Migrants, Dairy Farmers and Agricultural Land-Use in the Humid, Tropical Hillsides of Northern Honduras

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Introduction

Deforestation in Central America appears to have declined in recent years but is nevertheless continuing, particularly in the poorest countries of Guatemala, Honduras and Nicaragua. El Salvador has less than 12% of its territory remaining in forest, most of it severely degraded (Utting 1990, p. 1). Kaimowitz (1995, p. 11) estimated that deforestation in Central America in 1990 was around 300,000 ha, down from 400,000 ha at the end of the 1970s. At current rates, Central America will have lost its remaining forest by the middle of the next century (ibid.) Accurate information on land use after clearing forest is not available, but Kaimowitz estimated more than half of the deforested area has been converted to cattle pasture (Kaimowitz 1995, p. 6).

Literature on deforestation in Central America generally cast the peasant farmer in the role of a perpetual nomad. Landless farmers were held to descend on the forest, cultivate an area for two or three years by means of slash and burn agriculture, and, once the soil was exhausted, sell it to a rancher for pasture land. (Parsons 1976; Leonard 1987; Myers and Tucker 1987; Nations 1992). This was usually referred to as "migratory agriculture."

Poverty was almost certainly the main driving force behind deforestation in Honduras, although deforestation was generally begun by the search for valuable hard woods. Migrant farmers commonly followed logging roads deep into forest zones, slashing and burning trees in order to produce food crops on small forest plots. Many of these small farmers eventually sold the "improved" land to cattle ranchers. In a few cases, large landowners hired wage or contract labor to clear forests on land appropriated for cattle-grazing. In both cases, the end product was pasture-creation. These processes were common throughout Central America (Nations 1992; Leonard 1987; Parsons 1976).

Honduras was one of the poorest countries of the region, and had one of the highest birth rates. Population was estimated to be 5.2 million in 1993, up from less than 3 million in 1974, and representing a 3.65% annual increase (SECPLAN 1989, p. 40).[1] While birth rates had been declining in urban areas, the fertility rate was still around seven children per woman in the countryside (SEDA 1993, p. 14), and approximately 60% of the population was rural (SECPLAN 1989, p. 42).

Rural-urban and urban-urban migration accounted for 25.9% and 31.7%, respectively, of internal migration (Bilsborrow 1991, p. 8). Migration to urban centres contributed to the high rate of growth of the urban population. Between 1974 and 1988, urban rates of growth were 5%, compared with 2.8% in rural areas (SECPLAN 1989, p. 40). Rural-rural migration (28.6% of migratory flows) and urban-rural migration (14.1%) (Bilsborrow 1991, p. 8), accounted for the tremendous increase in the number of population centres. Between 1961 and 1988, 1,426 new villages with more than 100 inhabitants *(aldeas)* and 15,268 new hamlets with less than 100 inhabitants *(caseríos)* were established (SECPLAN 1989, p. 41). The new settlements included

[1]Based on SECPLAN's revisions of the 1988 census, population growth was estimated to be 2.8% between 1974 and 1988 (Plan de Accion Amiental 1993). Based on Banco Central de Honduras (1991) and Hernandez Cruz (1992), Walker et al. (1992, p. 11) projected that population will decline between 1988 and 2000, resulting in a 2.75% annual rate of increase. In this study, the annual rate of 3.65% was used for 1974 to 1988.

land-reform communities, mainly in frontier lands in the north and east, and spontaneous settlements formed by migrants in forests and other uninhabitated zones.

Rural poverty was due largely to inequality in access to land and inappropriate land use. Approximately 80% of the land in Honduras was designated as appropriate for forestry use only (SECPLAN 1989, p. 135) because it was too steep for farming and soils were poor (SEDA 1993, p. 44). Although 2.8 million ha were classified as agricultural land, almost 4 million ha were being farmed. This difference of 1.2 million ha was largely steep hillsides classified as appropriate for forestry (SEDA 1993, p. 45).

Inappropriate land usage was associated with the unequal distribution of land. Ninety percent of the land designated as agricultural was in the hands of 10% of the producers. The remaining 90% of the farmers had to share what was left or use non-agricultural land (SECPLAN 1989, p. 140). Cattle raising accounted for an estimated 80% (3.2 million ha) of land being farmed (SECPLAN 1989, p. 114), indicating that a large portion of land designated as arable was being used for pasture. Thousands of poor, rural families had no option but to migrate to hillside areas ill-suited for agriculture. The very unequal distribution of land was a critical factor in environmental degradation occurring in Honduras.

This study describes the processes of migration and land use change in an area of northern Honduras that was undergoing forest-to-pasture conversion. The study was of an area of spontaneous settlement in the hillside forests in the north coastal region of Honduras (Figure 1). This was one of the remaining areas of broadleaf forest in Central America. The study sites were in River Cuero and River Santiago watersheds, partially forested upland catchment areas in the Atlantic Littoral. The objective was to illuminate how the processes of migration and changing land use affected forest cover. In addition, information collected provided background for a participatory research project on agricultural technology.

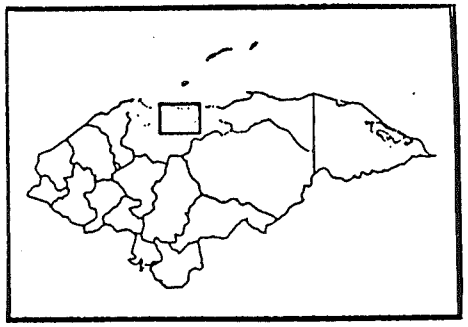
Methods

Site Selection

It was hypothesized that migration from western to lower-lying eastern areas of the region was a central component of the process of forest-to-pasture conversion in Central America. It was planned to have research focussed both in areas of expulsion and attraction in order to grasp, and to try to arrest, this destructive dynamic which was integral to understanding the problem of Central American rural development and conservation (Leonard 1987; Nations 1992; Parsons 1976; Utting 1991, Kaimowitz 1995). The Atlantic Littoral hillsides represented an area of attraction undergoing active deforestation.[2] Four additional criteria were used in site selection.

[2] The decision to locate research in the Atlantic Littoral hillsides of Honduras was the outcome of a meeting in August 1992 of a Central American hillsides consortium comprising CATIE (Centro Agronómico Tropical de Investigación y Enseñanza), CIAT, CIMMYT and IICA.

ATLANTIC LITTORAL OF HONDURAS



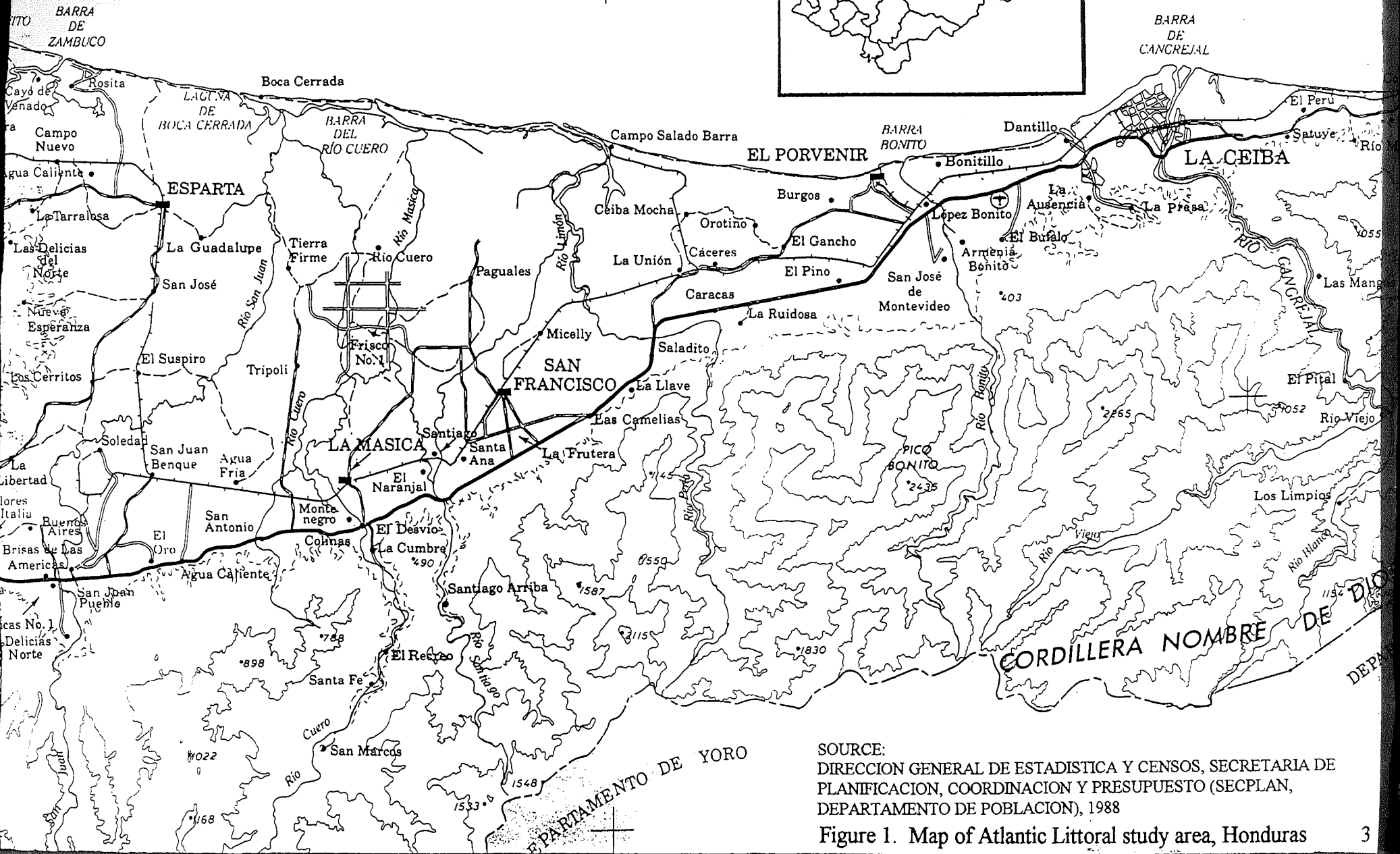


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Figure 1. Map of Atlantic Littoral study area, Honduras

First, institutional presence at the study sites was deemed essential. The presence of a COHDEFOR/CIDA bilateral project in the Atlantic Littoral hillsides was considered a positive factor in the provision of project support. The Proyecto de Desarrollo de Bosque Latifoliado (PDBL) was distributed in ten integrated management areas (AMIs) along the length of the Atlantic Littoral hillsides, and had personnel resident in each area. The project had been primarily concerned with forestry management and, later, agroforestry management, so a space for collaborative agricultural, as well as agroforestry, research was clearly provided. One of the sites selected, Rio Cuero, was an AMI. Rio Santiago was not, although the Santiaguito Woodcutter's Cooperative, a chapter of the larger Atlantic Littoral woodcutters' cooperative (COATLAHL), provided some local organization. The community was not receiving agricultural support.

A second criterion was a range of rainfall zones. The Atlantic Littoral hillsides, with average rainfall between 2,000-3,300 mm/a, represented a heavy rainfall regime. Nevertheless, rainfall is distributed in a bimodal pattern with a fairly distinctive dry season between February and May. This generally accords with the range of precipitation regimes set by CIAT for inclusion in its definition of "well-watered hillsides" (Carter 1991).

A third criteria was to include moderately acid soils. Although the Atlantic Littoral is assumed to have very low pH soils (PDBL 1991, p. 11), soil samples taken in the two watersheds of the study area were generally not very acidic. The lowest pH value was 5.2, obtained from a plot that had been cultivated, with fallow, for 40 years. The highest pH value was 7.3 from a plot which had been used for 14 years and recently planted with a mucuna cover crop. The large amounts of calcium contained in the organic matter were thought to explain the lower-than-expected pH. Long-term use could lower organic matter content and the pH of the soils.

The final criterion for site selection was relatively easy accessibility. It should be pointed out that frontier zones are not generally easily accessible. Nevertheless, sites within an hour's drive from La Ceiba with access routes were chosen. The 8-km road to the first community in the Rio Cuero site, El Recreo, was generally accessible year-round, although torrential fall rains washed out parts of the road from time to time. The municipality was in the process of extending the road to the community of San Marcos, another 6 km into the watershed. The community of Santiago Arriba in the Rio Santiago watershed was a few kilometers from the main La Ceiba-San Pedro Sula highway, at an elevation of less than 100 masl (meters above sea level), and was accessible year-round.

The Rio Cuero and Santiago watersheds lay adjacent to one another within the buffer zone of Pico Bonito National Park. Despite their close proximity, they represented two different dynamics. Rio Cuero was undergoing heavy in-migration and deforestation. In contrast, Rio Santiago had virtually closed itself off from in-migration by actively preventing incursions by migrants into the communal forest. Nevertheless, the cooperative had not been able to prevent cattle owners from buying privately-owned lands in order to sow pasture. In Rio Cuero, the conversion to cattle pasture was occurring more rapidly because ranchers had greater access to already-cleared land because of the much larger migrant population which was resident there. The different nature of the deforestation dynamic in the two cases was regarded as a positive factor in site selection since it allowed for a better understanding of the forest-to-pasture conversion process.

Collection of information

Data were collected using semi-structured interviews conducted between August 1993, and March, 1994, in the Cuero watershed of the Atlantic Littoral of northern Honduras. Semi-structured interviews involve use of a determined number of items the interviewer wishes to cover, while allowing the respondent to initiate discussion at any time around areas of interest. The interviewer evokes discussion around topics of interest so that information flows freely without the informant feeling that he/she is being subjected to a rigid set of questions. The ease with which conversation flows allows for constant interjection of the informant's ideas and goals. This approach demands more of the interviewer than the administration of a questionnaire and, if not performed carefully, can result in uneven information sets.

The decision to use this approach was based on the desire to ascertain the farmers' concerns and their views of opportunities for change. The study was intended as a precursor to a participatory research project. Had research funding for the participatory research project been in place, a community diagnosis of research problems would have been appropriate. Lacking long-term funding at the time, we felt a community diagnosis would raise community expectations unduly. Semi-structured interviews enabled us to chat with individuals and gather information. In each case, we explained that we hoped to use the information gathered to prepare a proposal for a participatory research project.

The second reason for selecting a semi-structured interview approach was to try to make information collection as unobtrusive as possible, so that people engaged in illegal deforestation activities would feel less threatened and more willing to discuss a variety of issues with us. Only a very small number of individuals refused to talk to us.

During the course of the interviewing in 1993 and 1994, we formed two farmer experiment teams (CIALs) in Santiago Arriba and El Recreo, notwithstanding the lack of long-term funding. The reason for the change of strategy was the offer of bean germplasm for testing from the Department of Agronomy of the Escuela Agrícola Panamericana at El Zamorano. Bean production, we had learned from discussions with farmers, was one of the key problem for local producers. All farmers mentioned the problem of plant disease *("hielo")* in bean cultivation. Because farmers always chose the highest and steepest slopes to grow beans in an effort to minimize fungal disease, it appeared that bean production was the cause of a good deal of erosion. With community approval and community selection of farmer teams, we began a limited form of participatory research in October 1993.

Selection of households and respondents

Information gathered in interviews in the first two communities located in the Cuero and Santiago watersheds was exploratory. Subsequently, a comprehensive set of interview topics was organized for interviews in the communities of Santa Fé and San Marcos. These interviews, which totalled 128, have been used in the analyses given below. When comparable information was available from the first two communities, for example on migration and landholdings, it was incorporated in the analyses. For information based on all communities, the sample size was 186.

The number of people residing in the watersheds was unknown,[3] so informants were selected according to geographical location. We tried to cover as wide a geographical range of households as possible and to include households from all the different community "neighbourhoods" and hamlets. This was particularly important in the case of San Marcos, because the population was spread among a number of hamlets in the upper watershed. Such an approach made it more likely that both newer and older migrants would be included because older migrants were often located closer to the community centres than newer arrivals. Because a census of the communities was not available, the percentage of the population interviewed is unknown. We estimate that close to half of the households in the communities were in our sample.

We attempted to interview heads of households, and did not restrict interviewing to male heads of households. On average, males were better informants about land-use than women. Men were more involved in cropping and land clearing than women. Women were more likely to be involved in small livestock production. This was consistent with other studies in Central America (Karremans, Radulovich and Lok, 1993). Our preference was to talk to male heads of the household, but we also talked with women and other adults.

Description of study sites

The watersheds of Rio Cuero and Rio Santiago

The Atlantic Littoral region of northern Honduras was one of the remaining zones of tropical or broadleaf forest in Central America. The tropical forest area is located on the steep, ocean-facing slopes of the mountain chain, the Cordillera Nombre de Dios, which runs parallel to the Atlantic coast. This chain is interrupted by numerous water courses which carry the runoff from the heavy rains down towards to the ocean, producing a series of steeply-sloped watersheds, running south to north, along the coast. The coastal plain itself was largely deforested except in a few protected areas close to the coast.

The Rio Cuero and Rio Santiago watersheds were situated on the western flank of Honduras' largest national park, Pico Bonito. The park covered an area of 107,300 ha, of which 53% fell within a demarcated buffer zone region (Rodríguez 1992, p. 31). Economic activities in the two watersheds were conducted mainly within the park's buffer zone. Recent changes to park legislation had allowed for logging inside that part of the nuclear zone which bordered on the upper reaches of the Cuero watershed. Activities within the buffer zone were to conform to certain land use guidelines, but there were no controls in place to enforce specific patterns of land usage. Slash-and-burn agriculture and cattle ranching were taking place within the buffer zone. In the area of the Cuero watershed, the buffer zone was slowly advancing towards the virgin tropical forests of the park's nuclear zone.

In the lowest reaches of the watersheds, forest could be found as low as 100 masl, and, in the case of Rio Cuero, rose to 1,600 masl (PDBL 1993). This area encompassed Humid Tropical Forest (0-200 masl), Very Humid Subtropical Forest (200-800 masl) and Very Humid Sub-Tropical Low Montane Forest (800-1800 masl) (Rodríguez 1992). The lower forest areas and large sections of the medium-altitude forests in the watershed areas

[3] The results of the 1993 agricultural census were not available at the time of the study.

had been destroyed through cutting and burning for agricultural use. Nevertheless, in the Santiago watershed there was forest cover on large sections of hillside to the east of the river which was situated within close proximity of the community.

A study by the PDBL (1993, p. 3) in the Rio Cuero watershed provided information on the distribution of slopes (Table 1). Information on slope distribution was not available for Rio Santiago.

Table 1. Slope distribution, Rio Cuero watershed, northern Honduras (PDBL 1993).

Slope, %	Area, ha	Area, %
0-10	382	2
10-30	2,164	13
30-50	4,232	26
50-75	4,733	30
75-100	2,678	17
> 100	1,886	12
Total	16,975	100

The geographical pattern of land-use was the same in both watersheds. The communities occupied land close to the rivers. Land nearby, covering slopes around 0-30%, was increasingly dedicated to pasture. Agriculture, mostly for the production of maize and beans, and some rice, was situated on more steeply-sloped lands, sometimes reaching 100%. In Rio Cuero, only 15% of the land had a slope below 30% slope and could be considered to have an agricultural land-use capacity. PDBL concluded that, on slopes of between 30 and 50%, agroforestry or agriculture with conservation practices was permissible where the soil was sufficiently deep (60-100 cm). Agroforestry could also be practiced on slopes of up to 75% where deeper soil conditions permitted (PDBL, Mapa de Capacidad de Uso, Rio Cuero). Thus, according to the PDBL study, agricultural and agroforestry activities could be practiced over a wide area of the watershed.

The Study Communities

The main communities in the hillside areas of Rio Cuero were El Recreo, Santa Fé and San Marcos. To reach El Recreo it was necessary to take an 8-km mountain road from the entrance to the lowland town of La Masica, on the main La Ceiba-San Pedro Sula highway about 50 km west of La Ceiba. Santa Fé and San Marcos lay above El Recreo in the watershed. Sante Fé was on the western side of the river and was less accessible because of problems in crossing the river at certain times of the year. "San Marcos" referred to a community as well as a collection of hamlets around the tributaries of the Cuero river: San Marquitos, Quebrada Galana, Quebrada Zacatalosa, Quebrada El Pital and Quebrada El

Cacao. Some of the hamlets, such as El Destino, El Manchón, El Higuerito and Betania were far enough away to be considered villages in their own right. The latter three were many hours walk from the road and were not included in the study (Figure 1).

The three main communities in the Rio Cuero uplands each had primary schools with two to three teachers in each. Poor teaching conditions, isolation, and low pay tended to make the teachers' attendance at the schools less than full-time. Because Mondays and Fridays were usually used for travel, the scholastic week was generally only three or four days. Finding replacements for teachers had proven to be slow. El Recreo had recently received a second teacher after three years of having only one teacher for 100 students, which had led to a forced reduction in enrollments.

Santa Fé was the first community in Rio Cuero with a school. It had begun more than 30 years earlier with students from the three communities. Some informants in San Marcos had studied, and learned to read and write, through radio. The school in Santiago was built in the 1970s by CARE. In 1993, it had approximately 50 students with one teacher in attendence for all six grades. All the older members of the original settler families in the watershed were illiterate.

Settlement patterns in the two watersheds were affected by the desires to be close to services, most importantly schools, and to have access to the outside for the sale and purchase of goods and medical services. This had produced a nucleated pattern of residence. The earliest migrant families often inhabited the village centre and newer arrivals lived further afield. As migration into the Rio Cuero watershed was increasing, new arrivals and the offspring of earlier settler families were going further and further into the upper watershed in the hope of gaining access to their own land. Some of the older migrants who had come over the mountains from Yoro also inhabited distant hamlets. Other families continued to live within one of the three main communities to be close to schools but "owned" land in the upper watershed and commuted between the two. Thus it was not possible to describe the communities according to residence period in the watershed. Santiago Arriba, the only community in the upper Santiago watershed, had a much older, settled population descended from two settler-families who had arrived in the 1930s and 1940s. Most families in Santiago lived close to one another on community-owned lots.

In 1994, land in both watersheds was held in usufruct; i.e., it was not legally titled land. In many cases, those who had cleared the land had purchased a private document naming them as the usufruct holder. These documents were commonly used for buying and selling properties, although property boundaries had never been surveyed and were generally not accurately defined. In this case what was really being sold were "improvements" made by the vendor (Salgado et al.,1994, p. 38). Some individuals sold their land without having a private document made up, in which case, the sale was simply a face-to-face transaction between the parties involved. This was considered risky by most people.

The prohibition against deforestation was not being well observed in the Rio Cuero watershed, and made the issue of land tenure a delicate one. Some families were reluctant to discuss how much land they held and how they had acquired it. This was particularly true in the case of recent arrivals who had either cleared forest illegally or were awaiting an appropriate moment to do so. In Santiago Arriba, illegal clearing of community forestland was not apparent even though a sizeable number of people in the community were landless.

This was because the woodcutters cooperative had actively deterred clearing. Their determination to prevent clearing had been revealed in a recent incident between members of the woodcutters cooperative and a *campesino* family with a small herd of cows which had ended in the death of the cattle-owner after he had been caught felling trees in an area of community forest. There was tension between those who made their livelihoods from the extraction of wood and those who preferred to cut and burn forest in order to obtain agricultural land. If the woodcutters viewed the forest as a valuable resource they were likely to defend it faithfully. As I shall discuss later on, problems in the organization of woodcutters and government regulation of forest management had weakened the resolve to defend the region's forests.

Migration to the Atlantic Littoral hillsides

Human settlement throughout Central America has traditionally been concentrated in the highland areas located in the western portion of the region. In the past, the lower-lying hillsides on the eastern flank of the central cordillera, and the flatter plains that link the highlands with the Atlantic coast, were sparsely populated owing to the high incidence of disease generated by the humid conditions of the area.

Because of the increase in population density in recent decades and improvements in health, combined with the lack of outlets for urban employment, the rural population of the region had been forced to move into the humid Atlantic areas. Inappropriate land usage, associated with cattle production on agricultural land which had generated little employment, had helped fuel this out migration (DeWalt 1983; Stonich 1991; Myers and Tucker 1987, Leonard 1987). Cattle production, both for meat and for dairying, had spread rapidly into the humid lowlands, continuing the pattern of extensive land use in existence on the drier Pacific side. It is the nature of land-use and the human exodus that has imperiled the region's tropical forests which, until the 1960's, covered most of the eastern section of the isthmus.

Migration into the Atlantic Littoral area was previously motivated by the possibility of securing employment in the banana plantations situated on the coastal plain. In 1899 the first concessions of land were ceded to several transnational companies, most importantly, the United and Standard Fruit Companies, in exchange for the construction of a railway line along the coast. These companies expanded along the coast creating a high demand for labor, particularly in the decade of the 1920s when the industry reached its apogee.

With the coming of the Depression and the collapse of the international market, employment dropped precipitously. Subsequently, trade resumed, but the industry was plagued with higher costs associated with banana disease, and with labor problems which culminated in a widescale strike in 1954. By 1957, the Tela Rail Road Company, United's subsidiary in Honduras, was only employing half the number of people that it had four years earlier (Herrera 1989 in Lopez de Mazier 1991: 8).

The problems led the banana companies to adopt a new strategy in the 1960s. The transnationals began to contract local producers to cultivate bananas in order to lower the level of corporate risk. At the same time, they diversified into areas of production such as citrus and pineapples (ibid., p. 8). After 1962, with the passage of the first Agrarian Reform Law promoting colonization and the recuperation of illegally held lands (Ruben and Fúnez

1993, p. 13), these national producers were increasingly farmer groups organized into cooperatives for the production of export crops. This process of land transference from the transnationals to the cooperatives was reinforced in the 1970s by the new agrarian legislation. Moreover, the devastation of the coastal plains by Hurricane Fifi in 1974 led to increased land sales in the area. Forty per cent of the lands redistributed through the agrarian reform program were transferred between 1973 and 1977, and the greatest concentration of these holdings were located in the north of the country (Ruben and Fúnez 1993, p. 16).

By the early 1990s, the tendency towards indirect control by transnationals was reversed and the banana companies were once again seeking direct control over the production process. This tendency was supported by the Law of Municipalities in 1990, which allowed for the sale of cooperative and *ejidal* lands and provided the purchaser with legal title (*dominio pleno*). This law was rescinded one year later (interview, INA). In 1992, the Agricultural Modernization Law sought to title thousands of properties held in usufruct and provide greater security to owners and investors of capital. National or *ejidal* land occupied between 1965 and 1989 was eligible for privatization (Ruben and Fúnez 1993, p. 88). This enabled companies to buy legal titles from cooperativists who were willing to sell. And this possibility was increasingly available as co-op members became disillusioned with the collectives over the decade of the eighties.

The foreign banana companies were not the only interests involved in the purchase of the cooperatives in the coastal area. According to the study by Ruben and Fúnez, national companies, especially African palm oil producers, and individuals such as cattle ranchers, peasant leaders, and high-ranking military officials, were involved in the purchase of the coastal lowlands (ibid., pp. 71-74). In the case of land sales to the transnationals, as well as national companies, the cooperativists may sell up on the promise of future employment in the export sector. This condition has often not been met in practice. Others have been forced to sell on the basis of threats (ibid., pp. 46 and 73; CIAT fieldnotes). Those forced to leave the area after the sale sometimes migrated to the mountainous zones of the Department of Atlántida (Ruben and Fúnez 1993, p. 55; CIAT fieldnotes).

Settlement in the Atlantic hillsides

Our data support the contention that the presence of the transnational companies in the Atlantic Littoral, and later, the presence of cooperatives and other enterprises, concentrated the population on the coastal plain. Before the 1970s, the forested hillsides behind the coastal plains were rather sparsely populated. Informants living beside the Cuero River could easily name the families throughout the watershed. The situation in neighbouring Santiago watershed was the same.

Information collected from elderly informants in the study area of Rio Cuero, which flanks part of the coastal lands previously belonging to Standard Fruit, helps convey how life in the forest was occasionally interrupted by events occurring on the coast earlier in the century. Our eldest informant, a 93-year old man whose family migrated into the area in 1910, from Yoro, remembered how the watershed provided a route for merchants to transport their wares from the interior of the country, and other parts of Central America, to those employed by the transnationals. The route was used by the transnationals to transport money to the coast, *via* mule trains accompanied with armed military protection, and

overnight "hostels" were constructed to accommodate this diverse range of travellers. Rio Cuero was also where the telegraph wires traversed the mountains, linking Yoro to the coast, and attendants were frequently in evidence checking the lines.

Although the majority of early immigrants to the Department of Atlántida were drawn by the presence of the banana companies, the early settlers in the forested hillsides were often people from Yoro who "drifted" over the mountains in search of land. Nevertheless, some had links to capitalist activity beyond the forest. The banana companies contracted local people to cut posts in the forest to support the banana trees. Foreigners, searching for valuable hardwoods, principally mahogany, would advance cash to the forest dwellers in exchange for the delivery of wood.

Prior to 1970, there were a small number of inhabitants, mostly from adjacent areas, within the watersheds. After 1970, migrants began arriving from the western departments of the country in large numbers, especially in the late 1980s and early 1990s (Table 2).

Table 2. Birthplace of residents, communities of El Recreo, Santa Fé, San Marcos, and Santiago Arriba, Cuero and Santiago watersheds, Atlántida, Honduras, 1993-1994.

Birthplace	%[a]
Cuero or Santiago watersheds	14.5
Coast (Cortés, Atlántida, Colón)	16.1
West (Intibucá, Ocotepeque, Copán, Lempira, Santa Bárbara)	45.7
East (Yoro, Olancho)	16.6
Centre/South (Comayagua, Choluteca, F. Morazán)	3.2
Not known	3.8
Total	100

[a]Sample size = 186

The information collected on migration into these watersheds concurs with patterns in the national statistics. According to the 1974 and 1988 national censuses, Ocotepeque, Lempira, Intibucá and Copan were subject to heavy outmigration and Atlántida was among the receiving departments. The department of Santa Bárbara acted as a conduit to channel population from the western departments to the coast (Rodríguez de Simons 1991, p. 26). Likewise, Yoro was both a receptor and expeller of population, receiving migrants from Lempira and Copán, among others, while expelling population towards the coastal departments (Rodríguez de Simons 1991, p. 21).

The process of step-migration was evident in the study communities. Of the 102 respondents born outside the study communities or the Atlantic coast, 79% arrived by step-migration from elsewhere in the country (Table 3). The table lists only the last stopping place visited prior to arriving in the study communities. In many cases, migrants had spent time in several locations en route.

Table 3. Step-migration, communities of El Recreo, Santa Fé, San Marcos, and Santiago Arriba, Cuero and Santiago watersheds, Atlántida, Honduras, 1993.

Place of residence prior to migration to Cuero or Santiago watershed	%[a]
Coast (Atlántida, Cortés or Colón)	55.88
West (Santa Barbara, Copan)	31.37
East (Yoro)	12.74
Total	100

[a]Sample size = 102

The heavy migration from the western departments was a recent phenomenon, having occurred largely in the preceeding 12 years and particularly within the preceeding four years (Table 4). (Years in the community among those born in the study sites corresponds to actual age.)

Table 4. Place of origin by length of residence, communities of El Recreo, Sante Fé, San Marcos and Santiago Arriba, Cuero and Santiago watersheds, Atlántida, Honduras, 1993-1994.

	Place of origin, % by length of residence					
Years	Native[a]	Coast[b]	West[c]	East[d]	Center and South[e]	Total[f]
1-4	0	3.8%	24.7%	3.8%	1.6%	33.9%
5-12	0	2.1%	15.0%	2.7%	0	19.8%
13-19	0	3.8%	1.6%	2.7%	0.5%	8.1%
20+	14.5%	6.5%	4.3%	7.5%	1.7%	33.8%

[a]Born in community
[b]Department of Atlántida, Colon and Cortes
[c]Departments of Copan, Intibuca, Lempira, Ocotepeque and Santa Barbara
[d]Departments of Yoro and Olancho
[e]Departments of Choluteca, Comayagua and Francisco Morazan
[f]Sample size = 186. Length of residence not recorded for 7 respondents (3.8%)

The process of settlement in the receiving communities was characterized by concentrations of groups from the same sending communities and areas. This was because families, some of them quite extensive, migrated rather than individuals, and because communication by word of mouth to the sending area produced waves of migrants. Santa Fé and El Recreo were largely comprised of individuals from the western departments (Table 5). Of those individuals who had arrived in the Cuero watershed from the west in the past 12 years, 64% were either born or had passed through Santa Barbara, mainly through the northern part of the department close to the Guatemalan border. This area, Macuelizo, and in particular a zone known as Tras Cerros (or Tres Cerros), appears to have been the main locus of informational exchange about the Cuero watershed. In the case of San Marcos, the bulk of the population originated either in the west or from Yoro or Olancho to the southeast.

Table 5. Origin of migrants, by study community, Cuero and Santiago watersheds, Atlántida, Honduras, 1993-1994.

Community		Region of origin, % by community					
Name	N	Native[a]	Coast[b]	West[c]	East[d]	Center & South[e]	Not known
El Recreo	28	3.5	17.8	71.4	7.1	0	0
Santiago	29	31.0	24.1	24.1	20.6	0	0
Santa Fé	56	10.7	14.2	62.5	3.5	7.1	1.7
San Marcos	72	15.2	15.2	33.3	30.5	2.7	2.7

[a]Born in community
[b]Department of Atlántida, Colon and Cortes
[c]Departments of Copan, Intibuca, Lempira, Ocotepeque and Santa Barbara
[d]Departments of Yoro and Olancho
[e]Departments of Choluteca, Comayagua and Francisco Morazan

Santiago had a larger percentage of its residents born inside the community. This pattern indicates earlier settlement. In Santiago, 48% of the respondents had lived more than 20 years in the community (Table 6). Only 3.4% had lived there less than five years. In the other three communities, between 37.5% and 46.4% of the total population sampled had arrived within the previous five years.

Table 6. Number of years of residence, by study community, Cuero and Santiago watersheds, Atlántida, Honduras, 1993-1994.

Commiunity		Percentage of respondents by length of residence and community				
Name	N	20 yrs +	13-19 yrs	5-12 yrs	< 5 yrs	Not known
El Recreo	28	39.2	0	10.7	46.4	3.5
Santiago	29	48.2	17.2	24.1	3.4	6.8
Santa Fé	57	24.5	3.5	31.5	38.5	1.7
San Marcos	72	34.7	12.5	13.8	37.5	1.3

These different tendencies in the settlement process evident in the two watersheds can be understood from the perspective of location. Santiago was a short distance from the main coastal road. The completion of the highway in 1976, provided easy access to the community. By contrast, the other three communities required a steep climb up from the main road. In 1994, a feeder road had been under construction for four years. The construction of this road had fueled the inmigration of poor farmers as the rapid recent increase in numbers of migrants into the Cuero watershed shows.

This migration into the forests must be viewed in conjunction with the decline in employment opportunities within the banana industry and its replacement by other activities, less labor-intensive in nature, particularly cattle raising. Moreover, while Hurricane Fifi opened up certain opportunities in the lowlands for the cooperatives on lands formerly owned by the transnationals, it also forced migrants who were already living there to seek safer havens up in the hillsides. The wave of migrants into the forests in the seventies and thereafter were mostly individuals who had settled on the coastal plains before moving up into the hills. This pattern of step-migration, *via* the coastal lowlands, had continued up to 1993.

Another event of significance was the conflict with El Salvador in 1969. This conflict displaced large numbers of people living in border communities in the western departments. They frequently migrated in step-fashion through Santa Barbara before moving to the Atlantic Littoral in the eighties and early nineties.

Needless to say, heavy inmigration triggered heavy deforestation in the region of River Cuero. In Santiago, the strong woodcutters cooperative prevented migrants from intervening in the community forest and served as a disincentive to settlement in the community.

The data on inmigration, however, does not help to directly explain the amount of degradation associated with cattle production. Most of the large cattle owners were not recent migrants and they did not live in the communities but rather contracted migrants to take care of their livestock on their behalf. The destructiveness of cattle production was particularly notable in Santiago, notwithstanding the low level of recent inmigration, and also

around Santa Fé and Recreo, the Cuero communities closest to the highway. Residents living in the communities who did own cattle tended for the most part to have small herds of animals. The larger cattle owners, who mostly resided outside the watershed, were more likely to buy land which had already been deforested than to go out and deforest virgin territory. In the case of Santiago, the woodcutter's co-op had not been successful in preventing the spread of cattle pasture into the watershed since much of the land now in pasture was not part of the community forest but comprised private land which had been purchased from community members over the years. I shall return to the issue of cattle production in the section on land use below.

Factors affecting migration

The search for land, either because of landlessness, a shortage of land, or environmental factors (65%) were the major factors behind migration (Table 7). Families of migrants who left as children may have left for the same reasons. It is clear that the search for land was the overwhelming reason for migration.

Table 7. Reason for migration

	%[a]
Landlessness or too little land	51
Environmental factors (low yields, too little rain, aridity, etc.)	14
Conflict (Salvador/Honduras war, land tenure/boundaries, neighbours/family)	9
Pull factors (various: co-ops, family in area, wage labor-banana industry, desire for better land)	10
Left as a child with family (and exact reason not specified)	14
Other	2
Total	100%

[a] Sample size = 159

As discussed, most migrants had spent a good deal of time in one or more locations before arriving in the Atlantic hillsides. The reason for migration from origin communities may not have been the same as the reason migrants had left way-stations *en route* to the study communities.

The most common patterns were either *via* another Western department, specifically Santa Barbara, and/or *via* the coast. The majority of migrants (64%) arriving in the

preceding 12 years from the western departments had passed through, or were born in, Santa Barbara. In the latter case, their parents had departed from further west. The vast majority of these westerners passed through Macuelizo in the north of the department. Many subsequently spent time in communities on the coastal plains before migrating into the study communities. The lowland communities were situated in Cortes, Atlántida and Colon, as well as in the northern portion of Yoro. These areas were associated with the agrarian reform process even though migrants were often not direct beneficiaries of the land reform themselves.

Migrants were most likely to have left their origin communities because of landlessness or land shortage and environmental degradation. Landlessness was less prominent as a factor stimulating migration from Santa Barbara. Rather it was degradation, associated with the steepness of the terrain. In the coastal plain areas, lack of access to land and the failure of the cooperatives were the main issues. Nevertheless, environmental degradation in the foothills of the Atlantic Littoral was cited frequently, along with land shortages.

Cases studies: Migration *via* Santa Barbara

As noted, 64% of migrants from Ocotepeque, Lempira, Intibuca or Copán were born in or passed through Santa Bárbara. Migrants living close to the Salvadorean border departed from Ocotepeque or Lempira in 1969 as a consequence of the "Soccer War." Others left because of landlessness, too little or poor quality land, or environmental factors ("too arid" or "too much summer"). As one migrant put it:

> Before Copan was good; but the lands were destroyed due to the continual burning of the brush on the hillsides. It's now no longer worth cultiving maize, and beans also yield very little. So the people prefer to sow pasture and develop cattle-raising instead.

Examples of migrant trajectories from the west that have taken them through Macuelizo, and particularly Tras Cerros in the northern part of Santa Barbara follow.

> Juan is 42 years old. He was born in Corquin, Copan where he stayed until he was 15 years old working as a day laborer and milking cows in the big estates. From there he went to Tras Cerros, Santa Barbara. He stayed there for two years working as a laborer weeding pastures and cutting coffee. In 1986, he decided to come to Santa Fé. He left the previous locations in search of land since in Copan and Santa Barbara he had no possibility of acquiring land.

> Nacerio was born in Ocotepeque in 1950. When he was 10 years old his family moved to Tras Cerros, Santa Barbara. He stayed there for 25 years. He worked in agriculture planting maize, beans and coffee on his father's land. "There the tasks are different because the land is insipid; one works with a hoe and pure fertilizer and here [in Santa Fé] it's unnecessary." Later he left Santa Barbara in search of his own land, eventually arriving in Santa Fé.

Pablo arrived in Santa Fé two years ago. He is originally from Dulce Nombre de Copan. He left Copan for Macuelizo, Santa Barbara, in 1980, because he had nowhere to work. There, there were only fields for cattle and it's difficult to get land for rent. Rental lands are only available to those who work as peons for the same large landowners. In Macuelizo he slashed short fallows of two to three years and obtained 20 *fanegas*, or *cargas*, of maize. He bought a house plot but by 1985, he saw that the land no longer produced as it had before. The yields had fallen and output was only eight to ten *cargas* and after 1988, only five *cargas*. He thinks that the soil was washed away because when they prepared the land for sowing with hoe and scythe, they left it completely unprotected.

Tulio is originally from Mapulaca, Lempira. He left when he was 12 years old in 1969, due to the war with El Salvador. He came to the village of Guaymita, Progreso on the coast, and stayed for 7 years, working as a day laborer in cattle and cropping, until 1976. Later on he went to Macuelizo, Santa Barbara, where he worked for himself in agricultural activities until 1984. He had 4-1/2 *manzanas* (200 lb) where he cultivated maize and beans on the hillsides. He left because his lands were so far away and he had to cross the river. He came to Santa Fé in 1984, because he was advised that here there were forests for the taking.

Juan was born in Nueva Arcadia, Copan where he lived until the age of 12. At that time his family moved to Tras Cerros, Macuelizo, Santa Barbara, where he stayed for eight years. He helped his father work 13 *manzanas* of land that he had bought in the mountains. There he sowed beans, maize, oranges and coffee. Afterwards he separated from his family and came to Santa Ana, on the coastal lowlands, where his aunt lived. He stayed two years working as a laborer. He came to Santa Fé because his father had sold his land in Tras Cerros and moved to Rio Cuero.

Chano is 27 years old. He arrived in San Marcos in October 1993, from Tres Cerros, Macuelizo, Santa Barbara. He was born in Ocotepeque but when he was one year old he moved with his parents to Tres Cerros where he was raised. There he worked in agriculture: beans, maize and onions. The land has been ruined in Tres Cerros. He worked on the Guatemalan side. He accompanied his father-in-law to San Marcos to help him on land he had bought.

Maria is originally from San Marcos de Ocotepeque. When she was 13 years old (in 1958) she left with her parents for Tres Cerros, Macuelizo, because there harvests were good. The productivity of the area has declined. The land has turned into grasslands and there are many cattle owned by the rich. Rich people began buying up small producers' land, because yields in agriculture had declined. This process started some 20 years ago.

Macuelizo lies west of Quimistan, in the valley of Quimistan, which was an important area of cattle expansion during the 1950s and 1960s (Kaimowitz 1995, p. 14). In-migration in the 1960s and 1970s, occurred into a mountainous area northwest of the valley, which was still a

frontier at the time. It appears to have been an area of dispute between Hondurans and Guatemalans and various migrants spoke of losing their land to *chapines* (Guatemalans) when they lived in the region. By the 1980s, the mountainous zone was no longer an agricultural frontier. Migrants described an area increasingly of coffee farms and cattle ranches. These two trends were strong throughout the department of Santa Barbara. Pasture increased from 25% of land in production in 1952 to 71% in 1990. Coffee cultivation rose from less than 9% of land in production in 1952 to 16% in 1990 (Salgado et al. 1994, pp. 76 and 84). At the same time, by the end of the 1980s Quimistan and Macuelizo were among the most active land-sale regions in the department (Salgado et al. 1994, p. 95). Migrants' statements showed how sales were provoked, at least in part, by yields which had fallen steadily over the years since colonization of the area began.

A good deal of land use in northern Santa Barbara had clearly been detrimental to the environment. Migrants commented on the steepness of the hillsides, which had slopes greater than those in the Cuero watershed (on average probably above 50%), and on the open forms of cultivation which had led to serious soil erosion. Soil was described as "overworked" (*muy trabajado*), "tired" (*cansado, agotado*) and arid (*árido*) and only those who had planted coffee or who had cattle could make a go of it in the area.

Families also wanted land for subsistence production, however, and even those who had small coffee farms cited the desire to grow food crops as a reason for moving to Cuero. The price for land planted in coffee in Santa Barbara was considerably above land prices in the upper Cuero area and migrants were able to increase their hectarage by moving. Migration for these families represented a strategy of upward mobility. One family who had owned two *manzanas* of coffee land in Tres Cerros, sold their property for 5,000 Lempira in 1990 and purchased 18 *manzanas* the same year in Cuero for 7,200 Lempira. Another family sold two *manzanas* of coffee and a cement block house for 15,000 Lempira and bought a wooden house and 30 *manzanas* for 12,000 Lempira in Cuero. Yet another family sold 10 *manzanas*, planted in coffee, in Santa Barbara in 1985 at 10,000 Lempira and bought 30 *manzana* for 5,500 Lempira. Low coffee prices during the 1980s, coffee rust, and large family sizes were cited as factors influencing these migrants' decisions. The frontier nature of the Cuero watershed allowed families to extend their holdings and to benefit from the large supply of family labor available to most of them.

However, it must also be recognized that ignorance of soil conservation was also a problem. Many farmers, while recognizing that leaving soil unprotected on steep hillsides leads to erosion and declining fertility (*se lava todo el abono para abajo*), nevertheless commented gleefully on the production advantages derived from the natural fertility of the soils in the Cuero watershed, even though long term use without the addition of fertilizer and erosion control would inevitably lead to the same ill effects. In other words, the lower costs of production in Cuero, compared to origin and way-station communities, where fertilization had become virtually obligatory, must also be considered a factor motivating migration.

Case studies: Migration *via* the coastal land reform communities

Step-migration had taken many migrants (56%) through communities in the lowland areas of the Atlantic Littoral departments prior to moving into the hillsides. For the most part, this was the last destination before arriving in the study communities.

The "pull" of the Atlantic Littoral was in part associated with the land reform process. More than one quarter of land reform beneficiary groups were located in the Atlantic Littoral departments (SECPLAN 1989, p.17). Migrants were attracted by the possibility of acquiring land in these departments even though the majority of respondents did not become direct beneficiaries. Many of the migrants benefitted indirectly because they were able to rent land in the area despite the fact that this was not permitted under the reform legislation (Ruben and Funez 1993, p. 66). According to a survey, conducted by INA among farmer groups, 46% of these groups of cooperativists were renting part of their land (Ruben and Funez 1993, p. 67). Thus the benefits of reform extended beyond land recipients and permitted those driven from their homes by landlessness and/or land degradation to gain access to good-quality land on the coastal plains. The sale of cooperatives located on the north coast in the early 1990s sent both direct and indirect beneficiaries of the land reform into the hillsides. Ruben and Funez (1993, p 57) reported that 10% of the former cooperative members purchased land, mostly located in nearby mountainous zones.

Sales of cooperative lands were prompted for a number of reasons. A critical factor was the change in the political climate signalled by the introduction of the neo-liberal Agricultural Modernization Law in 1992. Nevertheless, the problems of the cooperatives themselves also contributed. Many had debts, were mismanaged, or were poorly organized, and all lacked the degree of support necessary to allow them to function effectively (Ruben and Fúnez 1993, pp. 91-104). Migrants cited dissatisfaction with the cooperatives or irregularities in securing legal title to the reform lands as reasons for leaving them. Often titles were bought out from under the cooperatives at very low prices by individuals with influence. In cases where resistence was offered, physical threats were made (Salgado et al. 1995, pp. 221 and 229). Ex-members of the Sombra Verde Co-operative in Esparta who had arrived in El Recreo in the early 1990s, all told of pressure on them to sell. The massacre of cooperativists who refused to leave a location in the River Lean area after it was "purchased" by a high-ranking military figure stuck in everyone's mind as a reminder of what might have happened had they refused the purchase offer. Land reform beneficiaries arriving in the Cuero watershed used the proceeds from the sale of cooperative lands to buy hillside properties.

> Carlos was born in Lucerna Ocotepeque. He is 48 years old. He was raised in El Paraiso, Copan, and stayed there until he was 27 years old. From there he went to Santa Barbara where he remained for 10 years. After that he went to Monte Abajo, Trujillo, Colon, and stayed there for 10 years. He joined the cooperative, Marañones Ltda. Not long after joining, the other members decided to sell the land. At the end of 1992 they sold 800 ha of land for 1.6 million Lempira. Because he had joined only two years before he was only given 25,000 Lempira. With this money he decided to go to Santa Fé in December of 1992.
>
> Juan Angel was born in Cololaca, Lempira. When he was 20 years old he left his family in Lempira and came to the coast, establishing himself in Santa Elena, Cofradia, Cortes. He joined a group of farmers called "Nueva Santa Elena" with whom he stayed eight years. He left the group because his companions were beginning to get irritated that he had acquired his own property. He lived there for two more years outside the cooperative. He decided to sell and with the 6,000 Lempira he received for his seven

manzanas, he came and bought 10 *manzanas*, in Santa Fé, plus a house plot, for 5,000 Lempira.

Jose Luis left the department of Copan with his parents. "Over there it's very dry and the hills are very steep." In 1962, they went to live in San Juan Pueblo. Later he joined a group of farmers from ANACH. The lands belonged to the group; there was no individual property. For this reason, he only stayed until 1980 when he went to live in Santa Fé.

Pedro's family comes from Lempira. They left in 1979 and went to Esparta. He joined a cooperative with 17 members organized by INA, but INA never arranged the land tenure properly and eventually the land was sold to a foreign company. Again, he was left without land and decided to go with his family up into the hills to El Recreo.

Rodrigo had arrived a year earlier from Sombra Verde, Esparta. He is originally from Candelaria, Lempira. He left there in 1974 looking for a new environment. "In Lempira, life is very difficult and one longs for a better life." Around 1981, he went to Sombra Verde, where he continued as an agriculturalist until the cooperative was sold in 1992.

Jesus was born in Macuelizo, Santa Barbara. He left there with his parents when he was five years old and went to Batan, near Progreso. When he was nine, he went to Sombra Verde. They had two *manzanas* and obtained two harvests of maize per year and one of rice. He left Sombra Verde because neighbours decided to sell their lands and they were threatened that if they did not sell theirs they would be taken from them. The purchasers wanted the land for bananas and cattle.

Fernando and his family had arrived in Santa Fé from Santa Barbara seven years earlier. In Santa Barbara they couldn't live because they didn't have any land. He stayed in La Masica with relatives and when they formed a cooperative, Santana Limitada, he joined. At the beginning there were 40 people but little by little they began to leave and only 25 stayed on. They cultivated maize and rice. He left because working in groups was very difficult-- some always worked more than others. On receiving his benefits from the cooperative, he went to Santa Fé and bought eight *manzanas* of land.

Cristino was born in Guarita, Lempira. He left in 1982 for the coast, settling in Ilanga, Colon where he stayed until 1991 when he came to San Marcos. When he left Lempira he was 23 years old. There he worked in agriculture. He left because he didn't have any land. His father had some but it was not enough. The *milpa* plots there were far away from the villages and the rents were high and yields low. He left because those who returned from the coast said that there the land was good. He moved to Colon because people said that there was land for everyone and he wanted to have his piece; nevertheless, after being there for nine years he never could acquire any, so he migrated to San Marcos.

Case studies : Settlement in the Atlantic foothills

There was one other trend in the data among those who have arrived *via* the coast. Some settled not on the flat coastal lands but in the foothills just behind the coast or in easily accessible watersheds. This included the hillsides around Tela, La Ceiba, and, to a lesser extent, Tocoa and Trujillo in Colon. These areas had generally become degraded over a period of 20 or more years resulting in declining yields and weed invasion by some very persistent grasses, such as Rottboellia cochinchinensis, and cattle had gradually been replacing annual crops. Rottboellia cochinchinensis, known locally as *caminadora* or *invasor*, became a particularly severe problem in areas where rice was being cultivated. This grass thrives in open tropical soils, but well-managed pasture providing a solid ground cover can easily prevent its propagation. Notwithstanding declining fertility and weed invasion problems, the group which had moved from the foothills higher up into the mountains probably represented more upwardly mobile migrants seeking to benefit from the sale of properties in the foothills in order to acquire either better quality or larger properties in the new location due to lower land prices.

> Don Julio came to the coast and settled in Cangeliquita, by the Rivers Mojiman-Lean, in the municipio of Tela. He stayed there for 21 years working in the hillsides. He had 30 *manzanas* of land but only four *manzanas* were apt for agriculture. The rest had coloured soils that were clayey and hard and only suitable for poor pastureland. On one occasion he went to River Cuero and saw that the crops did well, so he decided to go there to settle.
>
> In 1986, Rolando went to Mezapa, a place where some relatives of his were living. This place had good conditions but they only managed to acquire nine *manzanas* in the plains, which was really very little, bearing in mind that his children were big and needed to work. In addition, the place started filling up with ranchers and it was impossible to get land to rent. Rolando and his family stayed there for four years and in 1991 they went to Santa Fé.
>
> Before coming to Santa Fé, Alejandro used to work in Las Delicias, Tela. He always sowed maize, beans and, at times, rice. He planted in the hillsides because at that time there was plenty of forestland free for the taking. He had 36 *manzanas* of land but it was not very good and he was obliged to use urea, because without it he wouldn't have a harvest. In addition, grasses such as *cola de macho, puya* and *invasor* began to appear. He went to Santa Fé because he considered that it was better for agriculture and because he wanted to increase his landholdings and have cattle.
>
> Felix is from Magulile, Olancho. He left there when he was young with his family and went to live in River Viejo, Cangrejal. They bought a little land and bit by bit increased it until they had 100 *manzanas* They dedicated their time to agriculture and at the outset it was excellent. But the yields declined. They left River Viejo because the lands were too steeply sloped and because

there was an invasion of *calinguero* grass that spread rapidly after the harvest.

Nicolas was born in Las Delicias, Tela. From the age of 15 he had been a farmer, renting land, and always sowing maize, beans (one-half to one *manzana*) and a little cassava. "Here in San Marcos the land is better. In Las Delicias, there was *invasor* grass and it was a real problem for the crops because it grew very quickly and throttled them." There, in spite of these problems, the land was expensive (2,000 Lempira/*manzana*) and in San Marcos it was less (1,000 Lempira/*manzana*).

Santiago Arriba, one of the four communities in the study, represents a foothill community similar in many respects to those described above. Weed invasion was not a primary concern, although yields were generally quite low. Because of the forestry cooperative in the community, land had been maintained as community forest for the original settlers rather than passing to ranchers. Nevertheless, many of the original settlers had very little agricultural land and, were it not for the community forest, they would probably have been forced from the community long ago. Land which they were forced to sell had been consolidated into larger cattle holdings.

Demographic characteristics of migrants[4]

Literacy and education

Among the 116 male and female heads of households from whom information about literacy was obtained in the survey, 55% were illiterate. The figure of 55% illiteracy was slightly under that of 62% found by Buckles et al. (1992, p. 25) in their study which was carried out among migrants in different watersheds in the same area. Nevertheless, among the 45% who claimed to be able to read and write, literacy was minimal and it is likely that there was a percentage in the group with only numerical literacy. In other words, this is not likely to be a very reliable indicator of functional literacy.

Educational levels in the rural areas of Honduras are extremely low. According to the 1988 census, the literacy rate in the countryside was around 58%, up from 49% a decade earlier (Cano 1990, p.11). The literacy rate was 83% in urban areas in 1988. The situation in respect to education in the western departments, where nearly 48% of the sample originates, was even worse than in the rest of the rural areas. According to the 1974 census, when out-migration towards the receiving area was just beginning to increase, illiteracy was as high as 60% in some of these departments. By 1988, it had dropped to about 50%, but remained behind the country in general (Cano 1990, pp.11,14). Further evidence of the poor educational attainments of the population in the western departments may be deduced from the fact that less than 30% of the population between the ages of 5 and 29 attended an educational institution (Cano 1990, p.17).

Forty-three percent of sons and daughters of household heads in the sample had above grade 3-level education and 30% had grade 6 or above (Table 8). This was better than the statistical average for the rural areas, which showed that 75% of rural students did not go

[4]The sample includes a small number of residents who were not migrants. See Table 2.

beyond grade three (SECPLAN 1989, p.54). Nationally, 30.1% of students initiated grade six and 29.1% completed it (Cano 1990, p.25). Our information does not allow us to know whether the students actually completed each grade.

Table 8. Educational levels among the sons and daughters of River Cuero residents

Grade 6+	1.5%
Grade 6	28.6%
Grade 5	4.8%
Grade 4	7.9%
Grade 3	16.5%
Grade 2	10.7%
Grade 1	10.7%
No schooling	19.3%
Total	100%

*N=394

Despite the apparently higher-than-average level of education among migrant offspring relative to rural averages, our data do not allow us to establish any causal relationship between education and migration. Migrants may have had educational ambitions for their children, but schooling was almost never cited as a factor in the decision to move, and complaints about education available in the watershed were widespread[5]. The data do not clearly establish where the education was acquired. Because of the step-migration process, many migrant children were educated at a number of different locations, including the receiving area.

The low educational level of the rural population in the western departments, relative to the rest of the country, was almost certainly a factor serving to stimulate rural-rural migration since in the urban setting low literacy levels are more likely to have an adverse effect on employment prospects than in rural areas. Unfortunately, census information is only enlightening in so far as inter-departmental movements are concerned. It does not provide information on rural *versus* urban occupations of migrants.

[5] The educational facilities available to students in all four of the communities were extremely poor. Teachers generally put in at most four days per week and frequently attend to several, if not all six, grades. Text books were generally not available, classroom facilities were hot and crowded, and students regularly missed classes in order to help their parents in agriculture.

The background of poverty of the vast majority of migrants can be gleaned from census data showing mortality rates in the major sending areas. Infant mortality is a sensitive indicator of poverty since the very young are the most vulnerable to poor living conditions.

The rural areas of the departments of Copán, Lempira and Intibucá in 1974, had infant mortality rates above 100 per 1000 live births. Ocotepeque had a rate of 96 per 1,000 live births (Rodríguez de Simons 1990, p.22). These were among the highest infant mortality rates in the country. While they had fallen by around 30% in the following decade, they were nevertheless still the highest in Honduras.

Based on 57 informants living in the community of Santa Fé who provided information, there were 57 deaths to 350 live births reported among infants and young children, representing a child mortality rate of 162.8[6]. In San Marcos there were 481 live births to 51 deaths reported by 72 informants, or a mortality rate of 106 per 1000. These rates encompass periods of many years by informants as old as 83. The higher rate in Santa Fé may perhaps be explained by the percentage of the population from western departments (62.5%). In San Marcos, the origin of migrants was more diverse (Table 6).

The figures on child mortality collected by the study team in the communities of Santa Fé and San Marcos show rates that suggest strong parallels with those in the main sending areas although our information does not allow us to determine with precision all the ages and locations at which death occurred. In some of the cases, the exact age of a child's death could not be ascertained. Nor was it always certain that it was a live birth. Informants talked about their children who had died when they had suffered miscarriages too early in their pregnancies for these to be counted among the live births. We attempted to eliminate such cases but some remain unclear. For this reason, these figures should be treated as indications of child mortality rather than strict statistical measurements of it and are not directly comparable with national statistics. Nevertheless, given the concentration of westerners in Santa Fé, who have mostly arrived within the past 12 years, especially the past four (Table 6), we can assume that most of the deaths in this community occurred in the location of the western departments.

While childhood deaths were generally concentrated in the under-five age category, deaths among older children and youths from unknown diseases, as well as known infectious diseases, such as polio, meningitis, measles, were common, as were deaths from accidents, such as drowning while crossing the river. Violence among young men, leading to death, was another commonly cited cause of mortality in this older category. Even after passing the age of five, there was still a strong risk that a child would not reach full-adulthood for one reason or another.

Birth rates

Child mortality cannot be divorced from the very high birth rate. Data were collected from 52 women above the age of 40, and therefore at the end, or nearing the end, of their childbearing years. The average number of children among this group was 9.6. Data from the

[6]The Under Five Mortality Rate is the principal indicator used by UNICEF to measure the well-being of children. The Honduran statistics employ infant (0-1 age range) mortality to measure well-being. The figures employed in our study focus on the group 0 and under-5.

1988 population census put the number of children per woman in the rural areas at seven (SEDA 1993, p.14). However, according to a CELADE study in 1983, the fertility rate for women in agricultural salaried households was 8.6, more than double the rate of women in the upper-middle strata (Bidegain 1991, p. 11). Educational level influenced fertility: rural, illiterate women had 8.4 live births compared to 2.8 for women with more than seven years of formal education living in Tegucigalpa (ibid., p.11).

The birth rate in the study sample was higher than that for poor, rural women at the national level. The sample comprised individuals who may have had a poverty level greater than that for "salaried agricultural households." A high fertility rate leads to close birth-spacing which contributes to the difficulty of providing adequate care to infants, with negative consequences for their survival.

There was no indication among the migrant group interviewed that family size was declining. Women in the sample were not, for the most part, using birth control. In the few cases where women had been sterilized, it was related to medical problems rather than regulation of family size. Lack of information on family planning, lack of access to adequate health services, resistence from men, and the influence of religion, were the principal reasons for the continuance of the very high fertility rate, along, presumably, with the rather high risk of losing a child to illness or accident. Fundamentalist protestant sects, in particular in Santa Fé, were responsible for providing resistence to the idea of birth control and for promoting unchallenged male dominance within the household. Contraception was equated with an invitation to "loose behaviour" on the part of women, in the mind of the local pastor who had spoken against it. Nevertheless, women with very large families, as well as younger women wishing to avoid this fate, showed considerable interest in the topic during the course of the interviews.

Fifty percent of the women in the sample had their first child below the age of 20; 17% had their first child at the age of 14 or below after they were "stolen away" (*robada*) by their prospective partners. It is hard to know whether such stealth was really forced on women or was akin to elopement. Whatever the circumstances of the formation of these unions, the children resulting from them, when they were of short duration, were commonly taken into the household of the grandmother. Unions, particularly among younger couples, were unstable. Legal marriage was rare among migrants and relations dissolved easily, leaving the women, in most cases, with the children. If these young mothers formed another union, as they commonly did, their children did not always accompany them. This may have resulted in underreporting of first births.

Nearly 14% (N=16) of the women questioned reported their first birth at over 26 years of age. This probably included those who failed to report earlier births from earlier unions particularly when the interview was conducted in the presence of the later spouse. Even with the high reported fertility rate there may have been underreporting of total number of births and overreporting of the age at which the first birth occurred.

There were few young, single-female-headed households in the communities since life on the frontier for a single woman with young children was extremely hard. Those who found themselves in this situation were probably more likely to go to cities where they can find paid employment than to migrate to a rural frontier area. Single women with older sons who were capable of carrying out slash and burn agriculture, however, were present.

Men involved in second or third unions were likely to seek a spouse considerably younger than themselves. In 36 cases (35%), there was an age difference between husbands and wives of ten or more years. In 18% of the cases, the age difference was greater than 15 years. Men were often reluctant to discuss earlier unions and how many children they had in the presence of the current spouse. Notwithstanding the number of children either spouse brought to the relationship, the man almost certainly wanted to have children with the new spouse if possible. The instability of relationships probably served to increase the number of children that a woman bore during her lifetime. It could have acted as a disincentive to undergo sterilization because a sterilized woman would have been considered a less-than-desirable partner.

Although the average family was large, average household size was only six members. This may have reflected the early age at which young people sought independence from their parents' households, as well as the number of young families present in the sample who were just beginning the domestic cycle. Because houses were constructed out of locally available materials, labor and access to a plot of land were more important to establish a household than funds to cover the cost of housing materials. Even if young adult couples endeavoured to have their own houses as early as possible, they probably would have required access to family land unless they were able to carve their own plot out of virgin forest. Saving enough money from agricultural or forestry earnings to buy land was increasingly hard to achieve as land prices rose.

Land tenure and land ownership

Land tenure

Land tenure in Honduras was mainly based on *de facto* rather than *de jure* rights. Approximately 80% of all land was held in usufruct *(dominio útil)* and lacked legal title (SEDA 1993, p.79). In the study region in 1993/4, farmers did not have legal title. Many had a private document naming them as the occupant and paid taxes to the municipality. The payment of taxes was considered by the farmers to provide them with tenure security and recognition that they were the rightful owners. Some individuals without documents had lost their land and farmers considered land sales without private documents very risky. Migrants clearing land at the frontier did not pay taxes and the municipality had no way of knowing who was there.

In May and June 1995, a government-sponsored land titling campaign was operating in the study zone, providing landholders with the opportunity to legally title their lands. Since many farmers believed that the lands were rightfully theirs, they refused to pay the government to provide a title. Moreover, after discussing the titling program with farmers in different communities it appeared that the cost of purchasing a legal title was not consistent. Residents of San Marcos and Santiago told us that the rate was 250 Lempira/ha. The cost was reported to be 150 Lempira/ha in El Recreto and 200 Lempira/ha in Zapote, a neighbouring community in the San Juan watershed. These differences may have resulted from converting hectares to *manzanas*, or may have been a product of rate variation depending on the extension of land to be surveyed and the location. In any case, the result was a sense of confusion and a feeling of anger on the part of San Marcos residents who

believed they were paying 100 Lempira/ha more than those in El Recreo to purchase legal title.

The lack of interest exhibited by many people in titling arose, I would argue, not out of plans for short-term residency in the area, but rather from the fact that people do genuinely believe that they already "own" the land. This sense of "ownership" means that lack of legal title does not imply that agricultural decision-making is necessarily short-term. This observation is supported by a study in Comayagua and Santa Barbara which found that six years after the land titling program went into effect in these areas that investment and production changes had been negligible (Salgado et al. 1994, p.46).

Land ownership

Landownership in the four communities presented similar patterns (Table 9). The degree of concentration present at the national level had not developed. At the national level, 63.9% of farms were less than 5 ha. In the four study communities, the percentage of farms was spread more evenly through *minifundia* to middle-size properties of up to 50 ha. In the top category were cattle producers who generally had several properties extending from the hillsides to the coastal lowlands. In Santiago, in the area leading up to El Recreo, and between El Recreo and Santa Fé, there were large areas owned by a small numbers of ranchers. These areas were under permanent pasture and there was considerable pressure on small farmers who had flatter land to sell to ranchers. Since San Marcos was a considerable distance from the coastal road, large cattle ranchers had yet to buy lands in this community. Once the road through the watershed is completed, this situation will surely change.

Table 9. Landholdings, communities of El Recreo, Santa Fé, San Marcos, Santiago, Cuero and Santiago watersheds, Atlántida, Honduras, 1993

Size of holdings, ha	Number	%
< 5	27	14.36
5 - 9.9	30	15.95
10 - 19.9	36	19.15
20 - 49	26	13.83
50 - 99	3	1.6
> 100	5	2.66
Landless	48	25.53
Unknown	13	6.91
Total	188[a]	100.0

[a]The sample includes properties of two large cattle ranches whose owners lived in the lowlands. They are not included in other data reported.

The landless category included individuals who had access to family land but claimed to be landless. In some cases, relatives, charged rent for the use of the land or demanded a portion of the harvest in exchange for land. This practice was also used by those who have no family relationship to the renter. While these individuals who had access to family land should perhaps not be labelled as landless, the fact that they regarded themselves as such means that they fell into the group which was awaiting the opportunity to acquire land. From the point of view of deforestation, all the self-described landless posed a threat. This was a quarter of the population sampled.

Land distribution less concentrated than the national average was consistent with a frontier zone where individuals had been free to cut forest. In addition, larger holdings were consistent with a strategy of keeping sons on the family property. Migrants often cited the need for land for their children, especially their sons, as a reason for migration. By offering their sons or sons-in-law access to land, household heads increased the probability that their offspring would stay to support them in old age. The fact that some individuals continued to seek access to land independent of that available to them in the family, indicated tension within the family grouping.

Having access to sufficient land to keep the family intact was a very logical desire given the dynamics of family relationships among the very poor once family members are no longer in close proximity. Unlike urban migration which often increases earnings which can be remitted to the family, permanent rural-rural migration to frontier areas effectively severed economic ties with those left behind in the sending area. This was because earnings were low and communications poor in frontier areas. Among poor households where family members had a low level of education, the prospect of receiving remittances from kin who had migrated to other rural areas was undoubtedly very low, unless the migrant obtained a position in commercial agriculture. Frontier zones provided the resources to maintain poor families intact and provided members with continuing support, which was especially important during their later years when they could not work. Control over land acted as an incentive to the maintain family loyalty, and distribution of lands prior to death occurred infrequently. Women sometimes held land in their own right but this generally involved widows, or, less often, women who had separated from their husbands and managed to take a share of the family property with them.

The role of land in maintaining families as a cooperating unit served as an incentive towards carving out larger parcels from the forest than was required for subsistence purposes. Thus earlier settlers often held large chunks of both forested and deforested land. Nevertheless, family crises, particularly illnesses, in conjunction with the low income-earning capacity of the land relative to the high labor investments required to make the land produce, often forced early settler families to sell land to new migrants and cattle ranchers.

The preference for extended family landownership and the larger-than-average size of properties in the area does not square with the concept of migratory agriculture described in much of the literature dealing with deforestation. The widely-held view is that migrants descend on an area of forest, cut it down in order to farm it for a couple of years, and then sell it to a rancher when it is exhausted (Parsons 1976; Leonard 1987; Myers and Tucker 1987; Nations 1992; PDBL 1990). While this may be the predominant practice when the land

is of such poor quality that rotation in the foreseeable future is impossible, it is not rational when rotation is an option. Pioneer farmers were more apt to obtain access to more land that required and maintain a good portion as it as fallow, as secondary forest, or as primary forest. This produces a system of land rotation, rather than migratory agriculture. This may be glimpsed from the nature of land distribution between forest/fallow and land-in-use in Santa Fé and San Marcos where detailed land-use information was obtained.

Table 10. Land allocation by size of holding, Santa Fé and San Marcos, Cuero watershed, Atlántida, Honduras, 1994

Parcel size, *manzanas*	Number of farms	Average area, by use and total, *manzanas*				Average area, fallow+forest, % of total
		In use	Fallow	Forest	Total	
>25	19	12.9	23.8	4.6	41.3	69
16-25	16	5.8	10.0	2.1	17.9	68
6-15	32	3.5	3.8	1.2	8.5	59
1-5	5	1.3	1.9	0	3.2	59
Landless	37	–	–	–	–	–
Not known	19	–	–	–	–	–

Farmers held 60% or more of their land in the form of forest or fallow, generally allowing them to rotate their plots (Table 10). Small farmers, who were more likely to be later migrants or early migrants who had lost part of their land, may have owned insufficient land to fallow it adequately. In some cases, exhausted soil fertility may have forced farmers to move to the frontier. However, more commonly, those with insufficient land rented land rather than exhaust what little they had. The land rental market in the zone was quite open and supply was relatively plentiful. Thus cattle ranchers, for the most part, were not purchasing land which was no longer suitable for crop production. Rather, they purchased the best land; i.e., the flattest land conveniently located to roads. This land carried a price four times higher or more than land on steep hillsides. Poor farmers, who had low opportunity costs of labor, may have opted in favour of walking an extra two hours each day to a plot at the forest frontier if this meant extra cash in their pockets from the sale of the higher value property. And so goes the process of forest to pasture conversion in the area under study.

Different forms of land use in El Recreo were supposed to be reflected in the tax rate. Municipal officials reported to Hernández-Mora (1995) that residents paid higher taxes on land planted in perennial crops than on land sown in annual crops and no taxes for land in forest. Residents were unaware of such distinctions and claimed they were charged a flat rate on all land owned (cited in Kaimowitz 1995, p.49).

According to Rodríguez Torres, in 1992 more than 28% of the land in the Cuero watershed within the buffer zone of Pico Bonito Park to the east of the river was being used for agriculture without conservation practices. According to PDBL, only 2% was strictly appropriate for agricultural uses (Rodríguez Torres 1993, pp. 64-68). While theoretically a diffential tax rate might be appear to be a logical mechanism for charging the user for the value of land according to use, setting tax rates for land-uses deemed inappropriate would seem to legitimize them and, indeed, to acknowledge the lack of political will to change this situation. That such a scale of tax rates was not followed in practice, showed even less desire to penalize ranchers and slash and burn agriculturalists, while unfairly penalizing those who did conserve forest areas.

Crop production

When the Spanish arrived in Honduras in 1503, the Atlantic Littoral area was populated by Tolupanes, often referred to as Xicaques. Their area of influence extended from the Sula Valley, which bordered on Maya territory to the west, to the mouth of the River Aguan (Tojeira 1982, cited in Rivas 1993, pp. 48-49) on the east. The Tolupanes cultivated root crops but were primarily hunter-gatherers, who lived from the products of the forest and numerous rivers that flowed through their hunting grounds (Chapman 1978, cited in Rivas 1993, p. 149). Even today the river banks in the forests of the Atlantic Littoral are full of wild tubers and many migrants supplement their diet by gathering of wild yams (Discorea convoluvacea) and *malanga* (Xanthosoma violaceum). Nevertheless, cassava was almost undoubtedly cultivated, as it is by other tropical forest dwellers, such as the Pech and the Tawahkas, who live further east and whose cultures remain cassava-based.[7]

The humidity of the coastal forest zone and the semi-nomadic way of life associated with hunting and gathering would have made maize and beans extremely difficult to produce. Cassava does well in moist environments and can be preserved for a year in the ground.

The main staples of the Maya were maize and beans. The lowland Maya also practiced shifting agriculture within tropical forest areas, but in forest considerably drier than the forests of the Atlantic Littoral.

The inhabitants of the forests of the Atlantic Littoral today are migrants from many parts of Honduras, but particularly from the western departments. Thus, a large percentage of the migrants share the maize and beans culture of the Maya. These migrants tend to hold plantain and cassava in rather low regard. Their first priority is put beans and *tortillas* on the table, despite the less-than-optimal conditions for these crops in their new surroundings.

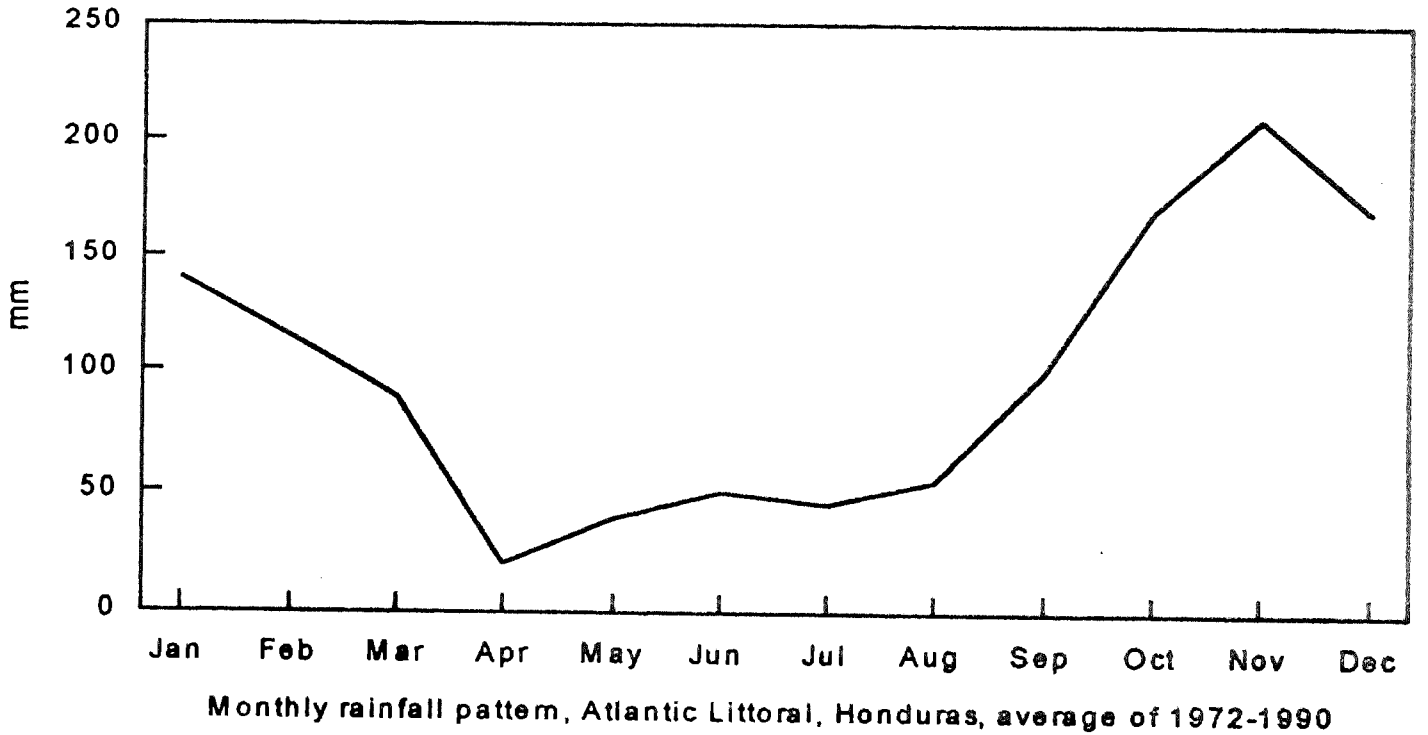
Enviromental conditions for production of maize and beans in the Atlantic Hillsides have may been improved by inmigration. Older residents suggested that the opening up of the forest had lowered the severity of *hielo*. (*Hielo* is used for a variety of diseases (see Bentley 1991)), including fungal diseases engendered by high humidity. As the forest has been cleared, the incidence of *hielo* has tended to diminish. New diseases have probably

[7]Interviews conducted among the Pech in the community of El Carbon in January and February, 1994, revealed that bean production was a recent phenomenon. Previously, beans had been purchased from *ladinos* in San Esteban, southeast of Carbon, or exchanged directly for cassava bread (*sasal*). Older residents remembered hearing from their parents and grandparents that maize was not produced by their ancestors.

accompanied the increase in production. And, the problem of *hielo* in beans (mainly web blight) has been partially resolved by cultivating beens in eastward-facing mountain tops that received the early morning sun, reducing relative humidity and disease incidence.

The coastal plains of the Atlantic Littoral of Honduras receive 2,000 to 3,300 mm of rainfall per year (Figure 2). Rainfall data for the hillsides were not available. According to farmers in the Rio Cuero and Santiago watersheds, the dry season was more pronounced than the data on distribution would lead one to believe and farmers expected only low amounts of rainfall between February and May.

Figure 2. Rainfall in the Atlantic Littoral 1972-1990 (Sain and Matute 1993, p.198)



There were two distinct production cycles in the Atlantic Littoral. The spring cycle, or *primavera*, and the fall cycle, or *postrera*. The *postrera* began shortly after the heaviest rainfall period in November/December. The primary crops were maize in *postrera*, maize in *primera*, beans in *postrera* and beans in *primera*. In addition, bean seed, rice and chiles were produced. The spring cycle, or *primavera*, took place after the rainy season began usually in mid-June.

Maize cultivation

Traditionally the *primera* was the most important (Sain and Matute 1993, p.199) but with the advent of mucuna (Mucuna deeringianum), a perennial legume used as a cover crop, which was applied extensively in the *postrera* cycle throughout the area (Buckles et al., 1992), the latter had become the major maize cycle.

Postrera

There were two systems of maize production in *postrera*. In the past, fewer farmer produced maize in the *postrera* and those who did used a one-year bush fallow known as *guatal*. This was less fertile than a mucuna-fallowed area. Nevertheless, many farmers had continued to employ the "slash" as a mulch to preserve moisture during the dry season. A short fallow eliminated the need to burn since it was relatively easy to sow among the smaller stems present in young vegetation. Moreover, burning at the end of the heavy rainfall period was exceedingly difficult.

Mucuna, or "fertilizer bean" *(frijol de abono)*, refers to a number of species belonging to the family Fabaceae. In Honduras, the species most widely cultivated is Mucuna deeringianum (Buckles et al., 1992). Shortly after the rains end, the mucuna plant produces seeds and the vegetative cycle ends. Farmers cut the tangled mass of mucuna covering their fields, and left it as mulch. Most farmers in the study area relied on natural reseeding of mucuna which occurred as the seed pods dried. Maize seed was introduced directly into the mulch a week or so after cutting mucuna. During the maize cycle, farmers controlled resprouting mucuna plants by hand using a machete, or with herbicides. At the end of the *postrera*, which occurred just prior to the resumption of regular rainfall, the mucuna plant spread rapidly over the recently-harvested plot forming a thick "mattress" of organic material capable of producing up to 9 tons/ha of dry matter (Buckles 1994, p.3). According to Triomphe (personal communication), the benefits from mucuna derived from the minerals leached from the rotting biomass, rather than from its effect as a live cover crop. Growth of biomass continued throughout the rainy season. The plant was ready for cutting at the end of the vegetative period the following November or December. Farmers could return to the same plot each year without longer fallow periods.

According to Buckles (1994), mucuna reached hillside farmers of the Atlantic Littoral area of Honduras in the early 1970's. It was probably introduced to Central America in the 1920s by banana companies using it mainly as mule forage (Buckles 1994, p.13). As the process of immigration to the Atlantic Littoral began to speed up in the 1970s, with the growth of the cooperatives and later on with the movement of many migrants towards the

hillsides, so the diffusion of mucuna grew rapidly. Most farmers obtained their seed from other farmers in the area (Buckles et al. 1992, p.24). Buckles et al. estimated that 83% of the farmers in the Atlántida area studied, or approximately 5,250 farmers, have had direct experience with mucuna. Mucuna was used most extensively in areas with heavy rainfall distributed in a bimodal pattern (Buckles 1994, p. 19).

The introduction of mucuna was transforming the pattern of maize production in the area. Fifty farmers out of 83 (60%) interviewed in Rio Cuero were using the mucuna system to produce maize in *postrera*. Thirty-three (40%) were using the traditional slash-mulch system. Farmers in Rio Cuero who did not use mucuna, or who had insufficient mucuna, generally used *guatal* for the *postrera*.

Mucuna was a recent introduction to Rio Cuero. Six years of usage was the longest known case. In-migration had been very heavy in the preceeding few years and the pattern of adoption was still quite mixed. Moreover, landlessness made access to mucuna plots more difficult. A rental market existed but the higher rents for land under mucuna were prohibitive for some farmers.

Table 11. Maize yield, Santiago and Cuero watersheds

	Rio Cuero		Rio Santiago	
	Yield, kg/ha	N	Yield, kg/ha	N
Postrera				
In mucuna mulch	1,770	50	1,190	2
In slash mulch	1,280	33	998	8
Primavera	1,170	78	1,170	16

In Rio Santiago, only two farmers had sown mucuna and most people interviewed were ignorant of the practice of using mucuna. Partly as a consequence of this, the productivity of land in the *postrera* was lower and fewer people elected to plant in this cycle in comparison with the *primavera*. Low adoption was a reflection of the limited nature of population movement into the watershed which clearly negatively affects the flow of new ideas and technology. Difference in mucuna usage between the two watersheds may not have been wholly responsible for the variation in yield. Agricultural land in Santiago was generally more degraded than in Rio Cuero because of its older settlement pattern. Comparison of yields between the two adjacent watersheds is interesting since it points to the potential for yield improvement in the former case through the use of mucuna.

Table 12. Costs and net revenues, production of *postrera* maize with mucuna, 1 *manzana*.

	Costs	
Activity or input	days	lempira
Land rental		150
Land preparation	8	120
Planting	4	60
Seed, 25 lbs		20
First weeding	2	30
Herbicide, 24D		30
Backsprayer rental		30
Second weeding	2	30
Herbicide, Gramoxone		45
Backsprayer rental		30
Doubling	4	60
Harvesting	6	90
Transportation, field to house[a]	4	240
Mules, 12 days		60
Shucking	12	180
Transportation, house to point of sale[b]		320
Total costs		1,525
Total sales[c]		2,240
Profit		715[d]

[a] Based on average yield of 24 *cargas* (1.7 ha) on the cob

[b] 16 *cargas* at 20 lempira/*carga* from above San Marcos to main road

[c] Based on average sale price on main road in Spring 1994; i.e. 140 lempira/*carga*, and average yield of 16 *cargas/manzana*

[d] US$107/ha

The results for farmers using mucuna are more reliable for the Rio Cuero watershed than for the Santiago watershed because of the sample size. The Rio Cuero sample included farmers who had been sowing mucuna for only a year as well as farmers who had had it for six years, so the yield increase of 38% over farmers who had not used the cover crop was substantial. Preliminary results from 18 plots directly sampled by Triomphe in the 1994 *postrera* in Rio Cuero of 1.9 tons were similar (preliminary estimates, 1994)[8] and rather higher than that found by Buckles et al. (1992, p. 18), of 1,373 kg/ha. This may perhaps be explained by the fact that Rio Cuero was not highly degraded and so recuperation of soil

[8] Triomphe warns us that the sampling method employed which extrapolates from a small area to one ha likely overestimates production by 15-20%. Triomphe also converts from on-the-cob maize estimates to grain weight using a .7 conversion factor, I converted at a more conservative .66. Clearly the conversion rate varies from year to year depending on how good the crop is.

fertility with mucuna was more rapid than in the communities selected by Buckles et al. Both averages were below 3.5 tons/ha, reported for San Francisco de Saco, where some producers have had 20 years of experience with mucuna (Triomphe, personal communication 1994).

Costs of the slash/mulch system were slightly less than the mucuna system because of lower land-rental costs (Table 13). Because of lower average yields, harvesting and transportation costs were also lower. Land preparation costs and weed control costs were slightly higher.

Table 13. Costs and net revenues, production of *postrera* maize, slash/mulch, 1 *manzana*

	lempira
Total costs	1,185
Total sales[a]	1,649
Profit	464[b]

[a] Based on average sale price on main road in spring 1994; i.e. 140 lempira/*carga*, and average yield of 12 *cargas/manzana*

[b] US$69/ha

The effect of mucuna usage had been to increase the area of maize sown in the *postrera* planting. This may be grasped by comparing the average area sown by each producer with mucuna versus the size of the average plot using *guatal* and indeed, the size of average plot in the *primavera* cycle.

The average size of 50 plots with the maize-mucuna system was 1.95 ha, compared to an average of 1.09 ha for 26 maize-*guatal* plots. Based on 78 plots, the average size for plots of maize in *primavera* was 1 ha.

Findings at the regional level show that output in the *postrera* harvest increased in importance relative to the *primavera* harvest, from 35% of the total in the early 1980s, to more than 50% of the total at the present time as mucuna usage has increased (Sain, Ponce, Borbon 1993, p.146). In Rio Cuero, average plot size under mucuna was 79% larger than average plots without it in the *postrera* cycle and nearly 94% larger than average *primavera* maize plots. The effect of mucuna upon planted area in the Cuero watershed was even more dramatic than at the regional level.

Apart from the stimulus provided by the higher yields obtained by employing mucuna, farmers benefitted from higher prices in the marketplace from the *postrera* harvest because it was too dry in most regions of the country to produce crops during this season. In the *primavera* cycle, producers all over the country harvested maize around the same time, causing a seasonal price decline during the months of October to December. Atlantic Littoral farmers had a comparative advantage over other parts of the country in the production of dry season crops. Farm gate prices for maize in the 1990-1991 *postrera* cycle were

approximately 23% above the average yearly price. Prices during the *primavera* maize cycle were 25% below average (Sain, Ponce and Borbon 1993, p.152).

The other advantage accruing to farmers in the Atlantic Littoral from the *postrera* harvest was the much healthier nature of the crop because it was harvested in dry weather. Losses during the *primavera* were high because farmers had to harvest at the wettest time of the year. Daily rainfall reached 200 to 300 mm or more. Heavy rainfall in the October-December period made drying the maize cobs difficult. A high moisture content lowered the price. Yields calculated by farmers were often derived from on-the-cob estimates. We have used the conversion factor of .66 to arrive at the average grain estimate. However, in years of poor harvest, the conversion factor may be lower, i.e. a grain/cob ratio of .5. Farmers commonly referred to the advantages of dry season cultivation because of the lower rate of crop loss.

From an environmental standpoint the *postrera* cycle was also more desirable than the *primavera*. Notwithstanding heavy rainfall at the outset, the soil surface was covered throughout in both the mucuna and slash/mulch systems. Farmers did not specifically mention the erosion-reduction effect of mucuna. Farmers did not burn vegetation because the mulch conserved moisture, provided nutrients and was regarded as beneficial for weed control. Mucuna, in particular, was highly valued because it smothered most competitive weeds and reduced the labor required for soil preparation.

Farmers expressed concern about the potential for landslides in very steep areas where mucuna was planted. They noted that mucuna smothered most trees and damaged root systems that would hold the soil in place. Some had planted Gliricidia sepium which, with some attention, seemed capable of withstanding the tangle of mucuna vines.

Primavera

Farmers selected parcels for planting in early May. Farmers routinely selected secondary forest of three or more years for cutting and burning (71% of the sample). Those selecting secondary forest below this age did so because of lack of access to more mature bush. Three years of regrowth produced large amounts of biomass. Tree height reached 15 to 20 ft and tree girths reached 6 to 8 in. The biomass provided a large store of nutrients, mineralized through burning. Long fallows reduced the need for weed control because grasses were less prevalent than in short-fallowed land. Farmers often remarked on the abundance of vegetation in the area as a positive factor in *milpa*-making, despite the greater labor requirement. This was generally compared to the dryness of the areas that they had left behind and the stunted nature of secondary forest development which contributed to low yields. Finally, the selection of fallows of three years or more allowed farmers to better conserve soil fertility. If fallows of one year had been used repeatedly, fertility would have been exhausted rapidly.

Farmers did not select secondary forest on the basis of height alone, although they did tend to avoid stunted forest areas. They also looked for other characteristics in the vegetation that steer them in the direction of good soils. The color of the vegetation was critical. Farmers looked for bright green vegetation and avoided yellowy patches which indicated the presence of redder soils. Red soils were regarded as "ruined," meaning they had a nutrient

deficiency. Dark soils were rich in humus *(abono)*. They were more "humid" and "spongey" in texture, with better drainage.

Farmers look for certain plants to tell them about soil character. Martinez (1994) discussed indicator plants and their properties. Although most farmers were from other parts of the country, they generally had botanical knowledge appropriate for the study region. Most of the plants present in the area were also present in the low-lying valleys of the western departments (Martínez, personal communication). Despite differences in rainfall regimes and soils, migrants were bearers of cultural knowledge appropriate for making decisions in a new environment. This was different from the situation among pioneer migrants to the Amazon, who had limited knowledge of their environment and tended to select very poor soils (Morán 1985).

The decision to use fallows of three or more years in the spring cycle made burning a virtual necessity. There was too much "slash" to be able to plant crops, even in two-year fallows. The decision to burn in *primavera* was virtually universal. Farmers also cited problems with plant disease, particularly maize ear rot (*maíz muerto*), when they failed to burn, as well as animal damage because the thick cover provided refuge to forest animals. Climatic conditions at this time of the year favored the development of *maíz muerto*, although studies have not proven that burning *per se* reduces the incidence of the disease or the presence of the inoculum (Rio and Cáceres cited in Bentley 1990, p. 23).

Fields were cut and burned in early May. With later burning, regrowth was less; but, if too late, the burn was negatively affected by the rain. Maize was sown in June, following bean planting. However, farmers did not cite weed regrowth prior to planting as a problem necessitating prior herbicide use as in some regions. Rainfall in *primavera* was a good deal lighter than in *postrera*--no heavier than rainfall in the semi-arid zones of the country.[9]

Several local farmers said that they had experimented and that unburnt milpas (*siembras en crudo*) increased the incidence of the disease. This seems entirely possible if the higher heat and humidity generated by the rotting vegetation made conditions more appropriate for development of *maize muerto*. Whatever the case may be, this information was passed onto newcomers who continued to burn although most had been able to observe, in origin and step-migration communities, the ill-effects of repeated burning. Some farmers clearly articulated that burning year after year affected forest regrowth, eventually deprived the soil of humus, and reduced the soil to a "ruined," "arid" condition. Yearly burning in the same area was not yet a practice. Because farmers recognized that with repeated soil exposure to the heavy rains "all the humus gets washed out" *(se lava todo el abono)*, they fallowed after each production cycle. Fallowing produced such a mat of vegetation within a three-year period that farmers felt they had to burn in order to plant successfully. Until a better system is introduced, farmers will continue to adhere to this traditional practice.

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[9]In Choluteca, apart from a marked *canicula* or *veranillo* as it is known locally, in July and August, when rainfall declines abruptly, rainfall between May and October is heavy, at times reaching 300 cm/month. This is also true of other southern and western departments of the country (SRN, n.d.). The rainy season comes to an abrupt halt at the end of October or November. The Atlantic Littoral receives northers, or cold fronts, from October to February that produce high precipitation levels, rather than the precipitation generated by southeasterly trade winds.

After burning, activities in the *primavera* were similar to those in the *postrera*. Farmers largely used the same seed; mostly Olotillo, and some Tusa Morada, both landraces. They planted the same amounts (3-4 seeds per hole), and mostly used the same distancing (2-3 ft between plants). Most used herbicide for weed control, rather than manual cleaning with a machete, in mucuna and forest fallow, or *milpa*, systems. In the former, herbicides were used as much to keep down weeds as to control the regrowth of the mucuna. Sixty-seven percent relied on herbicides as opposed to manual control, for the first cleaning. Sixty-four percent of the sample engaged in a second clearing at 1-1/2 to 2 months. Of these, 80% applied a second dose of herbicide, usually Gramoxone. Herbicides, even those specifically designed to kill broadleaf plants, were applied without apparent ill-effect on the longterm health of the mucuna. Farmers claimed that it helped calm "it a little, nothing more." Very few farmers applied fertilizer in the *postrera* or in the *primavera*.

The only noticeable difference in activities between the two cycles was the tendency towards more superficial planting in the *primavera*. The decision on planting depth weighed seed loss due to animal consumption (birds, mice, forest animals) against germination problems increased by deeper planting. Heavy rains clogged up the hole on top of the recently planted grain, preventing seed germination, or alternatively, the hole became water-logged and the seed rotted. If the farmer considered animal consumption to be the most probable, he adopted a deep-planting strategy. If the second, he chose to plant close to the surface. Seeds planted closer to the surface with a special stick *(barreta tendida)*, which opened a hole angled into the hill face, generally avoided becoming water-logged and got more benefit from nutrients, such as organic matter, calcium, magnesium, most of which were concentrated in the top soil. However, the seed could also be eaten rather easily as it was rapidly extractable from such a position. Deeper planting helped prevent this and acted to provide moisture to the seed. Farmers using mulch systems ran a higher risk of animal damage to the seed since mulches provided a refuge in which a host of animals could take cover. Most farmers (85%) chose to deep-plant in the *postrera*. In the *primavera*, 46% of the farmers interviewed chose to shallow-plant because they viewed the onset of the rains and the risk of a low germination rate to be greater than the risk of animal damage which was reduced by burning the vegetation cover.

Table 14. Costs and net revenues, production of *primera* maize, 1 *manzana*.

	lempira
Total costs	1,158
Total sales[a]	1,075
Profit (loss)	(83)[b]

[a] Based on average sale price on main road in October 1993; i.e. 100 lempira/*carga*, and average yield of 10.75 *cargas/manzana*

[b] Net loss of US$12/ha, based on exchange rate in October 1993, of 7 lempira/$1).

The *primavera* maize cycle required more labor than the *postrera* cycle in land preparation and sale prices were lower (Table 14). Costs were slightly higher than the *postrera* slash/mulch system.Not surprisingly, farmers who planted large areas in this cycle using hired labor complained that there was no money in it. Indeed, there was not and farmers took a loss. Since most were employing family labor, this was not evident. All farmers who provided information on production costs put a price on labor-time.

Bean cultivation

The principal bean cycle was *primavera*. A small number of farmers produced beans in October/November, primarily for seed, for use in the following *postrera* cycle.

The importance that farmers placed upon the *primavera* bean cycle, compared to the *postrera*, inhered in the higher yields (Table 15) even though the value of output per unit was considerably higher in the *postrera* because of price increases.

Table 15. Comparison of bean yields and area planted, Rio Cuero

	Area, ha	N	Yield, kg/ha	N
Primavera	.65	80	1,190	74
Postrera	.44	72	810	56

Postrera

Site selection in the *postrera* took into account that the beans would likely be subjected to prolonged dry spells during the cultivation period. Farmers looked for humid areas around mountain streams, either on slopes or flatter lands, and at lower elevations, relative to the *primavera* cycle, as will be discussed below. Notwithstanding the expectation of prolonged dry periods, 52% of the farmers reported burning the slash prior to planting as opposed to leaving it as a slash-mulch, even though 95% of the farmers selected short fallows of one year only and which therefore would provide manageable ground cover. The primary rationale for burning the slash was the belief that beans were more susceptible to disease if they were close to rotting vegetation. The deep-seated belief regarding the desirablity of removing all vegetation from the vicinity of beans may be gauged from the fact that of the three people who planted beans in mucuna, two of them burned the mucuna prior to planting. No farmer would have considered doing this in the maize/mucuna system. Nevertheless, 48% of farmers did not burn the slash at this time of the year, although for some this had more to do with the impossiblity of doing so, which was governed by the timing of cessation of the winter rains.

Probably because of the commonly-felt need to burn the slash in the *postrera* bean planting, which meant waiting until the winter rains eased somewhat, beans were generally planted later than maize. Eighty-seven percent of farmers planted in February; the remainder in January. Ninety percent of farmers planted Danli 46, a bush bean, although some also planted a 50-day bean at the same time. The remaining farmers preferred only faster maturing, 50-day varieties. Ninety-eight percent of farmers shallow-planted beans to avoid

germination problems stemming from too much rainfall in the first week after planting. (Animal damage was generally minimal with beans.) Farmers believed that beans rooted better in the looser top soil and grew more quickly, with more foliage, because of the concentration of nutrients contained in the top layer. Surface planting also eased the task of uprooting at harvest time. Four seeds per hole (93%) were planted in the expectation that germination would be less than 100%. Seventy-eight percent of farmers employed a planting distance of 1 ft between plants. Farmers expected smaller plants in this cycle. In addition, they desired to provide soil cover to limit weed growth.

Herbicides were not employed. Farmers weeded once at three weeks by hand with a curved scythe or machete. The former, when used in conjunction with a slash-mulch, was employed under the mulch to sheer off the weeds without exposing the soil. When the beans were ready for harvesting, the plants were uprooted and generally left to dry on the ground. Bundles were strung between two trees. This was time-consuming and was not required if the weather was dry. Finally, the beans were beaten free of the pods on a large canvass supported between four poles.

Table 16. Costs and net revenues, production of *postrera* beans, 1 *manzana*.

	lempira
Total costs	1,150
Total sales[a]	3,975
Profit	2,825[b]

[a] Based on average sale price on main road in May 1994; i.e. 530 lempira/*carga*, and average yield of 7.5 *cargas/manzana*

[b] US$422/ha, based on exchange of 8 lempira/$1).

Estimated average costs for bean production in *postrera* were 1,150 lempira. These were lower than costs in the primavera (see Table 16) derived from lower land preparation costs and lower labor and transportation costs based on lower yield.

Primavera

The main goal in *primavera* was to eliminate excess moisture. Farmers selected high areas on very steeply-sloped hillsides to encourage rapid run-off of rainfall. East-facing slopes were chosen in order to receive the sun at sun rise which allowed rainwater, which had collected on the plant from the previous day's rainfall, to evaporate before the heat from the sun "cooked" the water and plant. Ideally the soil should be stoney, crumbly in texture, and dark in color. Clayey soils were considered poor for producing beans because they retained too much water, increasing water-logging and relative humidity.

Farmers used a well-developed fallow of at least two to three years, preferably four years or more. Plots were slashed in April and burned before the rains were expected in May. Plots higher up and well-exposed to sunlight dried more quickly and burned better. A better burn meant less weeds and less disease, according to farmers. Eighty-five percent of the

farmers planted in May, as soon as the first rains arrived. Those who planted later in June or July often used a faster-maturing variety. The majority used Danli 46, as in the *postrera* cycle, which took 2-1/2 to 3 months to mature. Farmers aimed to have their crop harvested before the heavy *postrera* rains began in September.

As in the *postrera*, nearly all farmers (97%) shallow-planted, and 87% put four grains into each hole. Planting distance was greater than in the *postrera*. Eighty-seven percent of farmers left 1-1/2 to 2 feet between plants. The rationale for this was the expectation of greater plant development as a consequence of the longer fallow period in combination with heavier rainfall and the need to provide the space in which this growth could occur. Too little space between plants, farmers believed, would increase moisture retention and relative humidity, which was likely to provoke *hielo*, or web blight, as well as helping to "cook" the plants. Farmers had a tendency to plant with the slope because of the difficulties of contour planting on very steep inclines. This aggravated erosion caused by planting on steep inclines.

As in the *postrera*, farmers employed only one cleaning at three weeks (92%), which was with a machete or curved scythe. At maturity, the beans were pulled up, tied by the stems and formed into bunches which were hung upside-down to dry. The drying process took three to four weeks and was undertaken because of difficulties of drying the beans during the rainy season. If the daily rains were too prolonged and heavy, farmers risked their beans sprouting and losing the harvest. Once the beans were dry they were beaten with sticks to remove the shells, bagged, and taken by mule to the house.

Bean yields compared favourably with national averages. Average yields in Honduras in 1989/91 were 736 kg/ha, up from 595.7 kg/ha in 1969/71 and 517.5 kg/ha in 1979/81 (CIAT 1993, p. 67). Averages in the Littoral were 1.1 t/ha in 1975/76 and 810 kg/ha in 1977/78 (SRN 1980, pp. 20-21). In the late seventies, the Atlantic Littoral had the highest bean yields in the country (SRN 1980. p. 10). In Rio Cuero average yields were 1,190 kg/ha and 810 kg/ha in the *primavera* and *postrera*, respectively (Table 15).

Bean trials conducted through participatory research with farmers in Rio Cuero produced an estimated 1,820 kg./ha from one of the varieties. This suggested considerable potential for bean production for the region. Matute (1992, p. 36) estimated that 48% of the beans consumed in La Ceiba, the country's third largest city, came from a few watersheds in the Atlantic Littoral area.[10] Moreover, because north coast farmers harvested in May and August as opposed to November when the majority of the farmers put their bean crop on the

[10] According to Matute, 9.67% come from Piedras Amarillas, 37.11% from Yaruca, and 1.61% from Descombros (1992,p.35). These figures did not take into account a number of other watersheds in the vicinity, such as Rio Cuero, which were also bean producers. In addition, according to Matute, 19..34% of the beans arriving in La Ceiba originated from Colon which had approximately the same climatic characteristics as Atlantida. This suggests considerable potential for the northern region in bean prodution given the development of germplasm which is more humidity tolerant.

market, they avoided low prices due to seasonal market gluts.[11] Thus, Atlantic Littoral farmers generally had a comparative price advantage in beans production in Honduras

Table 16. Costs and net revenues, production of beans in *primavera*, 1 *manzana*.

Activity or input	Costs	
	days	lempira
Land rental		100
Land preparation		
Cutting and slashing fallow	16	208
Burning	2	26
Planting	6	78
Seed, 100 lbs		250
Cleaning	3	39
Pulling up, bundling and stringing for drying	25	325
Beating, shelling and bagging	12	156
Transportation, field to house	4	240
Mules, 5 days		65
Muleman	2	26
Transportation, house to point of sale[a]		220
Total costs		1,439
Total sales[b]		3,630
Profit		2,137[c]

[a] 11 *cargas* at 20 lempira/*carga* from San Marcos to main road
[b] Based on average sale price on main road in August 1993; i.e. 330 lempira/*carga*, based on 11 *cargas/manzana*
[c] US$365/ha, based on exchange rate of 7 lempira/$1 in August 1993.

The October cycle

Bean seeds from the *primavera* harvest would not last, under prevailing post-harvest storage arrangements, until the *postrera* planting. Farmers said they did not germinate well. The October planting provided fresh seed for the *postrera*. Nevertheless, few farmers engaged in it because yields were so low and those who did generally failed to obtain more seed than planted. Nevertheless, at a minimum, farmers obtained fresh seed. Planting conditions were similar to those selected for in the *primavera* although the slash was

[11] In August, however, North Coast farmers must compete with farmers from the main bean producing areas, viz. Paraiso, F. Morazan and Olancho, where there is also a harvest at this time. These farmers benefit from the presence of the canicula in their area which enables them to harvest the beans during a relatively low rainfall period; the canicula is not apparent in the north however, and beans from the area tend to be of a lower quality.

generally too wet to burn. The best soils for this very wet cycle were well-drained, sandy soils.

Farmers who did not plant in October generally bought fresh seed from one of the farmers who did plant or from outside the area. This sometimes led to the sowing of inappropriate material or may have involved travel to communities with a reputation for producing good bean seed, such Rio Viejo in the Cangrejal Valley behind La Ceiba or some of the Yoro communities on the far side of the cordillera where rains were less heavy. There was a serious shortage of seed for planting in the *postrera* because of the length of time between plantings and the lack of adequate storage capacity for seed maintenance.

Rice cultivation

According to respondents, rice was produced by 13% of farmers. Rice production may have been underreported because it was generally cultivated in only very small amounts for household consumption. The low rate of cultivation was culturally as well as environmentally determined; however, most importantly it was determined by cost factors.

Migrants from the western departments produced and consumed primarily maize and beans. Rice did not play a pivotal role. This was in contrast to the coastal diet, where rice was the principal staple. Most migrant families consumed rice but only in approximately equal proportion to beans, the main protein source and a much higher value crop. Maize *tortillas* were the preferred starch accompaniment to beans.

Since maize and beans were the preferred foods, families were less willing to devote time to rice production which coincided with peak labor demands in the production of the other two crops. Rice was sown in May after the first rains and, depending on the variety sown, harvested in August or October/November. Either way it competed with the *primavera* harvests of beans and maize. Most local farmers claimed that rice could be successfully produced only in well-burnt forest fallows. Short fallows did not function to guarantee a good rice crop. While the need for fertile soil may have been partially responsible for the demand for forest fallow for rice, most importantly, it was the issue of weed control. Competition from weeds, and particularly grasses, such as Rottboellia cochinchinensis, which were more pervasive in shorter fallows, made rice production too labor-intensive, or too costly if herbicides were employed, to be worthwhile, given the cultural preference in favour of maize and beans.

In areas of forest fallow, rice was the preferred crop since the land was considered to be too humid for maize or beans. Farmers often sowed rice in the first cycle after clearing forest. Thereafter, fallows were shorter and rice production was less likely. Those who continued to cultivate rice tended to plant on soils that retained moisture well, such as somewhat clayey soils. Some people even used "coloured soils" (red soils). In other words, rice did not generally compete for land with the preferred maize and beans crops since these were not planted under the same soil conditions.

Rice, like other *primavera*-cycle crops, was harvested in wet weather. This reduced the quality of the crop and the price the farmer received. The Atlantic Littoral was a substantial rice-producing region. Rice was mainly produced on lowland properties along the coastal plain and because many of the producers were large, farmer cooperatives or private

producers, and local intermediaries were accustomed to buying in volume. Small upland producers whose grain was generally of a low quality had no bargaining power with buyers. Moreover, most lowland producers faced lower cost curves due to mechanized production and much lower transportation costs. This latter issue was particularly critical since upland rice producers typically were far from the main road. In other words, those producing rice at the forest frontier, where environmental conditions were considered by farmers to be most suitable for this crop because of lower weed competition and greater humidity, had to pay the highest transportation costs. As a consequence rice was not profitable and was produced infrequently for sale.

Other food crops

In addition to the principal food crops discussed above which are eaten on a daily basis, many farmers also grew root crops, especially cassava, as well as bananas (*guineos*) and chayote *(pataste, patastillo)*, for household consumption. These crops are almost never sold. The tendency was to grow them close to the house where they could be harvested as the need arose. Because they could be planted at more or less any time of the year, they did not compete for labor at peak times. Moreover, owing to the close proximity to the house, women and children were more likely to be employed in some aspects of cultivation, such as harvesting, thereby avoiding the withdrawal of male labor from grain crops.

Tabasco chile pepper production

The production of Tabasco chile peppers was a new and rapidly growing activity in the River Cuero watershed. In 1992/93, only a small number of families in San Marcos produced chile. In 1993/94 most of the entrepreneurial households in the watershed were engaged and many more households planned to enter chile production during 1994/95. The largest area under chile recorded was two *manzanas*. Some producers had as little as one-quarter of a *manzana*. Nevertheless, chile production was competing for labor time with beans in the *postrera* planting and was reducing the amount of beans planted for commercial purposes.

The local market for Tabasco chile pepper was a sauce-making and bottling factory in nearby San Juan Pueblo. There were no other local purchasing outlets. The factory owner bought freshly-picked peppers and advanced seed and cash to contracted producers. To qualify for cash advances, producers had to be able to carry the plants through the early months of production with their own resources. Around the time of flowering, producers wishing to enter into a contract with the factory were visited by a technician to assess the health of the crop and estimate the harvest. If the owner passed this test and signed the contract agreeing to sell his crop to the factory, he received advances on the harvest with which to buy the chemical inputs required for the remaining period of production. Production costs were considerable, based on records from two farmers working on a joint plot during 1993/94 (Table 17). Notwithstanding the higher costs and longer period of production relative to other crops, such as beans, the profits were high.

Table 17. Costs and net revenues, production of Tabasco chile pepper, 9,000/pepper plants/*manzana*.

	Costs	
Activity or input	days	Lempira
Land rental		100
Seed bed preparation and cleaning	12	168
Land preparation	20	280
Herbicide application	3	42
Planting	14	532
Resowing	3	
Hoeing	9	126
Fertilizer application and disease control	124	1,610
Inputs		
Backsprayers, 2		819
MTD, 1 liter		70
Copper, 1 kg		40
Bayfolan, 1 liter		22
Counter, 2 kg		40
Formula, 2 qq		144
Pillaron Insecticide, 1 bottle		70
Champion fungicide		45
Formula, 4 qq		288
Fungicide, 1 gallon		280
Gramoxone, 1.5 gallons		280
Folidol, 1 liter		54
Bayfolan, 1 liter		24
Matador, 1 liter		45
Trodan, 2 liters		168
Urea, 4 qq		260
Tamaron, 1 liter		70
Harvesting, 10,636 lb at 0.35 lempira/lb		3,723
Transportation, 0.10 lempira/lb		1,064
Mule, 4 days		60
Total costs		10,424
Total sales[a]		24,453
Profit		14,029[b]

[a] Based on average sale price of 2.3 lempira/lb.
[b] US$2,113/ha

The production of chile peppers was high-risk crop because of the capital required and the risk of losses from disease. Central American and Mexican tomato and pepper production was seriously affected by Gemini Virus which is vectored by whitefly. Over-

spraying to control the disease had resulted in pest resistence and an explosion of whiteflies and the disease throughout the area. Because of the isolation of the study area and the limited use of chemicals, Gemini Virus had not become a problem. There was evidence of it in some of the plants in 1994, suggesting that chemical overuse could lead to problems in the future. This would most likely make production non-viable.

Those entrepreneurs who spearheaded the entrée into peppers had made relatively large sums of money. This money was being used for improved housing and, among those who had sufficient land, for investment in cattle (pasture improvement and the purchase of animals). One farmer who had savings from other enterprises planned to buy a vehicle to transport peppers to the factory. Transport was being provided by individuals from towns in the lowlands.

Tabasco pepper production required large labor inputs at harvest time. Planting took place in September so that peppers could be harvested during the dry season. This meant that everyone harvested Tabasco pepper at approximately the same time. Each plant should ideally produce a pound of peppers and a density of 10,000 plants per *manzana* was recommended (FHIA, n.d.). If approximately 50 lb are harvested per person in half a day, which was probably as much as can be expected given the extreme heat during the harvest period, it would require 200 half-work days to complete the harvest of one *manzana*. This was likely to be more labor time than most families can provide, especially since it was also when households were bringing in the bean and maize *postrera* harvests. For this reason, individual families would almost certainly be restricted in the amount that they can grow. The employment of women and of school children helped to ease the labor supply shortage. But, the factory would receive chile only up to a day after picking, and only the red fruits, so there was little flexibility around the harvest.

Commercialization of grain

Farmers sold the portion of their crop which was not retained for household consumption soon after harvest. This prevented spoilage and price reductions consequent upon the poor quality of the grain. Grain to be stored for household consumption, particularly beans, was normally dried to around 12% humidity to prevent it from becoming wormy. This extra drying was not undertaken for the entire crop because of the difficulties of patio-drying a large amount of grain. As a consequence, spring crops taken out during the rainy season, were subject to price reductions because of the high moisture content. This was especially true of *primavera* maize since the local harvest coincided with havesting time in the rest of the country where conditions were better owing to the earlier cessation of the rains.

Residents of the Cuero and Santiago watersheds considered the cost of transportation from their fields to their houses and also from the household to the main road where prices were more competitive than in the villages. Households were generally grouped at lower elevations and farmers' land was distributed up the hillsides. The more valuable land was closer to human habitation and access routes. The poorest farmers tended to have land two hours or more from their houses. Others prefered to live closer to their land near the source of the river Cuero even though this meant that their children would not be able to attend one of the schools because of distance and difficulties in crossing rivers. Either way, farmers payed a good deal for transportation to markets.

Families who had lived for some time in the watershed generally owned their own mules. Families without mules rented them during harvest periods and the cost of rental rose with demand. For those who lived high up in the watershed above the community of San Marcos, the cost of transporting a *carga* of maize by mule to the main road in the fall of 1993 was equivalent to approximately one-quarter of the crop's sale price. A mule cost around US$250 (2,000 Lempira) which was a large expense for most families whose entire average annual income may be no more than $600. Those without their own animals often sold to buyers in Santa Fé, which was accessible to trucks or tractors during the dry season and sometimes until later in the year, depending on the rains. Buyers deducted the cost of mule transportation from the final price.

Many later arrivals were landless and relied on rented land for planting their crops, and did not own mules. They had neither the capital nor the land on which to pasture animals. These individuals payed the highest rents on capital and were most negatively affected by the poor communications of the area. Among all those interviewed in the communities of San Marcos and Santa Fé, the most pressing community problem was considered to be the lack of an all-weather road connecting the communities with the lowlands. Residents seemed unconcerned, or oblivious to the fact, that a road would undoubtedly increase the amount of cattle ranching in the watershed with negative effects on the landless and indeed, ultimately on the forest, as small farmers and the landless would find themselves forced further afield in search of land for crop production.

Household consumption of grains and income from grain production

In order to estimate household income and consumption we defined a modal household based on detailed consumption data for 31 households. Since the average number per household in this smaller sample was 7, rather than 6 as in the larger sample, the consumption figures are somewhat overestimated. They have been adjusted downwards to take this difference into account.

An index was developed which gave children school-age and below half a point, as well as children under the age of 12 not in school. Other members were given a point. This index yielded a modal household comprising 5.5 consuming units. This was adjusted to 4.7 consuming units in order to calibrate it to the average household with a membership of 6 people.

Because most farmers did not pay labor costs, nor rents on capital (land, mules, etc) cash income was higher than that present in Tables 18 and 19. This represents the minimum that was likely to be earned. If the value of food consumed is added to this, the value of farmers' production was $899 or $755. However, since purchased grains were necessarily priced above those of grain sales, the real value of production, once imputed consumption costs are included, is higher than this[12].

[12] Villagers working on the road in the watershed, netted only $686. Moreover, since the road crew was never paid on time, most workers were forced to sell their "monthly pay vouchers" to intermediaries who forwarded them a percentage of their pay cheque and kept the other percentage for themselves whenever it came through. This reduced the annual salary for road building to around $500. However, in reality most of those working on the road also produced their own food either by assigning the task to other family members or by working themselves on weekends.

Table 18. Income and consumption data, San Marcos and Santa Fé (Group with Mucuna).

	Area, *manzanas*	Yield, *cargas*	Production, *cargas*	Consumption, *cargas*	Net cash, $
Beans					
Primavera	0.78	10.94	8.53		
Postrera	0.53	7.43	3.93		
Total			12.46	2.71	325
Maize					
Primavera	1.2	10.75	12.9		
Mucuna *postrera*	2.33	16.3	37.98		
Total			50.88	11.42	209
Beans and maize					534

Table 19. Income and consumption data, San Marcos and Santa Fé (Group without Mucuna).

	Area, *manzana*	Yield, *cargas*	Production, *cargas*	Consumption, *cargas*	Net cash, $
Beans					
Primavera	0.78	10.94	8.53		
Postrera	0.53	7.43	3.93		
Total			12.46	2.71	325
Maize					
Primavera	1.2	10.75	12.9		
Slash/mulch *postrera*	1.3	11.78	15.31		
Total			28.21	11.42	75[a]
Beans and maize					400

[a]Assumes *primavera* harvest, produced at a loss, was consumed and *postrera* harvest was sold.

Cattle production

Cattle production in the area was essentially of two kinds: that which was carried out by people living in the lowlands who pasture their animals in the hillsides, and that which was

carried out by migrants who lived in the watershed itself. The former was part of a larger system of production which was oriented towards selling milk mostly to the Leyde dairy in La Ceiba. The latter was generally small-scale and mainly for the production of milk for sale in the watershed and/or for the manufacture of cheese which could be sold in the lowlands, as well as for the sale of young steers.

Lowland agriculture in the department of Atlantida was dominated by dairying, pineapple and African palm oil production. These activities replaced banana cultivation which held sway in the lowlands until the 1960s. According to the 1993 Agricultural Census, pasture (both natural and cultivated) comprised 50% of censused department lands, including forest and fallow; pineapple and African palm oil accounted for 9 per cent of the total (SECPLAN 1994). In other words, nearly 60% of censused lands were devoted to these three commercial uses. These activities took in nearly all the coastal plains as well as the flatter lands in the foothills and upland watershed valleys.

Concentration of land within the commercial crop sector was notable: just seven holdings accounted for 10% of all censused lands; at the other extreme, 62% of holdings comprised 8.3% of the total area (SECPLAN 1994). The largest holdings belonged to Standard Fruit (Dole) and to some of the other agro-export companies producing African palm oil. Within the ranching sector holdings were generally more modest. According to a 1995 study conducted in the department by the Ministry of Natural Resources, the average lowland ranch was 65 ha with 29 animals in milk production (SRN 1995)[13].

Ranching, the main economic activity in the region, was dominated by dairying, although dual purpose production in reality characterized most operations.[14] The emphasis on dairying in the coastal plains of Atlantida, along with the neighbouring departments of

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[13] Dole pineapple employed an estimated 4,000 persons according to information provided by the mayor of the municipality, El Porvenir (personal communication) where Standard Fruit concentrated pineapple operations on 2.5 thousand ha of land (SECPLAN 1994). In other words, pineapple production was relatively labour intensive, employing 1.5 persons/ha. Unfortunately, African palm oil production was much less labour intensive and covered a local area nearly five times as large (11,723 ha) (SECPLAN 1994). Nevertheless, dual purpose ranching, which occupied the largest share of department land, employed few people on an area basis: just four persons per ranch or approximately one person per 16 ha (personal communication Ing. Jorge Rivera, SRN).

[14] Dual purpose production referred to the practice of raising calves of both sexes and leaving them with their lactating mothers until eight to twelve months when the young steers were either sold or kept to fatten for later sale. According to a 1995 SRN study, only 3.9 per cent of cattle ranchers in Atlantida sold calves at birth, or, in other words, could be characterized as more specialized dairy farmers (p. 10).

Yoro and Colon, gave the region the distinction of being the principal "milk valley" (*cuenca lechera*) or main milk producing region of the country (SRN 1995).

The growth of ranching in the region was rapid. Between 1952 and 1993, the cattle population in Atlantida expanded from 27,583 head to 147,233, representing an increase of 434% (Sunderlin and Rodríguez, 1996). The expansion of the local dairy industry was well illustrated by production data from Leyde S.A., the country's largest milk processing plant which was located in the city of La Ceiba, Atlantida, in the midst of the "milk valley". Sula, the second largest milk processor, was located in San Pedro Sula, the commercial hub of Honduras, which was situated at the valley's western end. As the following chart shows, production at the Leyde plant rose from three million litres in 1974, when the company was in its infancy, to approximately sixty million litres in 1993 (SRN 1995, p. 12).

Purchases of raw milk, 1973 to 1990

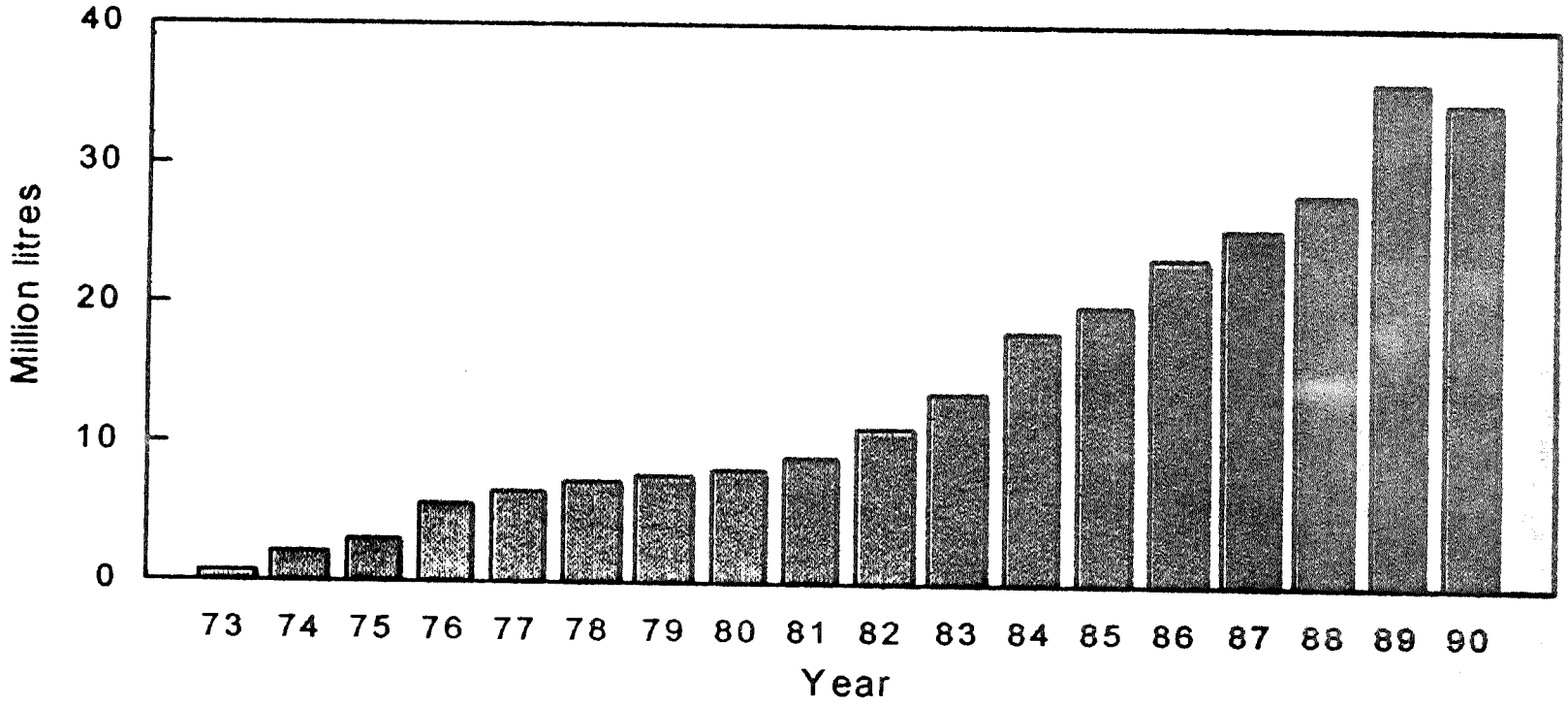

Figure 3. Milk purchase, Leyde Dairy, La Ceiba, 1973 to 1990
(Internal document, Leyde 1990, p.43)

In addition to Leyde and Sula, there were also between 20 to 30 artesanal cheese-makers in the region (Rivera 1995, p. 4). These varied from small family establishments to two larger operations. The amount of milk processed by the twenty-one cheese operations included in a study by Rivera (1995),[15] oscillated between 80,300 l/day to 94,700 l/day in the period of highest output (rivera, 1995, P. 8). This was a substantial amount; indeed, the average represented more than half of the quantity of milk processed by Leyde on a daily basis.

Ranchers selling to Leyde[16] and Sula delivered their milk directly to the milk trucks or to reception centres on the only paved road than ran across the coastal plains between San Pedro Sula, La Ceiba and Trujillo. By contrast, those cheese-makers who owned transportation generally drove off the beaten track to collect the farmers' milk at the farm gate. However, the cheese-makers, who lacked refrigeration (Rivera 1995), paid producer prices that were subject to marked seasonal variation depending on supply.[17] Leyde and Sula, by contrast, had substantial processing and refrigeration capacities and could better manage supply in accordance with the market thereby minimizing fluctuations in producer prices.[18] It was the desire to be close to these milk collection services in order to access the more stable prices offered by the major dairies that placed a high premium on easily accessible properties and helped to raise land prices close to the main road.[19]

The growth of dairy farming and competition between ranchers and agro-exporters for lowland properties no doubt helped to spur more intensive landuse. Thus, while the cattle population in Atlántida expanded by 434 per cent between 1952-1993, the increase in pasture was considerably less: 260 per cent over the same period (Sunderlin and Rodríguez, 1996: 4).[20] Studies of the Atlantic littoral region put the average stocking rate at 1.5 animals per hectare (See Rivera, 1995: 3). This is close to double the average for the country and, indeed,

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[15] This study was commisioned by me in order to gather data on the informal cheese sector. There were no comprehensive studies dealing with the region's cheese-makers.

[16] In 1994, there were around 2,000 ranchers selling to Leyde (SRN 1995, p.12). Nevertheless, milk sales from just 35 producers comprised 38% of the total sales to Leyde. Some of the larger producers were shareholders in the company (personal communication, Ing. J. Rivera).

[17] Notwithstanding the lack of refrigeration, many cheese-makers did store cheese over considerable periods, especially between July and January when supply was high across the region and prices were low. The cheese produced was dry and flakey in texture and could be conserved by periodic airing and mould removal (Rivera 1995).

[18] For example, in June 1995, when production peaked in the country, prices paid to producers by intermediaries and cheese-makers were only 1.7 Lempiras/l compared to 2.6 Lempiras/l paid peak season (June-September) Leyde did not pay the regular price on all milk purchases (rivera 1995); for example, surplus production was bought by Leyde at 70% of the government-controlled price in June/July 1995. Leyde's refrigeration capacity was limited to 67,000 l/day (SEC 1995). Sula had capacity for 80,000 l (Bravo -Baumann 1987, p.10).

[19] In 1995, agricultural land close to the city of La Ceiba and to the only paved highway connecting lowland communities, was selling for around US $ 2,000/ha; land in the foothills but close to the highway was half that amount, while the flatter upland valley properties, some distance from the paved road but suitable for grazing cattle, were going at around $600/ha. Steep hillside properties without legal title, located far from the main road and close to the forest frontier, were priced upwards from $100/ha.

[20] These authors' figures are derived from the four agricultural censuses published between 1954 and 1994.

well above that of Latin America as a whole.[21] Consonant with this is the increased adoption of 'cut-and-carry' systems, a land intensive practice in which penned or stabled animals are fed cut forage.[22] This practice rose from 1 per cent in 1982 to 19 per cent in 1989 in the Atlantic littoral region (Rivera, 1995: 3). The use of improved pastures for grazing purposes has also become widespread.[23]

Despite improvements in pastures, output per milking cow across the valley is less than 5 litres/day and an average of only one-quarter of the animals per holding are in production at a given time (SRN, 1995: 13, Appendix 8). The predominance of dual purpose production and the use of mainly Zebu/dairy cow crosses lowered milk output. Nevertheless, ranchers preferred the hardiness of the cross breeds and the security provided by the income accruing from the sale of young steers over specialization in dairying (SRN 1995, p.8). The long calving intervals were believed to be associated with nutritional deficiences (personal communication R. Martinez, DVZ), however, the use of feed supplements was rare (SRN 1995, p. 19).[24] In other words, intensification was only partial.

Pricing policy no doubted played a role in slowing the pace of intensification. Honduras had amongst the lowest producer prices in Central America (SEC, 1995).[25] Low milk prices were part of a government policy of cheap food, supported by low tariffs on imported milk. While this policy had helped to boost exports of milk products, mainly of white cheese and cream to El Salvador during the dry season,[26] it had also supported the low risk, dual-purpose strategy adopted by most ranchers of the region.

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[21] Sunderlin and Rogriguez (1996) estimate the national stocking rate at 0.82 animal units per hectare by disaggregating the total number of cattle in the 1993 census into animals above one year and below one year. The latter are counted as one half and the former as one whole unit (p.13). Ledec (1992) reports the Latin American average as around one head of cattle per hectare.

[22] Pastures employed for this purpose include King, Napier, Taiwan and Texas Grass (Pennisetum purpureum). This practice is both land and labour intensive.

[23] The SRN 1995 study found that 47% of surveyed farmers used Alicia (Cynodon nlenfuencis), 41% employed guinea grass (Panicum maximum, 38% Braquiarias and Bressanta)(SRN, 1995: 16).

[24] According to Nicholson et al. (1995) the reluctance to engage in more intensive production requiring additional inputs stemmed from the fact that most farmers in the tropics do not take the opportunity costs of land into consideration in their calculation of cost. These authors argued that cattle production was regarded as a way of retaining the investment in land. Thus farmers' primary concern was not with net income above total costs but rather with net income above variable costs. The dual purpose system kept variable costs to a minimum (p.728).

[25] For example, while prices in Honduras in January 1994 were only 15 cents/l, prices in neighbouring Guatemala and in El Salvador were 31 and 38 cents/l respectively. Between 1984 and 1993, average yearly milk producer prices in Honduras were US23.5 cents/l; however, there was considerable variation around this mean, for example, in 1990, the average price for the year was only US15 cents/l. In June 1995, Honduran prices were adjusted upwards to 31 cents/l; however, by that time Salvadorean and Guatemalan prices had risen to 45 and 42 cents/l; only Nicaragua had similar producer prices (SEC 1995).

[26] Cheese-makers interviewed by Rivera (1995) reported average total daily exports of 14,000 lb of cheese and 11,000 lb of cream to El Salvador. Most of this production came from two large cheese-making operations in the department of Colon. If these figures were correct, it would mean that more than 4 million kg of dairy products per year were exported to El Salvador. Rivera, however, urged caution with this data. Since he conducted the interviews as head of the cattle division of the Atlantic littoral office of the Ministry of Natural Resources, cheese-makers may not have reported their output correctly; underreporting seemed the most probable. Whatever the case, these figures were certainly a very far cry from the United Nations figure that put Salvadorean cheese imports from Honduras at only 145 thousand kg in 1992 (UN 1994). The latter figure in fact more closely corresponded to Leyde's exports to El Salvador (see SRN 1994).

Low productivity associated with the long intervals between calvings had made it relatively common for lowland farmers to employ hillside properties for "dry" cows (*ganado de ahorro*) when access to milk markets was unnecesary.

As a frontier area where prices were still relatively low, the Cuero watershed was being sought for such purposes by lowland farmers. Thus small farmers who owned flatter, riverside properties mentioned the constant pressure on them by larger ranchers to sell up. And for a small crop farmer, an offer to buy his land at as much as four times the price of his neighbour's property may have been too tempting to resist. In all likelihood, he sold and either bought or cleared land further up in the watershed.

Local hillside cattle production

Cattle owners who lived in the upper Cuero watershed itself were likely to have fewer head of cattle than lowland dairy farmers. Only 17 of the 126 households interviewed in San Marcos and Santa Fé owned cattle. The largest local producer had 50 animals in 1994. Two had between 20 and 30, and 8 had 1 to5. We were provided with the names of 30 local cattle owners in the upper Cuero watershed, around San Marcos and Santa Fé, which was estimated to be the total number of local owners in 1994. These farmers generally converted their milk to curds for cheese-making because the local milk collection center was at minimum a 3 to 4 hour walk, and their daily output was low. Curds were made daily and cheese was made every three days. Farmers received around US$1 per pound of cheese in 1994. It took approximately 6 l of milk, the average daily output of a local milking cow (worth about 22 cents/l), to make this. The whey residue was used for fattening pigs. Some of the milk may also have been sold within the watershed. Production rates and reproduction rates per animal were similar to those in the lowlands. Stocking rates were much lower (2 *manzanas* per animal).

Small hillside farmers aspired to own cows because the work involved in looking after them was much less onerous than hillside crop production and the risk was also considerably less. For example, three animals producing 15 l of milk per day yielded approximately 15 lb of cheese per week and would earn $780 per year, assuming constant milk production over the year. Sales of young steers, maybe two per year, would bring in another $280. Labor inputs involved one daily milking, bathing every 8 to 10 days, and various veterinary exercises, such as deparasitization, vaccination, plus two weed control sessions per year to maintain the pasture area. This yielded close to what an average family produced from grains, once the consumption bill was included, with considerably less expenditure of effort.

Nevertheless, the amount of land required for producing grains was much less than that required for cattle production, even taking the fallow periods required for grains production into account. Farmers estimated about 2 *manzanas* per head of cattle, or 24 *manzana* for a herd of 12 cows, compared to a 10 *manzana* average for grains production, including fallow. Once farmers had acquired the necessary start-up capital, it was relatively easy to build up a herd. The main constraints were steep land, generally unsuitable for pasture, and the distance from the main road which made fresh milk sales problematic.

The major dynamic in both watersheds was the development of small dairy herds for local farmers and much larger herds for lowland farmers seeking land to maintain dry animals.

The less labor-intensive nature of dairying, contrasted strongly with hillside cropping systems which demanded considerable amounts of back-breaking labor. Anyone who has watched a hillside farmer hauling sacks of grain up 80% slopes in the pouring rain can readily understand the deeply-felt desire that many had to switch to cattle production. Moreover, the risks from inclement weather were much lower with cattle than with crops. Cheese-making provided an option to surmount transportation problems, and the yearly production of steers generated a source of fully transportable wealth. Unfortunately, cattle production did not absorb enough people to provide an economically sustainable system for the region.

An improvement in pastures could increase stocking rates. Most hillside farmers employed Merkeron, Guinea grass, African Star Grass and Brachiaria, as well as pasturing their animals in *guamiles*.[27] In fact, none of the farmers in Rio Cuero with cattle had sufficient pasture for their animals given the local rule of thumb of 2 *manzanas* per animal. These farmers made up for the lack of pasture by grazing their animals in *guamiles*. The shortage of pasture was related to the frontier nature of the area and to the difficulty of sustaining pastures once they had been sown.[28]

Women's activities

Small livestock

Pigs and chickens were found in most households in the area. The poorest households sometimes had only chickens. Pigs generally represented a form of saving which served in particular as an emergency fund against illness and other unexpected demands for cash. Chickens were kept mainly for day-to-day consumption of eggs and the occasional consumption of meat by the household. Some poultry and egg sales occurred. In some of the the poorest households, nearly all the eggs were sold rather than consumed. Most families interviewed did not consume meat; i.e., chicken or pork, more than twice a month. When there was a hunter in the household, game from the forest was eaten with some regularity.

There were few women who worked in crop activities because of the distance of these activities from the villages. This was associated with the nucleated nature of settlement patterns and the extensive nature of agriculture. The women who did work in crop activities were members of early migrant families. They were the wives and daughters of the pioneers. This

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[27]A few farmers also employed King Grass but only one used it as a cut-and-carry rather than a grazing system. This farmer claimed to have raised milk output by 25% by maintaining his animals stabled and cutting and chopping the fodder. His previous, extensive form of production, had employed only one person per 18 *manzana*. Under the cut-and-carry system, he kept 6 animals per *manzana* and labor demand was 1 person per 3 *manzana*, or six times as much. The farmer lived in the community of Santiago Arriba with easy access to the main road and carried out all the chopping activities himself. Such a labor-intensive system is unlikely to be employed widely in the hillsides where access to market is difficult. Moreover, a forage system of this nature requires nitrogen inputs since the absence of animals in the system means that urea and other animal excretia are not being returned to the soil. Such an intensive system is not recommended for the poorer hillside soils (personal communication, Peter Kerridge).

[28]The common use of Merkeron in the hillsides made pasture maintenance difficult and permitted rapid secondary forest regrowth, because it flowered during the wet winter period, therefore limiting seed production. The clumping nature of Merkeron and King Grass allowed water to run in between the clumps, and led to erosion and promoted weed infestation. Brachiaria provides much better soil coverage but was less frequently used by hillside farmers.

was particularly true of some of the women in Santiago. The strong family networks provided the women with childcare support not readily available to women in the other communities. These women also brought felled logs downstream, a dangerous occupation which had recently led to the death of someone in San Marcos.

The care of small livestock fell to women because livestock were kept close the home and women could combine childcare with productive activities. The raising of small livestock and the cash generated through sales of meat or eggs provided women with a source of income over which they generally exercised some control. This income was used for household necessities such as matches, cooking oil, and washing powder. More importantly, it was often used for medicines and food supplements, such as dairy products, for children, which might otherwise have been omitted from the weekly household shopping list. Women's income allowed purchases which might not have been made with income generated by men.

While nearly everyone wanted to increase the number of small livestock in order to improve family nutrition and raise cash incomes, they identified a number of serious limitations. The most common limitation on raising pigs was the damage caused to neighbouring properties. It was not uncommon to find machete wounds on pigs inflicted by enraged neighbours. Although many respondents cited the need for pigpens, virtually no one built them because it cost much more to feed pigs once they were fenced in than when they could roam freely around the house eating refuse and human waste. The same argument pertains to chickens, although, in this case, it was not damage to neighboring properties but rather damage to the animals themselves, caused by mountain cats, which necessitated the building of chicken coops.

Resistence to fencing animals was primarily related to economic risk because of the high incidence of mortality and disease among small livestock. A few animals could eat refuse and human waste supplemented with maize and so represented a low-risk investment, but larger numbers of animals had to be fed on scarce foodstuffs which could otherwise be consumed by humans. The most frequently cited illnesses were cholera in pigs and pox in chickens. Most people knew that vaccination could prevent the latter, but did not have the funds to buy the vaccines. In addition, the lack of refrigeration made the efficacy of the vaccines questionable in some people's minds.

Outside of waste products, feed for small livestock consisted mainly of maize, although some people fed a variety of root crops and bananas to pigs. Maize was produced by the males of the household. This meant that small livestock production, which was women's work, was dependent on output from men. Increasing women's income, therefore, depended upon men's willingness to increase output or reduce grain sales. This would have reduced income which normally accrued to them, and which may or may not have gone to household use. The high rate of alcoholism among men in the communities meant that a good portion of income earned by them was not directed towards the well-being of the household. Although men and women stated that they wanted to increase the number of livestock, and hence, household food supply and income, this may not have been possible without changes in the systems of land-use and social organization.

Women's other activities

In addition to the care of livestock, women derived small amounts of income from the sale of bread in the communities. A few washed and sewed clothes, and, in households with cows, women were involved in cheese-making. Substantial numbers of women, along with children, had begun harvesting Tabasco chile peppers. This was mainly done by women and children because men were said to be too impatient to do it well. The work required a good deal of manual dexterity and fortitude in the face of pepper burn. In 1994, following the success of a few innovators who introduced the crop to the watershed the previous year, many producers began to produce it which put considerable pressure on labor supply at harvest time. Wages were forced up to 40 centavos/lb which meant that women and children could easily make around US$2.5 for half a day's work. This was above what men were earning. Nevertheless, the harvest encompassed only a two month period at the end of the dry season. Production of Tabasco peppers was likely to grow considerably, opening the way to higher wages due to labor supply shortages at harvest time. This will provide new income-earning opportunities for women and children.

There was some out-migration of young women to work as domestics in La Ceiba or in Tela. These women were single or single parents. In the latter case, the women left their children with their mothers. For the most part, as in other frontier areas (Townsend 1993), there were few local income-earning opportunities available to women. The isolation and distance from markets made commercial undertakings extremely difficult, especially given the cultural trappings of *machismo* which meant that women were subject to constant suspicion from their spouses, making even short absences from the home difficult to arrange. More importantly, women could not accept work outside the home because of their high fertility. The absence of employment opportunities meant that there was little incentive to try to regulate fertility.

Forestry and agroforestry

Forestry

The communities of San Marcos, El Recreo, and Santiago had access to community forests within the buffer zone of Pico Bonito National Park. San Marcos had access to 8,471 ha and El Recreo and Santiago had access to 900 ha each (PDBL 1993; personal communication, F. del Gatto, COSPE). Pressure from cooperativists in San Marcos to allow selective logging in the nuclear zone of the park had extended the communal forest boundaries. This surprising decision may have been related to the gradual disappearance of valuable hardwoods inside community forest boundaries. The high cost of transportation from San Marcos had made the extraction of lower-value, non-traditional woods less viable for this community. Vested interests involved in the commercialization of wood may also have been involved. This position is supported by the relatively large amount of municipal funding which had gone to the construction of a road to San Marcos for the purpose of facilitating wood extraction.

In the absence of effective national or municipal policing to prevent unauthorized interventions, forest conservation demands that local communities derive benefits from

common property as an incentive to preserve it for the common good. In Honduras, the notion of protected areas was simply a notion. There were no effective, institutionalized means of enforcing legislation designed to prevent incursions into the country's forests. The most efficient deterrent appeared to have been a military presence, although in the area of study this had happened only sporadically. Nevertheless, the few weeks that members of the local battalion did spend high up in the Cuero watershed in 1993 and 1994, showed this to be a highly effective weapon against clearing forest. All informants bent on clearing land expressed reluctance to go ahead with their plans for fear of reprisals by the military. A well-trained "green brigade" for forest protection would seem to be an excellent institutional development, independent of collective policing of community forests.

The necessity for outside support for community forest protection stemmed from the fact that new immigrants, and the offspring of early migrant families, had goals which conflicted with those of established migrants whose livelihood was partially dependent on logging. This led to tremendous tensions within the communities. The tensions might have been resolved more easily with outside mediation. On the other hand, the community of Santiago had prevented outsiders from clearing community forest. Santiago represented a case of successful community resolution of a serious problem. Nevertheless, this method sometimes had tragic consequences; for example, when a member of the woodcutters cooperative killed a poor rancher over a dispute involving clearing forest.

An impediment to raising the income of local woodcutters was the technology used for logging. COHDEFOR demanded that woodcutters who were members of the co-ops and AMIs under its control use pit saws because it was believed that, once the loggers acquired chain saws, they would log their way to the furthest reaches of the Mosquitia. Labor-intensiveness was regarded as the only way to brake the pace of logging. Concern about the woodcutters' proclivities to ignore sustainable cutting regimes once armed with chain saws may have been justified. Nevertheless, other groups and individuals illegally working in the forest could not be prevented from using them. As a consequence, their output per unit of labor was much higher than that of cooperative and AMI members. More importantly, the quantity of illegally harvested wood on the local market lowered prices received by authorized woodcutters. This increased cooperative members' dissatisfaction with logging and decreased their interest in forest protection.

The means to safeguard community forests were also affected by social organization. After COHDEFOR was formed in 1974, forest dwellers were integrated into groups as part of the state's social forestry program. The Federación Hondureña de Cooperativas Agroforestales (FEHCAFOR) was created to represent regional cooperatives. COATLAHL (Colon Atlántida, Honduras, Limitada), formed in 1977, represented north coast woodcutters. The AMI concept was introduced in 1986, to bring about integrated forestry development. Some cooperatives, were incorporated, but not all, such as the case of Santiago. Despite the fact that COHDEFOR was created to control and employ the country's forestry resources for the social well-being of communities, local people were not guaranteed long-term access to those resources and, as a consequence, took little responsibility for conserving the resource base. Tree tenure was insecure because the state, as lawful owner of country's forest resources, reserved the right to sell timber concessions on community, or anyone's, land (Vallejo Larios 1992, p. 3-5). This did little to aid conservation or

reforestation (ACDI-COHDEFOR cited in Vallejo Larios 1992, p. 23). The Agricultural Modernization Law again allowed private ownership of forest resources, and the way was opened for communities to acquire juridical rights over communal forests. With support from the PDBL, this had been achieved in some of the AMIs in the Atlantic Littoral region.

Organizational problems remained which served to alienate local people from wood-cutting as an occupation. Thus the number of individuals actively participating in the forest sector in the three study communities with community forest resources was less than expected. Santiago had 16 members, down from 22 at the outset. San Marcos had begun with 64 members but had 17 in 1987 (COATLAHL 1988). In 1992, it had 63 members but half were threatening to leave over a seizure of wood. Recreo had 18 members (PDBL 1993 PDT) although considerably fewer were actively participating in woodcutting. Nearly all those interviewed who participated, or had participated, in forestry activities complained about organizational problems and petty theft from local and regional leaders.

Organizational problems were found at all levels. At the lowest level there were problems between members working in pairs to handle the pit saws. At the local level, accusations of theft revolved around the illicit use of profits which were supposed to be returned to the members at year end, following the sale of wood by the cooperative. Local leaders were believed to underreport profits and had, at least once, absconded with them altogether. There were problems at the regional level over prices received for the sale of wood. The leadership was suspected of underreporting sales receipts and pocketing the difference. Because literacy was limited, leadership positions were generally held by the few people who could read and members were kept ignorant of what was occurring. This tended to occur in all projects, not only forestry projects. The distance of most of the cooperative locals from headquarters meant that often only one representative, usually the local leader, attended meetings. This enable him to report whatever he wished on his return. Nevertheless, there was nearly always suspicion and a good deal of ill-feeling. The woodcutters association in Recreo was not afiliated with COATLAHL and could sell wood where it could obtain the best price. The group was supported by the PDBL and had access to one of its vehicles for moving the wood. Although this removed one layer of bureaucracy, it had not succeeded in allaying suspicions of graft.

Organizational problems also occurred at the national level. For months in 1993 and 1994, all woodcutters associations were prevented from cutting wood while management plans were prepared and approved for each group. Foresters qualified to carry out the plans gravitated to the private sector where pay was higher. In Santiago, many of the members of the cooperative were landless. The delay caused considerable hardship because there were few employment alternatives available locally. Shortly after the plans been approved, and the wood-cutters had returned to work, a truckload of high-quality wood belonging to San Marcos was seized and impounded because it did not correspond to the woods approved in the management plan. It transpired that the error was in the loading the truck, not in the wood actually cut, but COHDEFOR did nothing to help resolve the issue. Infuriated cooperative members began selling their remaining wood wherever they could and were threatening to desert the cooperative in droves at the end of 1994. Meanwhile, wood illegally cut was transported with impunity all over the country if the transporters of the wood had

sufficient funds to pay off guards at various check points. Cooperative members did not have the resources necessary to ensure safe passage of their lumber.

Agroforestry

Cacao was produced in the area and was among the priorities commonly cited by many farmers for expansion and improvement. Upgrading the system would involve replacing local with higher yielding varieties, regular pruning, and thinning shade trees to reduce humidity and regulate light. Intercropping with a legume, such as Gliricida sepium or Erythrina sp., would obviate the need for chemical nitrogen inputs in a much higher-yielding system (FHIA 1988). The existing systems were low-maintenance and low-yield and improved production would increase the demand for labor.

Yields were generally extremely low, and, because of the predominant use of a local variety, the harvest period was restricted to a few months. Those who used a hybrid had year-round production, albeit with a greater concentration of output in the fall. In 1993/94, the price of cacao rose to 2.30 Lempira/lb, up from 1.50/lb Lempira in 1992/93. FHIA estimated that average dry output per *manzana* should reach 1,900 lbs/*manzana* (FHIA 1988). The potential for profit-making was lower for cacao than for chile pepper, but so were the risks. In addition, the long cacao harvest offered far greater flexibility in employing family labor than did chile pepper production.[29] The key is to increase system profitability by associating cacao with high-value crops.

The PDBL project was actively promoting agroforestry, particularly involving fruit trees. Trees were supplied to individuals participating in the forestry program. Fruit was mainly intended for household consumption, and for improving nutrition, since the distance from markets made all but a few high-value fruits difficult to market profitably. Rambuttan and mangosteen could probably be produced and sold at a profit. They are light to transport, were extremely high-value, and had a good market in La Ceiba. Fruits from trees provided by the PDBL, such as oranges, avocados, and lemons, were more difficult for people to market because of their weight and, generally, rather low prices.

Trees seedlings came from a germplasm bank developed by the PDBL in the agricultural school of the national university, Centro Universitario Regiónal del Litoral Atlántico (CURLA), located in La Ceiba. The project was also collaborating with the Fundacion Hondureña de Investigación Agrícola (FHIA), especially in cacao, bananas, and plantains. FHIA had done extensive research on cacao associations in its local experiment station in La Masica, in the lowlands of the Cuero watershed. One of the most successful was a cacao-black pepper-Gliricidia sepium association, to provide a system which was sustainable both in the ecological and the economic sense. Cacao was extremely well adapted to the high humidity of the region but, like other tree crops, suffered prelonged bouts of low prices. Intercropping with a high-value crop like black pepper gives farmers an alternative

[29]Since no one interviewed was carrying out cacao production as per the recommended FHIA practices, I have been unable to calculate the costs of production. The prices of Tobasco pepper and cacao were 2.30 Lempira/lb. Yield of peppers approached 10,000 lb/*manzana*, while for cacao it was 2,000 lb/*manzana*. In addition, cacao was costly to transport because of its weight. Drying raised the sale price and reduced weight. Producers lacking a cement patio or sufficently flat, open area for drying often sold it to local intermediaries who dried it for selling.

resource to tide them over periods of depressed cacao prices and, as a consequence, they are less likely to cut down their trees. Other agroforestry systems involving cacao being tested by FHIA included high-value wood species such as mahogany, laurel, teak and fruit trees.[30]

Discussion and Recommendations

The Atlantic Littoral of Northern Honduras represents one of the remaining areas of broadleaf forest in the region. There are no easy, obvious solutions to land-use problems in the hillsides of northern Honduras. Poverty is spearheading deforestation in the area and is so widespread that the stream of migrants, if left unchecked, will continue until there are no trees left to fell. The problem cannot be solved at the receiving end of this migrant stream. Policy changes which fundamentally alter land-use in the country are needed. Extensive cattle production, which covers some 80% of land under use, cannot be expected to absorb sufficient amounts of rural labor to adequately raise welfare levels and slow down out-migration. The lack of economic progress and productive outlets for labor means that children are often the only source of security for couples, and especially for women, in their later years. When economic resources are out of reach, poor families invest in human resources. Economic stagnation at a low level of development and a burgeoning population go hand in hand. The remaining areas of broadleaf forest provided one of the few refuges to which the poor have access and allows large families to stay together.

Our experiences with participatory farmer research in the communities of El Recreo and Santiago during 1993 and 1994 leads us to believe that this approach is an effective means of introducing farmers to new forms of production linked to indigenous methods and knowledge. The outcome is a form of syncretic technology generation. The technologies are much more likely to be of use, and therefore adopted, than those generated exogenously and "transferred down" to farmers. Most importantly, participatory research is a capacity-building process which helps to imbue farmers with a strong sense of their own ability to resolve technical problems as they arise.

Initially, farmer-led research will almost certainly focus on improved output, not conservation. Nevertheless, the approach underscores the social impact of production because of the degree of community involvement. Involvement of the scientific research community is also required. Researchers, such as those working in the CIAT Hillsides Program in Central America, are vitally important for helping to develop systems that are "land-friendly" in the long-term, which is not necessarily within the planning horizon of small farmers. Longer-term goals must be conceived in conjunction with present-day needs of resource-poor farmers. Participatory research provides a nexus for bringing these priorities together.

Experiments undertaken by the farmer teams in El Recreo and Santiago included bean germplasm testing and evaluation, maize varietal evaluation, legumes/cover crops evaluation, research on integrated pest management in beans, and post-harvest seed conservation

[30]FHIA was also working with hearts-of-palm germplasm. Hearts-of-palm offered a good market opportunity and was well-adapted to the region. Because palm heart requires cutting down the palm stem and leaving the roots intact, it may provide an opportunity to combine a tree crop with annual crops since shade would not pose a problem if cropping coincided with the period after the tree was cut (personal communication, R. Rodriguez).

research. Experiments involving tree crops were more difficult to organize because of the length of time required to get results and because germplasm used in one farmer's plot was likely to lead to long-term benefits for that farmer. To avoid favoring some individuals, it is recommended that testing tree germplasm be carried out on common property, such as school grounds, so the long-term benefits accrue to the common good. Use of the school yard would also allow students to participate with farmer-researchers in testing the technology and to receive the benefit of technical support. Tree-crop experimentation should be conducted *pari passu*, with annual crop improvements to maintain community interest and improve welfare, while perennial crops are developing and gaining acceptance.

It is important that participatory research not become a vehicle for increasing wealth differences in the communities. The structures of power and social dynamics in the communities have the potential to convert a community project into one that serves only the experimenters themselves. Our experiences in Santiago and El Recreo were entirely different. In Santiago, the leadership was altruistic and the team expanded to include a sizeable group of farmers. Participatory research tended to focus on the process itself. The research process became a means of community empowerment and enhancing self-reliance. In El Recreo, the process became more ends-oriented with a strong focus on research product. The experimenters, a recognized, elite corps of community innovators, tended to reserve information garnered through crop-testing for the exclusive use of the four-person team. This may simply have been part of the community dynamic in Recreo. It may also have been an effect of the PDBL project, since resources provided to participants had exacerbated wealth differences. Careful use of resources are required to avoid inequities, particularly when conducting experiments with crops that have long-term benefits.

Promising technologies, tested in El Recreo and Santiago, should be offered to farmers in other communities for evaluation and adaptation. It is recommended that the participatory research project work closely with PDBL to train project agronomists in the AMIs in participatory methodology. The participatory research project also plans to offer courses at CURLA and the John F. Kennedy Technical School to train agronomy students in the research methodology. We believe that the approach, which builds the research capacity of local technicians and the farmers themselves, will be an important contribution to resolving the very difficult problems confronting land-use in the Littoral Atlantic hillsides.

The PDBL was expected to continue. Nevertheless, community forestry will not be successful unless it is supported by agricultural and agroforestry improvements. For agroforestry, PDBL had developed a germplasm bank for tree species as a source of materials for extension efforts. Project time devoted to agriculture has been minimal and has not involved agricultural research. Nearly all farmers in the project area produced their subsistence needs and most produced maize and beans for sale in the marketplace as well. The majority of farmers migrating into the region were from the Western departments of Honduras, an area dominated by the Maya tradition of maize and beans production. Migrants are unlikely to abandon several thousand-year old cultural practices, notwithstanding the new environment, in the foreseeable future. Thus, grains production, the most widely practised activity of small hillside farmers, was least affected by the bilateral project.

Project action in the area of grains was limited because the land was mostly too steeply sloped to be suitable for annual crops. The PDBL project tried to convert farmers to

agroforestry in the expectation that, over time, this would lower the incidence of annual cropping. Nevertheless, farmers inside the project continued to be heavily involved in the production of basic grains for domestic consumption and for sale, and, according to information regarding future plans, were likely to continue producing grains for many years to come. Poor farmers will not abandon the production of subsistence crops in favour of higher-value tree crops, which involve cash transactions in an uncertain market place, because the strategy entails risks to survival. It is therefore recommended that land-use improvements begin with innovations in annual cropping, especially in maize and beans. This recommendation is similar to that made by Giasson in her study in the Cangrejal watershed (PDBL 1990). Despite the difficulties of making annual cropping sustainable on steep hillsides as population densities increase, research has to be focused on improvements in this area as a transitionary step towards a more desirable, long-term agroforestry program.

Agricultural technology alone cannot resolve this dilemma. Nevertheless, improved living standards, due to higher productivity and/or higher-value crops, in conjunction with sound agricultural management practices, would slow land sales to cattle producers. Only with a lower level of risk in annual cropping will farmers be prepared to reduce the area sown in these crops and invest labor and land in agroforestry systems, if these can be shown to provide for long-term household security. This may pose something of an dilemma for an international agricultural center, such as CIAT, whose goal is sustainable agriculture since achieving sustainability with basic grains under these conditions may not be feasible. If basic grains improvement is seen as a transitional phase towards agroforestry, rather than a stand-alone goal, it should be acceptable. CIAT would not be promoting basic grains production on forestry lands. It would be accepting the fact that thousands of poor farmers are producing grains under these conditions and trying to do something to improve productivity. Ignoring the problem will not make it disappear. Working with grain producers on hillsides designated for forestry use would not condone this land-use but seek to diversify to agroforestry. It is recognized that such a project is bound to be controversial.

In maize systems, research might be productively focused on the use of a cover crop for the *primavera* cycle in order to reduce the incidence of burning. On farmer in San Francisco de Saco had planted the *primavera* crop in mucuna directly after harvesting the *postrera*. He did not report a problem with *maize muerto*. Half of his land under mucuna was kept for the following *postrera* cycle and half was resown in *primavera*. The area set aside allowed him to produce mucuna seed that could be used to resow the *primavera* plot, since double cropping and the need to prevent mucuna from over-running the second crop meant that seed production in that plot would be minimal. The disadvantage of this system was the reduction in the amount of land under mucuna for use in the *postrera*, which was more profitable. The following year, the farmer rented land in *primavera* in order to leave the whole area for production in *postrera* (Triomphe, personal communication.) This indicated the need for a system based on a cover crop less competitive than mucuna for *primavera*. Farmers are unlikely to abandon the *primavera* in the foreseeable future because of the risks involved in production concentrated in one cycle, and because labor is available in the springtime.

While maize, the principal grain crop, was widely produced in conjunction with mucuna, which helped prevent environmental degradation, production of common beans (Phaseolus vulgaris) affected the environment in a negative fashion. Beans were produced

primarily at the onset of the rainy season and were not cultivated with a system of groundcover. In fact, farmers routinely burned all vegetation prior to planting. Because producing beans in regions of high heat and humidity tends to provoke disease, especially web blight (Thanatephorus cucumeris), farmers sought to plant beans on the steepest slopes and at the highest points to maximize insolation and rainwater run-off to minimize humidity. Burning was also believed to ameliorate the problem of humidity associated with rotting plant matter. Needless to say, soil and nutrient loss associated with beans cultivation was extremely heavy. It is difficult to visualize a sustainable system for beans production under these conditions. Farmers would almost certainly reject live barriers because they go against the logic of encouraging rapid rainwater run-off.

Zamorano, CURLA and the Secretaría de Recursos Naturales, with support from IPCA (Investigacion Participativa en Centroamerica), were testing new varieties for tolerance to high heat and resistence to web blight in the experimental station at CURLA. Farmer teams involved in participatory research had been organized by IPCA and were actively involved in the search for better-adapted bean germplasm using materials supplied by Zamorano through its RELAF (Red de Ensayos de Linea Avanzados de Frijol) project. It is hoped that varieties more tolerant of heat will allow producers to cultivate more in the drier season, and reduce the importance of the rainy-season cycle. During the drier season, beans were frequently produced in a mulch of weeds to conserve soil moisture and erosion effects were minimized. Nevertheless, low yields, associated with poor heat tolerance, tended to reduce production of beans at this time of the year.

Post-harvest storage of beans is vital because unless beans can be conserved from August until the February *postrera* planting, farmers are forced to buy what sometimes amounted to inappropriate seed from elsewhere, or to plant in October. The latter option, which occurred when the rains were at their heaviest, should not be promoted in the hillsides, where erosion and landslides could not be contained at this time. Instead, technology should be sought to allow farmers to conserve seed which maintains moisture at constant levels. Experiments were being conducted with the farmer research team in Cuero in order to compare germination rates under three different kinds of storage systems.

The maize and bean harvests in April/May were important because northern Honduras was one of the only areas where these crops were available at that time of year. The maize\mucuna system was important because it boosted production of maize when relative scarcity in the marketplace generated higher national prices. An improvement in bean cultivation in the zone has the potential to boost national production and offer producers higher prices than those available at the end of the principal harvest period.

The improvement of annual cropping/mulching systems must be done in concert with trees. Landslides in areas where mucuna was planted were widespread and farmers recognized the seriousness of the problem. Gliricia sepium was widely used as live fencing in the area. Because it is deep-rooting, it could be adopted to maintain soil on the slopes. Other species might also be employed. Research could be directed at combining trees with annual cropping/mulching systems.

Agroforestry, in conjunction with the maintenance of natural forest in some areas, is certainly the most desirable future land-use for the area because it is compatible with the steep terrain and hence has a role in watershed protection. Nucleated residence patterns

make the production of higher-value crops, especially fruits, risky since theft was common when the owner lived far away from the property. Fruit grown in the backyard was relatively safe. Fruit grown outside the immediate village was considered common property. Maize and beans were generally not items of theft since everyone grew them. Since Tobasco peppers could be sold at only one outlet, generally under contract, theft had not been an issue. Fruits such as *mangosteen* and *rambuttan*, or black pepper, which could be sold anywhere in La Ceiba, would almost certainly lead to increased pilfering. This threat would likely reduce the tendency to plant high-value crops on steep hillsides where soil protection was most urgently required. The introducction of these crops into the communities on a rather broad scale might reduce the incentive to pilfer the neighbour's harvest. Alternatively, the potential for profit-making from these new crops might be sufficient to bring about a less-nucleated pattern of settlement.

Legume-based pasture systems, such as wild peanut (Arachis pintoi) combined with Brachiaria have been promoted to provide long-term pasture sustainability. But the development of sustainable hillside pasture systems would have a negative impact on small and landless farmers. Degraded pasture and *guamiles* employed for grazing were often turned over to farmers who lacked sufficient land for the production of maize, generally with the condition that they sow pasture after the harvest. Renting or borrowing degraded pasture land allowed small farmers to avoid degradation, through overuse, of their own land or to use it for maize-mucuna. Improvements in pasture would end this system which conserves the natural resource base and sustains small and landless farmers economically. Poor farmers would have less access to land. Unless accompanied by diversification into activities that increase labor demand, "sustainable" hillside-pasture systems will probably contribute to environmental degradation because of increased deforestation, and increase of poverty. This conclusion is counter to the argument to intensify livestock production in forest margins in order to reduce pressure on the forest (CIAT 1990; Serrao and Toledo 1990).

CIAT has promoted the introduction of Arachis pintoi to lowland pasture systems in the area. The technology could easily spread to the hillsides, unless increased animal productivity and reproduction rates in the lowlands decrease demand for hillside pasturage for dry animals.

The COHDEFOR/CIDA forestry project tried to organize women into groups around a variety of projects, including collective poultry undertakings. Like many collective endeavours, it was not a success. In some cases, inappropriate technologies, such as commercial feedstuffs and pure-bred chickens from outside the area for a poultry project, were introduced. The difficulties of organizing women for collective activities were insurmountable. These poor, Honduran women exercised so little control over their own lives that they were unable to absent themselves from the household at agreed-upon times. Poor attendance led to conflicts and the dissolution of groups. The project had shifted to work with individuals, but had not addressed the conflicts of interest between men and women over the destination of grain crops.

One possible way to overcome this conflict would be to position women to produce their own animal feedstuffs. This would have to be accomplished in a way that was compatible with their domestic responsibilities. One promising avenue that we examined was the production of pigeonpea (Cajanus cajan) which, because it is a tree, could be produced

close to the house yet out of the range of the poultry. It could also be used for firewood, reducing the labor involved in its collection, although this was not women's work in the study area. Bananas for fattening pigs, normally grown close to the home, provide another good example. Cassava also has potential since it is likely to be grown nearby where it can be harvested at any time. Another question is whether green manures, such as mucuna beans, can be safely processed into feed. CIDICCO was doing experiments in this area. Cowpeas (Vigna unguiculata) offered another option. Whether or not there would be a conflict between the crop as food versus fodder would depend on cultural values. Some groups hold cowpeas in low regard while others place it on par with beans. Our experiments with several varieties of cowpeas showed them to be so productive and disease-resistent that conflicts over output seemed unlikely, independent of cultural preference. If manures could be employed as feedstuff as well as sources of nitrogen for grains, grounds for conflicts of interest would be reduced and women's income increased.

Forest conservation raises difficult ethical issues when the right of extremely poor people to a make a livelihood and support their families is involved. To deny these people their basic human rights is simply not tenable. Nevertheless, migrants infringe on the rights of other poor people who make their livelihoods in the forest. This is a particularly thorny issue when indigenous people who have historically lived in forest areas face massive incursions into their communal lands from *ladinos*. This conflict cannot be resolved at the point of in-migration. It has to be tackled at the source. This means dealing with land-use issues, particularly extensive cattle production and environmental degradation, in western Honduras. It means an active campaign dealing with "reproductive health" for women in combination with expansion of industrial employment opportunities for men and women. The lack of attention to broader development concerns was producing a situation which pitted the poor against one another in a struggle for survival. Tropical forest conservation cannot be divorced from these complexities.

The COHDEFOR/CIDA project and the Atlantic Littoral woodcutters cooperative (COATLAHL), found themselves immersed in this intractable problem. Management plans, based on careful inventories of community forests as demanded by the Agricultural Modernization Law before cutting forest, were rendered worthless if inventoried trees had already been axed and burned by cultivators when woodcutters arrived to cut them. Santiago residents who were cooperative members had defended their territory steadfastly over the years. The community of Santiago was distinct because three families who shared in the woodcutting tradition had long lived there and their points of view dominated those of newer migrants. This was not the case in the more recently populated and more diverse communities which formed the bulk of the settlements in the Atlantic Littoral hillsides. Members were less united because of shorter periods of residence and because they derived a greater portion of their livelihoods from agriculture rather than forestry. They were unlikely to risk their lives, or even a rift in the community, defending the communal forest.

The profitability of logging and the willingness of people to defend broadleaf forests depends on whether traditional, high-value, "colored" woods (e.g., Honduras mahogany and Spanish cedar) or non-traditional, lower-value woods (e.g., *Santa Maria, varillo, marapolan* and *rosita*) are harvested. At the time of the study, traditional woods were in danger of extinction in Honduras (IFC 1993), and non-endangered, non-traditional woods had a limited

market. Unless outlets can be found for the latter, forests will be perceived to have little value to local people. The development of an international "green forestry movement" which aims to promote sustainable logging, including the promotion of these little-known lumber species, is a step in this direction. This allows lumber extraction to be concentrated in small areas of the forest, leaving other areas undisturbed for longer periods (TTJ 1994, p. 25). Such an approach is being promoted by the Smart Wood Program, which was set up by the Rainforest Alliance. Woods are certified as having been harvested according to agreed-upon standards that allow for sustainable forest use. These programs are still in their infancy and, at present, loggers working with non-traditional wood face low prices.

Since the forest management plans required by the Agricultural Modernization Law stipulated that inventories of trees had to be submitted and approved prior to cutting, it would not seem unreasonable to allow the sawyers access to mechanical saws. This would allow cooperativists to engage in other activities and to increase their incomes. If they cut more than was permitted by the management plan, they would be penalized accordingly. This presupposes enforceable controls, however, which may not be available.

Finally, research should be coordinated with other institutions. Recommendations include:

•PDBL and CATIE in the areas of agroforestry. FHIA is working with PDBL in areas of agroforestry such as cacao and the incorporation of high value tree and other crops such as black pepper and laurel;

•Secretaría de Recursos Naturales, Zamorano and CURLA in the area of germplasm improvement, particularly beans;

•Secretaría de Recursos Naturales concerning the establishment of a collection of multipurpose legumes; and

•researchers from foreign universities working in the area of green manure and mulch systems.

Conclusions

Our study in two partially-forested, upland catchments of the River Cuero and River Santiago watersheds, shows that "migratory" agriculture may be called, more correctly, "rotational" agriculture, and that it can be sustained for a prolonged period when fallowing is adequate. Farmers are beginning to adopt an improved fallow system using mucuna as a green manure. Using this system, farmers can generally return to the same plots each year without exhausting the soil. With adequate fallowing, with and without green manure, substantial numbers of farmers have remained rather stable on their land. In some cases, three generations of farmers have farmed land in the watersheds.

Cattle production was spreading into the watersheds and the forest frontier was constantly under pressure. On the surface, farmer activities in the two watersheds seemed to duplicate what had been observed elsewhere. Nevertheless, the reasons were different and so the solutions required are also different. Many farmers in the watersheds sold their land to cattle ranchers because the farmers were very poor and ranchers could buy the better, flatter, higher-priced land for cattle pasture. An expanding regional market for dairy products,

especially from El Salvador, combined with low land prices, was making dairy farming a high-growth activity on the north coast where pasture is available year-round. Traditional grain farmers had not fared so well and prices often did not provide an adequate return on their investments.

The process of forest-to-pasture conversion, widely commented on in the literature on Latin and Central America, was vividly evident in the hillsides along the north coast of Honduras. Contrary to the prevailing view that pasture formation occurred once the land had been exhausted and was no longer suitable for annual crops, in the study area, the sale of land for pasturage was generally occurring before degradation took place. This tendency was related to the strong demand for milk by local processors, especially the Leyde factory, which helped bid up the price of land in the lowlands and surrounding foothills. A secondary effect of this demand was to raise land prices in the hillside valley areas high up in the watersheds. Notwithstanding their distance from the main milk markets, such lands could be used to pasture cows that were not in production. Poor farmers sold land which could be used for pasture because of the relatively high prices for such land relative to the prices of land on the steeper slopes. This tendency pushed poor farmers ever higher into the watershed, and put more pressure on the remaining forest.

This sequence of events means that improvements in pasturage, in conjunction with a strong demand for milk, are quite likely to increase the tendency towards deforestation in the hillsides because dairy farming will be even more attractive. This will engender more land sales and the further displacement of small farmers. Sustainable pasturage, in particular, will mean that landless and poor farmers who currently have access to degraded pasture land will have nowhere to go but toward the dwindling forests.

Against this scenario, however, there is the possibility that improved pasturage in the lowlands will lead to more intensive production and more importantly, to higher animal fertility rates - thereby helping to retain the cows in the lowland plains, closer to milk markets. Higher prices for milk may stimulate more intensive production in the lowlands by encouraging farmers to invest in new technologies (Simpson and Conrad, 1993); however, it may also promote more extensive production in the hillsides as farmers seek to expand production without increasing the risks associated with higher input levels (Nicholson et al., 1995).

It is certain that the milk industry on the north coast will continue to expand. Because the Atlantic Littoral area of Honduras enjoys a rainfall regime distinct from the rest of the country, it offers pasturage when it is in short supply elsewhere. This difference is important in explaining the success of milk sales to drier zones on the Pacific side where population was traditionally concentrated. El Salvador was a particularly attractive market because high population densities and the absence of a forest frontier in El Salvador meant that land rents were likely to comprise a far larger proportion of total production costs. Cheaper Honduran milk products gained easy entrance. Given the nature of demand for milk products from the area, and the relative abundance of frontier lands, there seems little doubt that supply will continue to expand in the foreseeable future.

In addition to the demand for land for dairying, there was a virtually inexhaustable demand for land, mainly for subsistence purposes, from poor and landless farmers from other parts of the country, particularly from the impoverished, western departments. These farmers

had been displaced from their origin communities, and from other communities during the migration process, by declining soil fertility associated with inappropriate land use, extensive cattle production and demographic pressures. Nevertheless, for the most part, the problem must be understood within the context of inequality of access to land which assigned the poor the steepest slopes, making degradation difficult to avoid. The very high fertility of this group compounded the problem many times over.

Sale of land for pasture did not necessarily mean that the land was exhausted, as is generally depicted in the literature. Because flatter land was generally better quality, it was likely to be less eroded than steeper hillside land. Rather, poverty prompted land sales. Any short-term crisis, such as a crop loss or an illness, led to the sale of land to satisfy the need for quick cash. Farmers displaced from their land in this way likely tried to clear forest higher in the watershed. Nevertheless, by far the greatest amount of forest was cleared by new migrants, and by the very large numbers of children of early settler families who could not be accommodated on a single family plot.

Seen in this way, the problems of deforestation and the spread of cattle ranching will not be solved by finding a solution to migratory agriculture, nor by improving pasturage. On the contrary, improved pasturage is likely to increase cattle-raising since it would raise profits. Likewise, rooting the producer in his lot was not the fundamental problem, although more sustainable methods were certainly necessary. Increasing farmer income through higher-value crops and/or higher yields, as well as improved health services could reduce the frequency of short-term crises and provide a cushion against losses. This would help slow land sales to cattle producers. Agricultural intensification would also help absorb the increase in the number of individuals as family sizes grow. Neverthless, attempts to increase productivity and/or the value of agricultural production must be combined with policies, such as socio-economic improvements in origin communities and the development of alternative outlets for migrants in industry. At the same time, family planning services must be made available to reduce the rate of population growth. It is not possible to talk about sustainable land use when the average number of births per woman reaching the end of her child-bearing years is 9.6.

These measures need to be combined with policing of the forest zones and a program of sustainable forestry management so local communities reap benefits from forest resources. Independent of the need to raise the welfare levels of hillside farmers, there is good reason to improve hillside land management on broader socio-economic and environmental grounds. Destruction caused by deforestation was not restricted to the locale where trees were being removed. Downstream watershed populations were severely threatened and inconvenienced by upsteam agricultural activities which caused periodic flooding and water shortages during the dry season.

The pressure on the country's remaining tropical forest resources thus seems to be infinite. There will be no forest resources to conserve unless action is taken. The group most likely to engage in resource conservation is small farmers-cum-sawyers who have a vested interest in maintaining the forest. Conservation will require ways to brace this group against the sweeping tide of migrants and milk producers. Specifically, it will mean improving the group's forestry and agricultural land-use options and the policy contexts within which these

sectors operate. The alternatives are to lose what is left of the country's forests and to create still more nomads who have no where to go.

Research centers, such as CIAT, which specialize in tropical forages and staples for small farmers, face a dilemma. Which particular line of research should be supported in the area? As this study makes clear, lowland, dual-purpose cattle production cannot be neatly separated from hillside farming activities. The two are intimately related and actions are taken in one area will almost certainly affect the other.

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Acronyms

ACDI:	Agencia Canadiense de Desarrollo Internacional
AIDs:	Agencia Internacional del Desarrollo
AMIs:	Areas de Manejo Integrado
APH:	Asociación de Prensa Hondureña
CA:	Centro América
CARE:	Comisión Americana de Remesas al Exterior
CATIE:	Centro Agronómico Tropical de Investigación y Enseñanza
CELADE:	Dirección de Estadísticas y Censos y Consejo Superior de Planificación
CIDA:	Canadian International Development Agency
CIDICCO:	Centro de Información y Documentación sobre Cultivos de Cobertura
CIMMYT:	Centro Internacional de Mejoramiento de Maiz y Trigo
COATLAHL:	Cooperativa Atlantida de Honduras Limitada
COHDEFOR:	Corporación Hondureña de Desarrollo Forestal
COSPE:	Cooperación para el Desarrollo de Emergencias del País
CURLA:	Centro Universitario Regional del Litoral Atlántico
FEHCAFOR:	Federación Hondureña de Cooperativeerativas Agroforestales
FHIA:	Fundación Hondureña de Investigación Agrícola
IICA:	Instituto Interamericano de Cooperativeeración para la Agricultura
INA:	Instituto Nacional Agrario
IPCA:	Investigación Participativa en Centro América
PDBL:	Proyecto de Desarrollo del Bosque Latifoliado
PRODEPAH:	Proyecto para el Desarrollo de Políticas Agrícolas de Honduras
RELAF:	Red de Ensayos de Línea Avanzados de Frijol
SECPLAN:	Secretaría de Planificación, Coordinación y Presupuesto
SEDA:	Secretaría del Ambiente
SRN:	Secretaría de Recursos Naturales
UNAH:	Universidad Nacional Autónoma de Honduras
UNICEF:	Fondo de las Naciones Unidas para la Niñez

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