] Currently, oranges, mangos, and avocados receive a high price on the streets of Santiago.

attention is paid to the total farm system, which inevitably supports the coffee production process by providing the cafecultores broader dietary/economic needs.

In El Jaimito, farmers and policy makers alike, should view the section's relatively healthy, agro-ecologic condition as an opportunity to implement changes that will insure sustainable agricultural production; rather to assume that all is well with the farming system. Government-aided expansion of caucho cultivation provides a promising example of the former attitude; however, lending policies which offer credit for agro-chemicals to boost commercial horticulture without taking needed steps to conserve the soil resource, represents a disturbing example of the latter.

When seeking solutions to the problem of sustaining the productivity of fragile hill lands, policy makers might explore the possibility of transferring traditional technologies from those regions of Latin America with a long experience in hillside agriculture, rather than automatically adopting technologies developed for the industrialized, flatland, farming systems of the developed countries. Certain methods of organic fertilization and slope management practiced by the highland natives of Guatemala, for example, may provide small-scale farmers of El Jaimito techniques for sustaining yields, without becoming ensnared by a dependance on inflationary agro-chemicals (Wilken, 1987 & 1989). However, agricultural prescriptions alone will not insure the long-term sustainability of small-scale hillside agriculture. If the government continues to overlook hill land regions when allocating resources for social services, or if additional sources of wage employment fail to materialize, hill land communities will have a difficult time retaining their young people. Without a stable group of young

farmers, the regional agricultural system lacks the flexibility to adapt to modern changes.

Concluding Comment

Four primary enquiries form the basis of the systems approach to problem solving; How did we get here? Where are we? Where are we going? and Where do we want to go? (Edens, 1989). The study of land use evolution offers more complete answers for the first three questions than regional analyses that fail to include a historical perspective. The final question is a political one, and a question which the foreign author has little right to answer-but will do so nevertheless.

Despite many descriptive details contained in this thesis, the author failed to mention that Las Auyamas and El Jaimito are exceptionally beautiful places. In most cases, the small-scale farmers of these areas do not want to leave. Government priorities and policies can help insure that these proud, hardworking folks remain in their hill land homes; or on the other hand, pressure the majority to leave. El Jaimito and Las Auyamas could play host to cattle, real estate merchants and vacation home owners; or could support communities of independent small-scale farmers. The author could cite statistics on urban unemployment, or declining national food production to support his view that hill land campesinos should be assisted in their efforts to stay on their farms; but in this matter, the author's conviction has an emotional basis and not a scholarly one.

APPENDIX

Questionnaire

* - Optional question

Introduction

a) Do you farm?
b) Do you have another job as well?
c) Do you own this house
d) Where do you get your drinking water? How far from the house?

Conuco

1.1) Are you working a conuco?
1.2) Is it rented, your own property, sharecropped...?
1.3) How many tareas is it?
1.4) What do you have growing there now? ...And other parts of the year?
1.5) When did you last fallow the plot?
1.6) For how long did you rest the land ? or; How much of the conuco is in fallow now?
1.7) Are you fallowing your conuco more or less than previously?
1.8) Do you plant crops in your conuco in sections or intercropped?

Kitchen garden

1.9) You have a kitchen garden?
1.10) What do you have growing there?

The parcels

2.1) How many parcels do you have? Does that include the conuco?
2.2) How many tareas and what distance from the house is each one?

For each parcel:

2.3) Do you own the land or is it rented, sharecropped...?
2.4) Is the parcel in pasture, tree crops, fallow...?
*2.5) How old are your coffee trees?
*2.5.1) What other useful plants do you have in the coffee plantation?

And in the rest of the farm?

2.6) How would you judge the soil quality; good, average, poor...?

2.7) The parcel is in what type of terrain; flat, rolling, steep...?

The property

2.8) Do you own the land or is it rented, sharecropped...?

*2.8.1) [If you had no land before] What were you doing then?

2.9) Did you buy this land, or was it inherited from your parents?

*2.9.1) What year did you buy the land?

*2.9.2) Was your parents land split up among their children? How much land did your parents have? How many children did they have?

For each cultivar:

3.1) Is it grown for the market or the home?

3.2) What was your production in the last harvest?

*3.3) [If for home consumption] For how long are you harvesting this crop once it has matured?

*3.3.1) During harvest time, how often are are you eating this crop?

*3.4) How long are you able to maintain stores of this crop?

3.5) The last harvest was normal, good, poor...?

*3.5.1) Why?

3.6) Through the years your production is relatively stable, declining, improving...?

3.7) What price did you receive in the last harvest? and the year before?

3.8) Whom did you sell to; the corner store, an intermediary...?

*3.9) Did you have to sell a part of your harvest on the stalk?

*3.10) Have you had to sell on the stalk before?

Changes in farm land use

3.11.1) Do you have more or less conuco land now or before?

3.11.2) " " " " " " pasture land " " " ?

3.11.3) " " " " " " tree crops " " " ?

For each type of animal:

4.1) How many of them do you have?

4.2) " " did you have 12 months ago?

4.3) " " have been born in the last 12 months?

4.4) " " have you sold in the last 12 months?

4.5) At what price did you sell them?

4.6) To whom did you sell them to; the butcher, an intermediary...?

4.7) How many animals did you have 10 years ago?

4.7.1) Why the change during this time? or Why don't you own more animals now?

The family

5.1) How many children do you have? Males? Females?
5.2.1) How many of your children are living with you now?
5.2.2) Are there other relatives or friends that are also living in the house?
5.3) Are any of your children living in the community and working here with you on the farm?

Farm and household tasks (family and hired labor):

5.4.1) Who prepares the conuco?
2) Plants?
3) Weeds, clears brush?
4) Applies fertilizer and pesticides?
5) Harvests?
6) Sells the harvest and animals?
7) Tends the animals?
8) Slaughters the animals?
9) Tends the kitchen garden?
10) Tends the children?
11) Cooks?
12) Keeps house?
13) Fetches water?
14) Looks for firewood?

Employees

6.1) The majority of farm work is done by family labor or hired help?
6.2) Is it fairly easy to find agricultural laborers for hire in the area?

Household economy

7) Does anybody else in the family live here on occasion, or send money to the house?
7.1) Where do they live?

For each person in the household:

7.2) Do he/she know how to read and write? or Is he/she going to school?
7.2.1) Where is the school? At what distance from the house?
7.3) Does he/she hire out to do agricultural work on other farms?
7.4) Does he/she have some non-agricultural rural employment?
7.5) Does he she have a job in the town? Which town?
7.6) Is he/she not working?
7.7) Where do the other children live?

Income

8.1) What is the most important source of income for the home: the harvest from your land, earnings from off-your-farm employment, or money that is sent to the house?

8.2) Does your income cover your costs?
8.3) What do you do when your income does not cover your costs?
8.3.1) If necessary, where can you go to get a loan?

Nutrition

9.1) Of the foods produced on the farm; what do you eat the most?
9.2) What foods do you buy?
9.3) Of purchased foods; what are those that you spend the most money for?
9.4) How many times a week do you eat meat; In good times? In hard times?
9.5) Do you produce the majority of your own food or do you have to buy the greater part?
9.6) Apart from food; what is the most important household cost; medicine, wages for workers, clothes...?

History

For the male and female heads of the household and their parents:

10.1) Where were you born?
10.2) [If not born here] When did you arrive to the area?
10.3) Why did you come here?

Standard of living:

11.1) When you arrived in the area,(or when you were a child) how many houses were there?
11.2) How was the life back then?...nutrition?.... the community?....etc.
11.3) And now how is it?

Land use evolution

12.1) When you arrived (or when you were young), were the farms the same size as they are now?
12.2) Was there more conucos?
12.3) What crops did you plant? Did people grow cultivars that are no longer planted around here?
12.4) Was there more or less land planted in tree crops?
12.4.1) In what years did the people plant unusually great amounts of perennials (coffee for example)?
12.5) Were there more or less animals back then?
12.6) Was there more or less pasture?
12.7) When was the last of the virgin forest cleared in this area?
12.8) Did the streams have more or less water?

Demographic evolution

13.1) During what period was there the greatest amount of people around here?

*13.2) If there were more people before, when did they begin to migrate from here?

*13.3) Are there more people leaving now than ever?

13.4) Where do they go?

13.5) Who are (were) these folks; the youth, the landless...?

13.6) Do those who leave sell their land?

13.7) Have you yourself thought of leaving? Why?

13.8) What makes you different from those who have already left?

Land market

14.1) Is there land in the area to buy, rent, or sharecrop?

14.2) Have you sold land? If so why?

14.3) What is a tarea of land selling for around here?

14.4) Why don't you buy land?

14.5) Can you obtain credit for land purchases?

14.6) Why don't you rent or sharecrop more land?

14.7) Who is buying land; small farmers, large ranchers, city folks...?

14.8) Are there large land owners around here, people that have over 500 tareas?

14.9) How much pasture, tree crop land, and conuco does a family like yours need to live decently?

Agricultural practices

15.1) What agricultural tools do you use?

15.2) Have the agricultural techniques that you use changed over time?

15.3) Which of the following technologies do you use?

a) Do you buy seed?
b) Do you plant along the contour?
c) Terraces, barriers, hillside ditches...?
d) Apply fertilizer?
e) " pesticide?
f) " herbicide?

*15.4) Why are you not using soil conservation methods?

Information systems

16.1) Where can you obtain agronomic advice; the radio, an agronomist, neighbors...?

16.2) How often does an agronomist pass by? Are they helpful?

16.3) Is there a producer's association? Is it useful?

16.4) How do you know the price of your crop before making a sale?

16.5) How often do you travel to town in a normal month?

16.6) Why do you go to the city and how do you travel?

The future

17.1) Since food prices are rising, are you planning on increasing your food production?

17.2) Would you be growing food for the market or principally for home use?

17.3) Do you think the youth will continue working in agriculture?

17.4) If the campesinos would receive help, what would they need to increase their agricultural production?

17.5) More generally, what is lacking in the community to improve the overall quality of life so the youth might like to remain?

BIBLIOGRAPHY

Abreu, Alfons, Manuel Cocco, Carlos Desprapel, Eduardo Garcia Michel & Arturo Pequero. (1989). Las zonas francas industriales en la República Dominicana: El éxito de una política económica. Santo Domingo: Centro de Orientación Economica.

Amigo del Hogar. (1986). "El café y la cuchara grande de los monopolios". Amigo del Hogar. Año 45, No. 469.

Antonini, Gustavo. (1968). Processes and patterns of landscape change in the Linea Noroeste, Dominican Republic. P.H.D. dissertation, Columbia University, N.Y.C.

Antonini, Gustavo. (1971). Peasant agriculture in Northwestern Dominican Republic. The Journal of Tropical Geography. Vol. 32

Antonini, Gustavo, Katherine Ewel & Howard Tupper. (1975). Population and energy: A systems analysis of resource utilization in the Dominican Republic. Gainesville: University Presses of Florida.

Augelli, John. (1962). Agricultural colonization in the Dominican Republic. Economic Geography. 38. (1).

Avery, Thomas & Graydon Berlin. (1985). Interpretation of aerial photographs. Minneapolis: Burgess Publishing.

Bebbington, Anthony & Judith Carney. (1990). Geography in the International Agricultural Research Centers: Theoretical and practical concerns. Annals of the Association of American Geographers. 80. (1).

Blakie, Piers & Harold Brookfield (Eds.). (1987). Land degradation and society. N.Y.C.: Methuen & Co..

Bremer, Jennifer, Tony Babb, Joshua Dickinson, Peter Gore, Eric Hyman & Madaline Andre. (1984). Fragile lands: A theme paper on problems, issues, and approaches for development of humid tropical lowlands and steep slopes in the Latin American region. Washington D.C.: Development Alternatives.

Browder, John. (Ed.). (1989). Fragile lands of Latin America: The search for sustainable development. Boulder CO: Westview Press.

Brush, Stephen. (1976). Andean culture and agriculture: Perspectives on development. In Hill Lands: Proceedings of an International Symposium. Morgantown: West Virginia University Books.

Bueno, Angela. (1990). Employee of I.A.D. Proyecto A.C.N. 87 Majagual, Las Terrenas. Interview by author, 1 December.

C.E.U.R.. (1989). Descripción del "Uso del Suelo" proyecto. Unpublished mimeograph.

C.E.U.R.. (1989). Selección area de estudio del "Uso del Suelo" proyecto. Unpublished mimeograph.

Campbell, David. (1990). A population-resource problem?. The CASID Connection, 5, (3). E. Lansing: Center for Advanced Study of International Development.

Carabello de Rosa, Elsa. (1985). Estudio de políticas de promoción de exportaciones de productos agropecuarios no tradicionales. Unpublished mimeograph.

Casley, Dennis & Krishna Kumar. (1988). The collection, analysis, and use of monitoring and evaluation data. Baltimore: John Hopkins University Press.

CEDOPEX. (1987). Boletin Estadistico Exportaciones En.-Dic. 1986. Santo Domingo: CEDOPEX Centro de Documentación.

CEDOPEX. (1989). Boletin Estadistico Exportaciones En.-Dic. 1988. Santo Domingo: CEDOPEX Centro de Documentación.

Censo Nacional Agropecuario. (1950). San Cristobol: Dirección General de Estadística.

Censo Nacional Agropecuario. (1960). Santo Domingo: Oficina Nacional de Estadística.

Censo Nacional Agropecuario. (1971). Santo Domingo: Oficina Nacional de Estadística.

Censo Nacional Agropecuario. (1981). Santo Domingo: Oficina Nacional de Estadística.

Censo Nacional de Población y Vivienda. (1935). Santo Domingo: Dirección General de Estadística.

Chambers, Robert. (1985). Shortcut methods of gathering social information for rural development projects. In Michael Cernea (Ed.). Putting people first. New York: Oxford University Press.

Croes, Edwin. (1985). Las estrategias economicas de los poderes mundiales para Centroamerica y El Caribe. Santo Domingo: Editora Taller.

Crouch, Luis. (1981). The development of capitalism in Dominican agriculture. P.H.D. dissertation, University of California at Berkeley.

De Chiara, Luigi. (1989). Nel paese dei parchi industriali. Terra Nuova: Forum 6, (15-16). Rome: Terra Nuova.

Demorizi, Emilio Rodríguez. (Ed.). (1973). Samaná, pasado y porvenir. Santo Domingo: Editora del Caribe.

Denevan, William, (1983). "Adaptation, variation and cultural geography." The Professional Geographer, 35, (4).

Denevan, William. (1989). The geography of fragile lands in Latin America. In John Browder (Ed.). Fragile lands of Latin America: The search for sustainable development.

DeWalt, Billy. (1985). Microcosmic and macrocosmic processes of agrarian change in Southern Honduras: The cattle are eating the forest. In Billy Dewalt and Pertti Pelto (Eds.). Micro and macro levels of analysis in anthropology: Issues in theory and research. Bouder CO: Westview Press.

D.G.E.. (1945). Mapa de la República Dominicana. Santo Domingo: Dirección General de Estadística.

Donkin, R.A. (1979). Agricultural terracing in the aboriginal New World. Viking Fund Publications in Anthropology no. 56. Tuscon: University of Arizona Press.

Dore Cabral, Carlos. (1986). El debate sobre la reforma agraria: Notas para una propuesta de estudio. Ciencia y Sociedad, 11, (4). Santo Domingo: Instituto Technologico de Santo Domingo.

Duarte, Isis. (1980). Capitalismo y superpoblación en Santo Domingo: Mercado de trabajo rural y ejecito de reserva urbano. Santo Domingo: U.A.S.D.-C.O.D.I.A..

Duarte, Isis. (1986). Trabajadores Urbanos. Santo Domingo: Talleres Graficos U.A.S.D.

Durland, William Davies. (1922). The forests of the Dominican Republic. Geographical Review, (12).

E.P.I.C.A.. (1979). Jamaica: Caribbean challenge. Washington D.C.: E.P.I.C.A. Task Force.

Eckholm, Erik. (1975). The deterioration of mountain environments. Science. 189.

Edens, Thomas. (1990). Professor of Resource Development and Entomology, Michigan State University. Personal communication.

Echavarria, Fernando. (1990). "Quantifying tropical deforestation in the Huallaga River Valley of Peru". Paper presented at the annual meeting of the Association of American Geographers. April 19-22, Toronto.

Erickson, Clark & Kay Candler. (1989). Raised fields and sustainable agriculture in the Lake Titicaca Basin of Peru. In John Browder (Ed.). Fragile lands of Latin America: The search for sustainable uses.

Fournier, Luis & Fernando Arturo Russell. (1987). "Uso del suelo y degradación ambiental en la zona occidental de la República Dominicana en el periodo 1972-1986". Paper presented at Seminario sobre teledetección, sistemas agrarios y degradación ambiental. June 19-21, Puerto Plata, D.R.

Fria, Benito. (1989). Government agronomist for the Municipío of Las Terrenas. Interview by author, 8 December.

Geilfus, Frans. (1986). Agricultores marginales y manejo de recursos naturales en Republica Dominicana. Medio Ambiente Caribeno, 2.

Geilfus, Frans. (1986a). Documentos Tecnicos para el Plan de Conservación en el Valle de Tireo. R.D. Unpublished mimeograph.

Geilfus, Frans. (1989). "La agricultura campesina". Paper presented at the October meeting of the Consenso Agrario- Foro Urbano, Santo Domingo.

Gómez, Carmen. (1987). Consideraciones sobre la situación nutricional de la población Dominicana. Poblacion y Desarollo. 6, (17). Santo Domingo: I.E.P.D.

Gómez,Carmen, Quitero Cedeño, & Antonio Tatis. (1987). Población rural y ecosistemas. Población y Desarollo. 6, (17). Santo Domingo: I.E.P.D.

Guerrero, Ramón Arturo. (1985). El hombre del campo: Presente y futuro. Amigo del Hogar. Año 44, No. 458.

Hartshorn, Gary, et al.. (1981). The Dominican Republic: Country environmental profile. McLean, VA: JRB Associates.

Hoetink. H.. (1982). The Dominican people 1850-1900: Notes for a historical sociology. Baltimore: John Hopkins University Press.

Hernandez, Luis. (1989). Bittersweet coffee. Grassroots Development. 13 (2).

Hiciano, Rafael. (1989). Government agronomist for Pedro Garcia area. Interview by author, 7 November.

Hills, Theo & Stanley Iton. (1983). A reassessment of the "traditional" in Caribbean small scale agriculture. Caribbean Geography. 1, (1).

Hoy. (29 November,1989). "Exportaciones de ZF serían de 580 millones". Hoy, Santo Domingo.

I.A.D.. (1981). Estudio de la realidad campesina y sus alternativas de desarollo. Santo Domingo: Instituto Agrario Dominicano

I.A.D.. (1979). Programa de consolidación de la reforma agraria: 1979-1982. Santo Domingo: Instituto Agrario Dominicano.

INCAP-ICNND. (1961). Food composition table for use in Latin America. Bethesda MD: National Institute of Health.

Juan del Rosario, Pedro. (1987). "Economica rural en la Republica Dominicana: Una nueva vision de los problemas agrarios". Paper presented

at Seminario sobre teledetección, sistemas agrarios y degradación ambiental. June 19-21, Puerto Plata, D.R.

Juan del Rosario, Pedro. (1989). Economica rural en la Republica Dominicana: Una nueva vision de los problemas agrarios. eme eme, 15, (83). Santiago R.D.: U.C.M.M..

Leonard, H. Jeffrey. (1987). Natural resources and economic development in Central America: A regional environmental profile. New Brunswick: Transaction Books.

Liogier, Alain. (1982, 1983, 1985, 1986). La flora de la Española, vols. I-IV. San Pedro de Macoris: Ediciones de la Universidad Central del Este.

Listin Diario. (July 29, 1989). "Las zonas francas en gráficos". Listin Diario, Santo Domingo.

Madruga, José Manuel. (1986). Azucar y Haitianos en la República Dominicana. Santo Domingo: Ediciones M.S.C.

Maguire, Andrew & Janet Brown. (Eds.). (1986). Bordering on trouble: Resource management and politics in Latin America. Bethesda MD: Adler & Adler.

Mejia, R. Hipolito. (1989). "Producción y consumo de alimentos en la República Dominicana". Paper presented at the July meeting of the Consenso Agrario- Foro Urbano, Santo Domingo.

Moquette Ortiz, Santiago. (1984). Estudios e informes de la CEPAL: La agricultura campesina y el mercado de alimentos: El caso de Haiti y el de la República Dominicana. Santiago de Chile: U.N. Publications.

Mosher, Lawrence. (1986). At sea in the Caribbean. In Andrew Maguire and Janet Brown (Eds.). Bordering on trouble: Resource management and politics in Latin America.

NARMA. (1981). "Natural Resources Management" (NARMA) project proposal for A.I.D. funding. Unpublished mimeograph.

Nations, James & H. Jeffrey Leonard, (1986). Grounds of conflict in Central America. In Andrew Maguire and Janet Brown (Eds.). Bordering on trouble: Resource management and politics in Latin America.

O.A.S.. (1967). Reconicimiento y evaluación de los recursos naturales de la República Dominicana: Estudio para su desarollo y planificación. Washington D.C.: Organization of American States.

O.A.S.. (1984). Integrated regional development planning: Guidelines and case studies from O.A.S. experience. Washington D.C.: Organization of American States.

O'Ferrall, Andréa. (1989). Tourism and agriculture on the North Coast of the Dominican Republic. Masters Thesis, Michigan State University, E. Lansing.

Olivo, Mercedes Mata, Dulce María Olivo & Graciela Paredes R.. (1986). Sanchez: Cien años de vida municipal. Sanchez: La Comisión de Historia.

Olson, Jennifer. (1989). The impact of changing socioeconomic factors on migration patterns in Rwanda. Masters Thesis, Michigan State University, E. Lansing.

ONAPLAN. (1989). Perspectivas de la economia dominicana para el periodo 1989-1992. Santo Domingo: Secretariado Técnico de la Presidencia: Oficina Nacional de Planificación.

Plunkett, D.J.. (1976). Hill land agriculture in the humid tropics. In Hill Lands: Proceedings of an International Symposium. Morgantown: West Virginia University Books.

Posner, Joshua. (1982). Cropping systems and soil conservation in the hill areas of Tropical America. Turialba. 32 (3).

Posner, Joshua & Malcolm McPherson. (1982). Agriculture on the steep slopes of Tropical America: Current situation and prospects for the year 2000. World Development. 10, (5).

Reiners, W.A.. (1983). Disturbance and basic properties of ecosystem energetics. In H.A. Mooney and M. Goodron (Eds.). Disturbance and ecosystems. N.Y.C.: Springer Verlag.

Ricart, Pedro Thomes. (1972). La economia del hato en la Española. eme eme, 1, (2). Santiago R.D.: U.C.M.M..

Richards, Paul. (1989). Agriculture as a performance. In Robert Chambers, Arnold Pacey, and Lori Ann Thrupp (Eds.). Farmer first: Farmer innovation and agricultural research. London:Intermediate Technology Publications.

Riley, Elizabeth, Rita Mena, José Guerrero & Andrés Duahajre. Impacto económico de las zonas francas industriales de exportación en la República Dominicana. Santo Domingo: Consejo Promotor de Inversiones de la República Dominicana.

Rocheleau, Dianne. (1983). An ecological analysis of soil and water conservation in hillslope farming systems: Plan Sierra, Dominican Republic. P.H.D. Dissertation, University of Florida, Gainesville.

San Miguel, Pedro Luis. (1987). The Dominican peasantry and the market economy: The peasants of the Cibao, 1880-1960. P.H.D. Dissertaton, Columbia University, N.Y.C..

Sanchez, Pedro. (1976). Properties and management of soils in the tropics. N.Y.C.: Wiley Press.

Sanchez Roa, Adriano. (1989). Campesinos, crisis agropecuaria e inflación. Santo Domingo: Editora Corripio.

Santos, Blas. (1980). El Plan Sierra: Una experiencia de desarollo rural en las montanas de la Republica Dominicana. In A. Novea and J. Posner (Eds.) Agricultura de ladera en America Tropical. Turialba: CATIE.

Santos, Blas & Inmaculada Adames. (1987). "Aspectos económicos y socio-culturales del manejo de cuencas". Paper presented at Seminario sobre desarollo de pequeñas cuencas hidrográficos. Nov. 30, Santiago R.D..

Sauer, Carl. (1966). The Early Spanish Main. Berkeley: University of California Press.

Sauer, Carl. (1981). Selected Essays 1963-1975. Berkeley: Turtle Island Foundation.

S.I.E.D.R.A.. (1980). Uso potencial de la tierra: Evaluación del recurso suelo en la República Dominicana. Santo Domingo: Dept. de Inventario, Evaluación y Ordenamiento de los Recursos Naturales.

Schomburgk, Robert. (1853). The peninsula and bay of Samaná in the Dominican Republic. In Emilio Demorizi (Ed.). Samaná, pasado y porvenir.

Smith, Meredith, Jose DeMoya & Blas Santos. (1986). "The Celestina: The impact of a social forest on food consumption and nutrition in the Dominican

Republic". Paper presented at the 1986 Farming Systems Symposium: Kansas State University, Manhattan, Kansas.

Stern, Steve. (1982). Peru's Indian peoples and the challenge of spanish conquest. Madison: University of Wisconsin Press.

Stocking, Mike. (1987). Measuring land degradation. In Piers Blakie and Harold Brookfield (Eds.). Land degradation and society.

Strahler, Artur & Alan Strahler. (1984). Elements of physical geography. third edition. N.Y.C.: John Wiley & Sons.

Treacy, John. (1989). Agricultural terraces in Peru's Colca Valley: Promises and problems of an ancient technology. In John Browder (Ed.). Fragile lands of Latin America: The search for sustainable uses.

Vandermeer, John. (1990). "The impact of public policy on deforestation in Eastern Nicaragua". Paper presented at Environment and Development Symposium. May 6 & 7, E. Lansing, Michigan.

Vargas-Lundus, Rosemary. (1988). Peasants in distress: Poverty and unemployment in the Dominican Republic. (Lund Economic Studies no. 43). Lund, Sweden: Universitetsforlaget Dialogos.

Warman, Arturo. (1981). Tenencia y uso del suelo: Una vision historica. In A. Novea and J. Posner (Eds.). Agricultura de ladera en America Tropical.

Wilken, Gene. (1987). Good farmers: Traditional agricultural resource management in Mexico and Central America. Berkeley: University of California Press.

Wilken, Gene. (1989). Transferring traditional technology: A bottom up approach for fragile lands. In John Browder (Ed.). Fragile lands of Latin America: The search for sustainable uses.

Williams, Robert. (1986). Export agriculture and the crisis in Central America. Chapel Hill: University of North Carolina Press.

Wilson, L.A..(1976). Some general problems of soil erosion of disturbed lands in the Caribbean. In Hill lands: Proceedings of an international symposium.

Yunén, Rafael. (1985). La isla como es: Hipotesis para su combrabación. Santiago R.D.: U.C.M.M. Publications.

Yunén, Rafael, Pedro Juan del Rosario, Helmut Schmorgmayer & Fernando Arturo Russell. (1987). "Deforestación y campesinado". Paper presented at the Reunión Anual del Distrito 406, Club Rotary International. May 2, Puerto Plata, R.D..

* Maps produced by Cheryl L. Hurley at the Center for Cartographic Research and Spatial Analysis, Michigan State University.