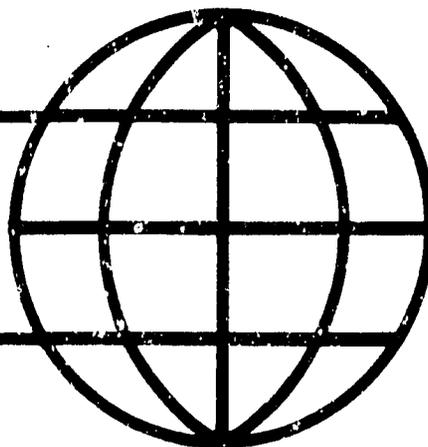


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**COOPERATIVE AGREEMENT ON HUMAN SETTLEMENTS
AND NATURAL RESOURCE SYSTEMS ANALYSIS**



Clark University
International Development Program
950 Main Street
Worcester, MA 01610

Institute for Development Anthropology
99 Collier Street
Suite 302, P.O. Box 2207
Binghamton, NY 13902

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Settlement and Deforestation
in Central America:
A Discussion of Development Issues

by
Jane L. Collins
and
Michael Painter

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Executive Summary

While concerns about environmental destruction in Central America, and particularly about the concomitant processes of settlement and deforestation, have been increasing in recent years, the relevant literature on the region remains surprisingly scanty and narrowly focused. Although a number of books and articles discussing these issues have been published, few are based on detailed fieldwork conducted specifically for the purpose of gathering reliable data on settlement and deforestation. Most literature that includes discussion of these topics treats them as tangential issues impinging upon research conducted with other goals in mind, or it applies the findings from one of the few field studies to interpret relatively casual observations made elsewhere. The result of this is that we have a fairly clear idea of the nature and dimensions of the problems posed by settlement and deforestation; but, considerable work is needed before we can expect to enjoy a similar knowledge of the range of possible solutions.

The issue that dominates the Central American literature is the conversion of tropical forest to pasture through the process of smallholder settlement. This phenomenon is widespread, affecting tropical forest areas throughout the region. The literature reviewed implicates several factors as responsible for driving the conversion of tropical forest to pasture. At a national policy level, beef cattle production for the export market has proven to be an attractive way to generate revenue for investment and to meet foreign debt obligations, and commercial beef consumers in the U.S. have come to see Central America as an attractively nearby source of inexpensive meat. As a result, national governments and international interests have cooperated to make inputs and credit available for cattle producers and to stabilize beef prices at attractive levels. This creates incentives for larger landowners to expand their beef cattle enterprises and frequently leads to a highly speculative land market in which poor farmers sell their land in order to acquire the cash needed to satisfy immediate consumption needs. When combined with the political repression and violence directed at smallholders in much of Central America, the pressures to move frequently are irresistible.

At the level of the smallholders themselves, a general decline in rural living standards over the past two decades has forced families to work harder in order to satisfy consumption needs and taxed household labor resources. Ranching seems attractive because it is less labor-intensive than farming once pasture has been established. Furthermore, the state efforts to promote ranching noted above make this an attractive activity to smallholders as well as to large landowners because of its apparent revenue-generating potential. Thus, state policies and the lack of alternative activities for smallholders seeking ways to satisfy consumption needs make ranching an unbeatable option independently of any consideration of its long-term sustainability.

Unfortunately, the opportunities that ranching offers turn out to be illusory for most smallholders. While a small percentage does succeed in making the transition from subsistence to small-scale capitalist ranchers,

most smallholders exhaust their resources before they are able to establish pasture and acquire cattle. They frequently sell out to wealthier interests able to complete the conversion of land they have cleared of trees into pasture and move deeper into the forest, hoping that the revenues from the sale of their land will capitalize them sufficiently to establish a successful enterprise in the new location. The lack of alternatives and the existence of success stories, although few and far between, encourage smallholders to perpetuate the pattern in spite of the high probability of failure.

The search for alternative forms of land use is hampered by a lack of technically feasible production options. This is a problem that needs to be addressed in terms of increasing our knowledge of the physical environment and the constraints and opportunities it presents for production, and in terms of strengthening local institutional capability to utilize that knowledge once it is available. The most basic need in terms of the physical environment is to conduct detailed land capability surveys that establish what types of production activities may be conducted on a sustainable basis in a given area. Considerable land use survey work has been done, but not in a comprehensive way. In many areas which have been surveyed, this has not been done at a level of detail adequate for making specific recommendations about particular settlement areas.

A second shortcoming in our knowledge of the physical environment is that little attention has been given to developing sustainable production systems that can yield acceptable revenues within the constraints imposed by land use capabilities. Throughout Central America national governments have tended to limit their support to ranching and conventional agriculture, with a heavy focus on production for export markets. Efforts by international agencies to promote environmentally appropriate and economical alternative forms of land use have tended to produce equally conventional forestry projects. While less destructive than ranching, these projects accomplish nothing in terms of solving problems such as income and employment, labor scarcity, and tenure insecurity that are closely related to the inability of settlers to establish themselves permanently in an area. At present, a settler who asks, "What can I do to earn a living if I don't turn this land into pasture?" is unlikely to receive an answer. Some research on possible alternatives has been conducted, but the lessons learned have not received extensive discussion outside of research circles. Likewise, the literature suggests that some functioning production systems managed by long-time residents of forest areas may lend themselves to modification in order to increase their income-generating capacity. But national governments and development agencies have expended few resources in pursuing these suggestions.

If improved knowledge about land capability is to yield benefits, it will have to be combined with improved knowledge of social and economic constraints on production. Narrowly defined studies focusing on soil nutrients, yields, and the cost and benefits associated with different production regimens are of little use if households lack the labor to implement the recommendations that result, or if tenure insecurity makes

investing in land improving inputs too risky to be practical. The available literature suggests that production systems that are sustainable and economical will have to be considerably more diversified than those that characterize Central America's settlement frontiers at present, and must include annual and perennial crops, livestock, and the gathering of forest products. The organization of production, and particularly the regulation of access to key resources so that they are not monopolized by small segments of the population, is a crucial problem to address if such diversified production systems are to prove practical.

Institutional support for Central American countries needs to occur at several levels. First, the agencies responsible for determining and regulating appropriate land use need to be aided in acquiring the skills necessary to assess land use potential and to generate development plans based on such assessments without relying upon international donors to perform this task for them. Second, this capacitation needs to go beyond narrowly defined technical training to sensitize personnel to the broader social and economic issues outlined above. At present, there are few people in positions of responsibility who understand that questions such as labor availability and land tenure are as central to successful development as soil properties or climate. Third, it is important to educate host country governments and national populations generally about the economic importance of sustainable production, and to develop a constituency for this approach to development that can represent its interests before the state in the same way that ranching interests have been represented up to now. Until institutional support is effectively carried out at all of these levels sustainability of production will continue to be a "foreigners issue" that may be tolerated, but will not be understood or accepted at the national level.

Introduction

Central America is a region where tropical forests are undergoing widespread conversion to other uses at rapid rates (Myers 1981a:59). The processes by which deforestation and settlement occur present remarkable commonalities from one environment to another--in general beginning with logging or road-building and ending in under ten years with the conversion of formerly forested land to cattle pasture. Smallholding farmers play a role in the intermediate stages of this process. They are frequently unable, however, to establish a permanent presence on the frontier. The cropping systems they establish have, in general, not been sustainable under the difficult conditions of the tropical forest environment. Careful examination of the conversion process can reveal the nature of the difficulties experienced by small producers in these contexts. It can also draw attention to the variability in settler experience that can result from differences in state policies, available infrastructure, the soil qualities and other environmental features of the settled region, and the particularities of the productive regimes that are implemented.

Smallholding farmers play a major role in agricultural production in all Central American nations. In Panama, for example, 60 percent of all farms have less than ten hectares of land (Conklin 1986). Production of food crops throughout Central America is overwhelmingly concentrated on farms of five hectares or less (Durham 1979, Nations 1980). In Costa Rica, "mini-farms" of less than 20 hectares have been shown to be more efficient producers of beef than "family size" and large farms (Tropical Science Center 1982:6). Small farmers in Honduras produce 60 percent of basic grains and 60 to 70 percent of livestock, even though their access to services is limited and government assistance is slow and often poorly timed (JRB Associates 1982:66).

Despite the major role that they play in production, the performance of small farmers in settlement zones has not been promising. Productivity has been low. A recent assessment of the agricultural sector in Panama notes that overall national yields have not increased substantially over the past two decades, and that this is due in part to the fact that increases in important producing areas are offset by low yields on marginal colonized lands (Conklin 1986:24). Small farm settlers are perceived as highly mobile, speculative and uninterested in long-term gains. While the conditions that lead them to engage in such production patterns are poorly understood, they are frequently blamed for the major part of the deforestation that is occurring in Central American environments (Tropical Science Center 1982:29-30).

The role that small farmers play in settlement zones cannot be divorced from their former position in their home communities and the factors that led them to seek new lands to cultivate in the first place. JRB Associates (1982:47) suggest that smallholders are less concerned with erosion per se than they are with the absolute lack of land. "In trying to deal with the problem of erosion and soil depletion in Honduras," they argue:

it would seem necessary to place more emphasis than has been done in the past on the prevailing socioeconomic forces which operate to produce the imbalance in the distribution of land rather than faulting the campesino and his practice of slash and burn agriculture. This would entail shifting attention to the current underutilization of the potentially most agriculturally productive lands...as well as a thorough examination of the expanding cattle export industry....

A multitude of constraints and difficulties condition resource management in rural Central America. A recent review of environmental conditions in the region notes that growing populations and patterns of economic growth cause both individuals and governments to over-exploit the resources at their disposal in order to satisfy immediate daily needs:

This 'mining' of the environment facilitates the short-term subsistence efforts of both people and governments, but has actually contributed to the on-going, long-term decreases in food production, per capita income, and physical well-being that are occurring (Leonard 1985:1).

This report notes that over the past few decades, the population of Central America has grown at a faster rate than any other world region, and is growing now at a rate higher than that of Latin America as a whole and equal to that of Africa. The environmental effects of such rapid growth are exacerbated by the fact that most people in Central America are still directly dependent on natural resources for their livelihood. Employment opportunities in both manufacturing and services are limited in most Central American nations. The fact that such a large proportion of the population still depends directly on the land is further complicated by marked inequalities in land tenure and notoriously low productivity. By all indicators, standards of living in rural areas of most of Central America are declining (ibid. pp. 2-5).

These features form the broad context within which settlement and deforestation are occurring. In some cases, governments and international agencies have supported settlement of new regions as a solution to the larger problems of overpopulation and inequality they are facing. In others, settlement has occurred in the absence of direct government encouragement and even in the face of efforts to prevent it. Local contexts of resource management are closely tied to these larger-scale problems. Patterns of regional resource competition and the relationships that pertain between interest groups in settlement contexts may reflect inequalities in access to resources and power that originate at the national level. The attention, or lack of attention, given to issues of productivity and tenure inequality in settlement areas reflect the relative importance that governments have accorded agriculture in the context of their comprehensive plans for economic development.

Hecht (1985) argues, however, that none of these models actually come to terms with the root cause of ecological destruction in the Brazilian Amazon. None address the way in which constraints and incentives (for

farmers of all size classes) are created by government policy. Hecht contends that the fundamental cause of ecological destruction in Brazil case has been the government's decision to adopt livestock ranching as the defining strategy of colonization in this Amazon.

Similar issues have been raised for Central America. JRB Associates, for example, have argued that improvements in land use in Honduras could be obtained without the provision of new credit. What is necessary, they argue, is a reallocation of existing credit away from government controlled programs and cattle ranching to small and medium-sized independent farmers (1982:66). The same could be said of technical assistance programs and other services in most Central American nations. What is required is not simply additional resources, but political decisions to support the most sustainable and efficient uses of land.

This paper reviews the available literature on settlement and tropical forest resource management in Central America (defined herein as Guatemala, Belize, Honduras, El Salvador, Nicaragua, Costa Rica and Panama). After summarizing what has been widely characterized as the dominant pattern of settlement in Central America, it examines more specific elements of the patterns of resource management encountered in settlement zones, including the effects of land access and tenure; issues of labor availability; the role of government services, land use planning and extension; and the impact of roads.

Despite a widespread interest in resource management issues in Central America, high quality field studies on settlement and deforestation are rare. Several excellent studies on agriculture and peasant economy exist (cf. Barlett 1982; Gudeman 1978; Durham 1979), but in most of these settlement and deforestation are tangential issues rather than the focus of research. As a result, the research that has been conducted on the topic is cited repeatedly, and the findings are applied to interpret processes of change in areas for which data have not in fact been collected. Since most of the in-depth research on settlement and deforestation has emphasized the transition from annual cropping to pasture formation in settlement areas, observers have been able to perceive this process occurring in areas throughout the region without conducting extensive fieldwork.

While the conversion of tropical forest to pasture is indeed widespread and urgently requires the attention of policy makers, our focus on the issue has been at the expense of other areas of inquiry. Little work has been done to document other types of production or production sequences. Some of these may prove to be as destructive as the expansion of cattle-ranching. More importantly, however, the literature provides evidence of the existence of stable production systems based on the adaptations of long-standing tropical forest residents to the exigencies of the environment, which may be amenable to intensification or modification in ways that will make them commercially viable. If we are to provide alternatives to the destructive land use that characterizes many of the Central American settlement zones, these systems need to be

examined in terms of their environmental consequences as well as their economic costs and benefits.

Some hints from existing field studies suggest that settlement processes may vary more from region to region than we suppose, and may at times be surprising. Studies in the Atlantic coastal region of Costa Rica have revealed that in-migrating populations do not always fit the stereotype of the highly mobile "precarista," who farms extensively and badly and then moves on. In fact, many new settlers adopt the more stable and diversified cropping/livestock systems of the region's longer-term inhabitants (Boyer 1980). In the Darién region of Panama, on the other hand, it has been noted that indigenous residents who formerly practiced sustainable systems of regenerative agriculture are currently adopting settler practices of converting previously cultivated agricultural lands to pasture (Heckadon et al. 1982).

It is commonly argued by environmentalists and social scientists that the one known sustainable production system for tropical forest lands is the traditional slash and burn agriculture of groups native to these regions. There is a wealth of documentation of these systems (cf. Nations and Nigh 1980, Nietschmann 1973, Helms and Loveland 1976).¹ Recognition of their value and attempts to isolate their adaptive features have provided important contributions to the development of agro-forestry systems for use in the humid tropics.

Nevertheless, it is rarely the goal of planners and administrators to bring forest lands into production in such an extensive manner, no matter how sustainable it may be. Where corporate enterprises enter a settlement zone, they are constrained to operate at a profit. The majority of settlers who enter these regions have long experience operating in a market economy, and expect to produce a cash return in addition to subsistence cropping. The levels of economic return sought from frontier regions are almost always higher than traditional systems of shifting agriculture can provide.

Where this is the case, efforts at tropical forest exploitation must be based on new knowledge. The development of sustainable but remunerative systems for the use of forested regions is only now in its infancy. It is unrealistic to expect settlers unfamiliar with a region to "stumble upon" adaptive techniques and forms of exploitation. They will certainly attempt to do so, but the odds are that their efforts will degrade the environment irreversibly before their efforts meet with success.

Documents prepared by environmental scientists, foresters and planners are virtually unanimous in their call for the support of research on naturally occurring forest products; for the development of rapid and low-cost methods of land capability assessment; and for continued research

¹ For examples outside of Central America see, among others, Clarke (1976), Conklin (1954), and Geertz (1973).

on sustainable agro-forestry and silvo-pastoral techniques. Technical research and training of scientists in these areas must continue. It can be supported and guided by two kinds of social research:

a) studies of how long-term residents of tropical forest regions have themselves attempted to sustainably increase the levels of economic return obtained from traditional systems of production (as they have, for example, in the Costa de Abajo of Panama or the north coastal regions of Costa Rica and Honduras).

b) in-depth studies of development projects in settlement areas that attempt to provide alternatives to the forest-to-pasture conversion sequence, focusing on settler strategies and responses to new productive strategies.

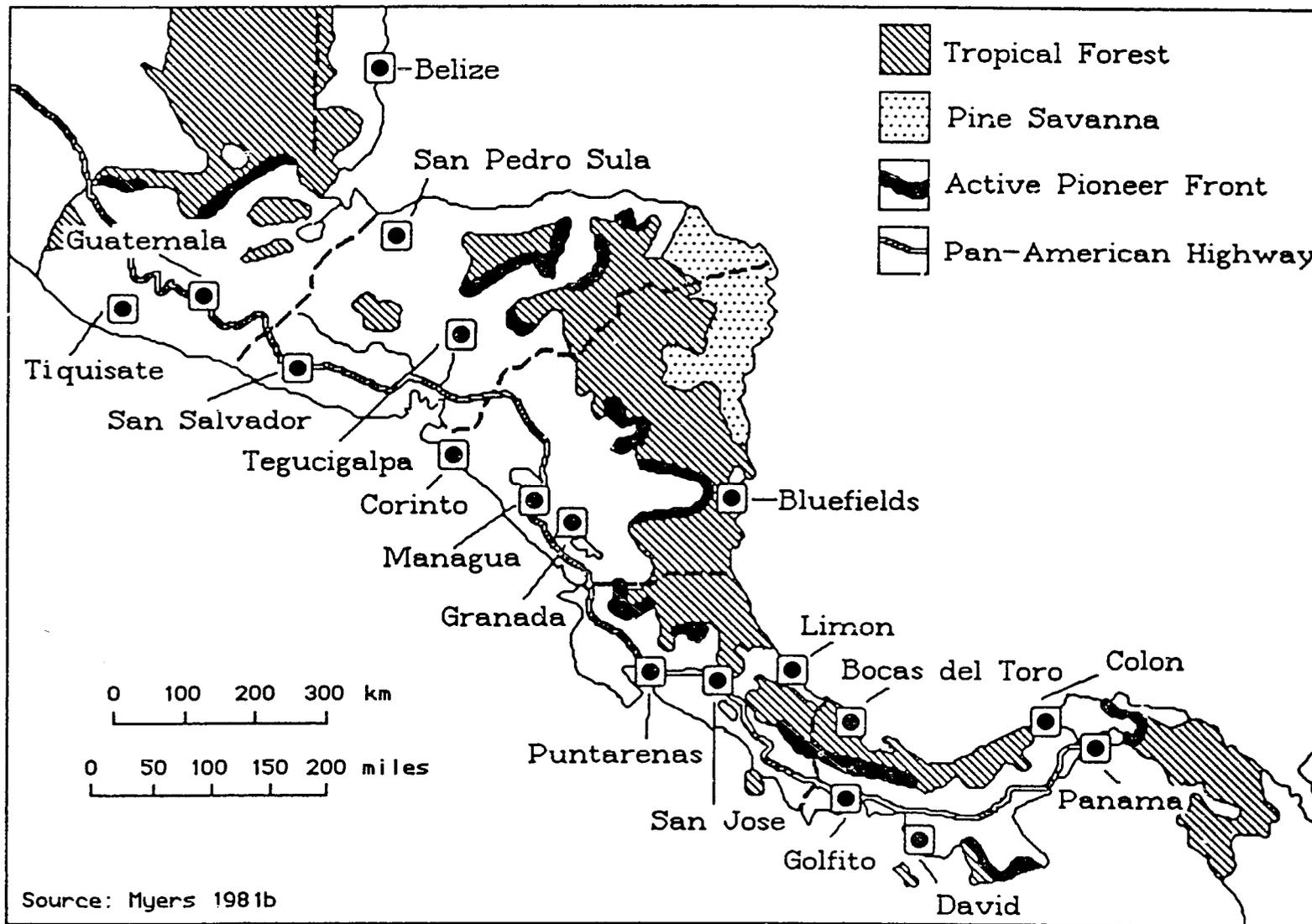
Hecht (1985) has described three approaches to understanding environmental degradation related to settlement in the Brazilian Amazon. The first is the Malthusian approach, which argues that population pressure leads to intensive and destructive patterns of land use. The second blames export agriculture for introducing destructive forms of mechanization and a mentality of production for short-term gain. The third approach has been called by Todaro (1977) the "inappropriate technology model." It argues that inappropriate land use technologies, promoted by planners and development agencies, are responsible for much of the environmental deterioration that is currently occurring in developing nations.

All of these approaches provide some measure of explanation for the resource management problems currently faced in settlement zones of Central America. Population is growing rapidly in the region. When combined with inequitable distribution of land in traditional zones of agricultural production, and its inappropriate allocation to various uses, this provides a strong motivation for migration to settlement areas. Techniques of shifting agriculture in settlement areas themselves may, as Boserup (1965) has suggested, be influenced by population pressure. As subsequent sections of this report will demonstrate, export agriculture--and most particularly export cattle ranching--is indeed responsible for many of the destructive features of land use in settlement zones. It is also true that governmental and international development programs promote culturally and ecologically inappropriate land uses in many cases. This is inevitable given the absence of programs to assess land use capabilities and the relative lack of development of research on appropriate resource management in tropical forest environments.

Settlement Processes: An Overview

Unlike some other parts of Latin America and the developing world, directed programs for the settlement of tropical forest regions of Central

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America have been few and their impact has been negligible.² Some attempts at planned colonization or distribution of tropical forest land have been conducted, including: Bataan in Costa Rica, colonization of the Petén in Guatemala, Bajo Aguán in Honduras, Coclesito in Panama and projects in the northeastern region of pre-revolutionary Nicaragua. None of these projects have approached the scale of settlement efforts in the Brazilian or Peruvian Amazon or in the Mexican lowlands, however. While their experiences have not been described or evaluated in any detail, none has been notably successful. Most Central American nations do not have government agencies that are directly responsible for colonization issues.

Instead, settlement in Central America has largely taken the form of the spontaneous movement of people from the heavily populated (and frequently ecologically degraded) central and Pacific coast regions to more lightly settled lands on the region's forested Atlantic coast. In some areas, such as Costa Rica or Honduras, settlers encounter commercial plantations or large farms (mainly bananas) in these regions, and may combine their efforts at tropical forest production with wage labor. In others, such as Panama, they move onto lands already inhabited by populations of long-standing who have developed effective techniques for surviving in the region. In all cases, however, settlers find themselves confronted with environmental conditions, cropping systems, and economic constraints that are new to them. Figure One illustrates existing areas of tropical forest and the pioneer front in Central America today.

There are few data to indicate the rate at which spontaneous settlement is occurring. In many areas, such as the province of Darién in Panama, rapid settlement may be combined with relatively high net rates of out-migration (Gandásegui 1980:75). This is a product both of the diversity of demographic trends encompassed at the provincial level; and of the settlement process itself, which may attract new migrants to lands being opened even as it expels others from regions exploited earlier (Heckadon 1982a). Rates of deforestation may provide the best indicators of the speed at which settlement is progressing, since even in areas cleared initially by large corporate operations, settlers frequently follow. It is estimated that two-thirds of all forest cleared in Central American history have been removed since 1950. Rates of clearing have increased in every decade since the 1950s. While 49 percent of the Central American landscape was in forest and woodland in 1970, this figure had dropped to 41 percent by 1980 (Leonard 1985:8). While the difficulties in measuring deforestation are great, national record-keeping abilities have increased in most countries in recent years, and these are further aided by remote-sensing techniques (Myers 1981a).

Areas of rapid settlement in Guatemala are mostly limited to the Petén, and have been carried out under the supervision of the military. In Honduras, the rain forests of the provinces of Yoro and Olancho are

²No attempt will be made here to review the various "relocation" programs implemented by Central American governments in recent years with military or security goals.

most affected. It is estimated that shifting agriculturalists alone deforest some 80,000 hectares of national forest annually (JRB Associates 1982:7). Despite Costa Rica's ambitious programs designating national parks and areas of forest reserve, both spontaneous settlement and projects sponsored by the Instituto de Tierras y Colonización (ITCO) have affected forests in areas such as Chiriquí, Sarapiquí, Golfo Dulce and the Llanos de Cortés. The Costa Rican Office of Economic Policy and National Planning (OFIPLAN) estimates rates of deforestation at 60,000 to 70,000 hectares per year (Tropical Science Center 1982:30). In Panama, McKay (1982) estimates that 60 percent of the country is in the process of colonization. Major regions of new settlement include the Atlantic coast regions of the provinces of Colón, Bocas del Toro and Veraguas, as well as the eastern region of the country (including the eastern half of the province of Panamá and all of Darién). Estimates of area cleared per year are not available, but Falla (1978) suggests that deforestation along the agricultural frontier was proceeding at 2.7 percent annually in the early 1970s.

While some settlement projects have been conducted in Belize, they generally have been small-scale, planned efforts (most recently to accommodate El Salvadoran refugees). The dynamics of these projects are quite different from those occurring in other Central American nations, and deforestation is not a significant problem (Robert Nicolait and Associates 1984). Colonization of tropical forests is not an issue in El Salvador, due to its overall dense population, advanced state of ecological degradation in many areas, and lack of a forested Atlantic coastal region. While little is known of current settlement trends in Nicaragua, a natural resource institute (IRENA) has been created and protected areas have been designated since 1979. While the Ministry of Agriculture initially encouraged peasants living in frontier regions to continue to clear the rainforest for food production, limitations were placed on this process and agroforestry techniques began to be promoted in 1983. Planned colonization projects begun under Somoza have been discontinued (EPOCA 1986:4). It should be noted that processes of settlement in the forested areas of the Honduran/Nicaraguan and Nicaraguan/Costa Rican borders have undoubtedly been affected by continuing hostilities in these zones.

The processes by which settlement progresses in Central American nations would appear from the existing literature to be remarkably consistent across time and space. Nations (1980:5) has described the flow of events in general terms:

Although the causes of deforestation in Middle America are complex, the major forces of destruction can be narrowed down to three: logging, colonization and export crop production. Usually the three factors work in tandem. Logging companies bulldoze roads through tropical forests to extract valuable hardwood trees; landless peasants use these roads to infiltrate into the area and colonize it for subsistence and cash crop agriculture; and finally, either the colonizing farmers themselves or a new group of capital intensive entrepreneurs clear what remains of the forest to produce

monoculture cash crops--usually cotton, coffee, banana, cacao or beef cattle.

Parsons (1976), Nations and Nigh (1978), Shane (1980), Myers (1981b), Heckadon and McKay (1982) and Partridge (1984) have all described the processes whereby timber loggers (or others who build roads) open a region; small-scale farmers follow; and in the wake of their efforts, cattle ranchers establish a presence in the region. While local variations exist, all Central American nations have experienced this pattern to a significant degree.

Evidence for such a process can be found in the available data on tropical forest conversion. Myers (1981b:3) estimates that internationally, 55,000 to 90,000 km² are lost annually to timber harvesting; 200,000 km² are destroyed or damaged by forest farmers; and 20,000 km² are converted to pasture. In the latter case, almost all the land involved is in Latin America, with the heaviest distribution occurring in Central America. Table 1 and Figure 2 represent the shift from forest to pasture in Central American nations from 1961 to 1978.

Several aspects of this process are of interest. First, as Nations and Komer (1983:13) have noted, "the damage wrought by commercial logging is not so much the result of what foresters remove from the forests as what they leave behind--namely the roads they construct...down these roads, like leaf-cutter ants on a forest trail come landless peasants from other areas of the country." The impact of roads in opening up new areas for colonization has been thoroughly demonstrated for Central America (cf. ISTI 1980, chapter 2; McKay 1982; JRB Associates 1982:33) and elsewhere (cf. Rudel 1983).

The scenario outlined also raises the question of why settlers enter a region so quickly once roads have been built--that is, what factors motivate them to migrate to the settlement zone. To quote Nations and Komer once again: "to blame colonizing peasants for uprooting tribal peoples and burning the rainforest is tantamount to blaming soldiers for causing wars....To understand the colonists' role in deforestation, one must ask why these families enter the rainforest in the first place" (1983:14). While demographic pressures clearly play a role in this process, they do not provide a sufficient explanation. In order to explain the particularities of the migratory process (why peasants come from some regions and not others, at certain times and not others, and with intentions of permanent or temporary residence on the frontier) one must turn to the situation in the home community.

Issues of land tenure and employment possibilities, as well as general patterns of social structure and resource distribution need to be addressed. Doing so would represent a significant departure from the main current of social science and ecological interpretations of resource use and resource scarcity in Central America, which has treated population growth as a self-evident independent variable responsible for stimulating continuing settlement and forest clearing. This is an attractive explanation because population growth is readily apparent to even the most

casual observer. In addition, prominent researchers such as Borgstrom (1973:26) and Bodley (1976:88) who have proclaimed Malthus' pronouncements regarding population growth as the major force shaping human history to be beyond criticism. However, as Durham demonstrates in his analysis of the ecological origins of the "soccer war" between El Salvador and Honduras, population growth accounts for only a fraction of the declining resource base of the rural population of El Salvador prior to the war. Any ecological interpretation of the origins of the war must also consider the increasing concentration of land in the hands of a small portion of the population.

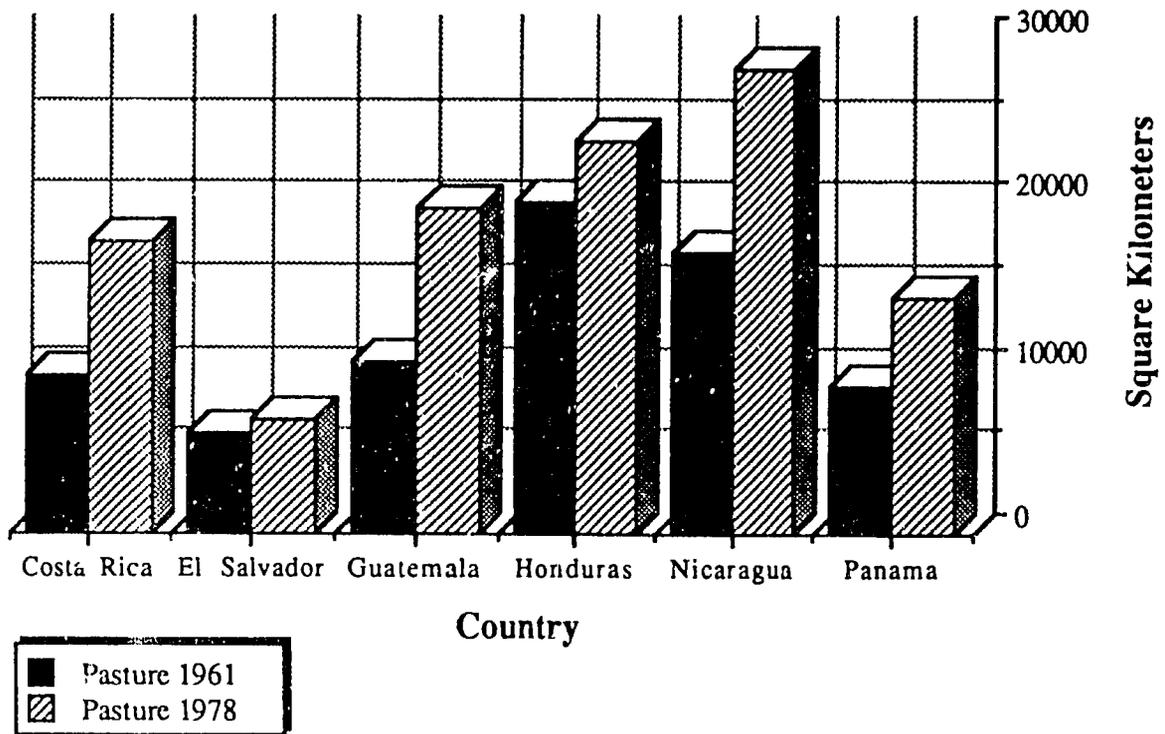
Table 1
Central America. The Shift from Forest to Pasture.*

<u>Country</u>	<u>Area (km²)</u>	<u>Pasture</u>		<u>Forests & Woodlands (km²)</u>	
		<u>1961</u>	<u>1978</u>	<u>1961</u>	<u>1978</u>
Costa Rica	50,700	9,690	17,640	28,480	19,300
El Salvador	21,390	6,060	6,900	2,300	0
Guatemala	108,890	10,390	19,760	84,000	44,000
Honduras	112,090	20,065	23,700	71,000	39,000
Nicaragua	130,000	17,100	28,200	64,320	44,000
Panama	75,650	8,990	14,300	41,000	32,000
Total	498,720	72,295	110,500	291,100	178,300
			(+65%)		(-39%)

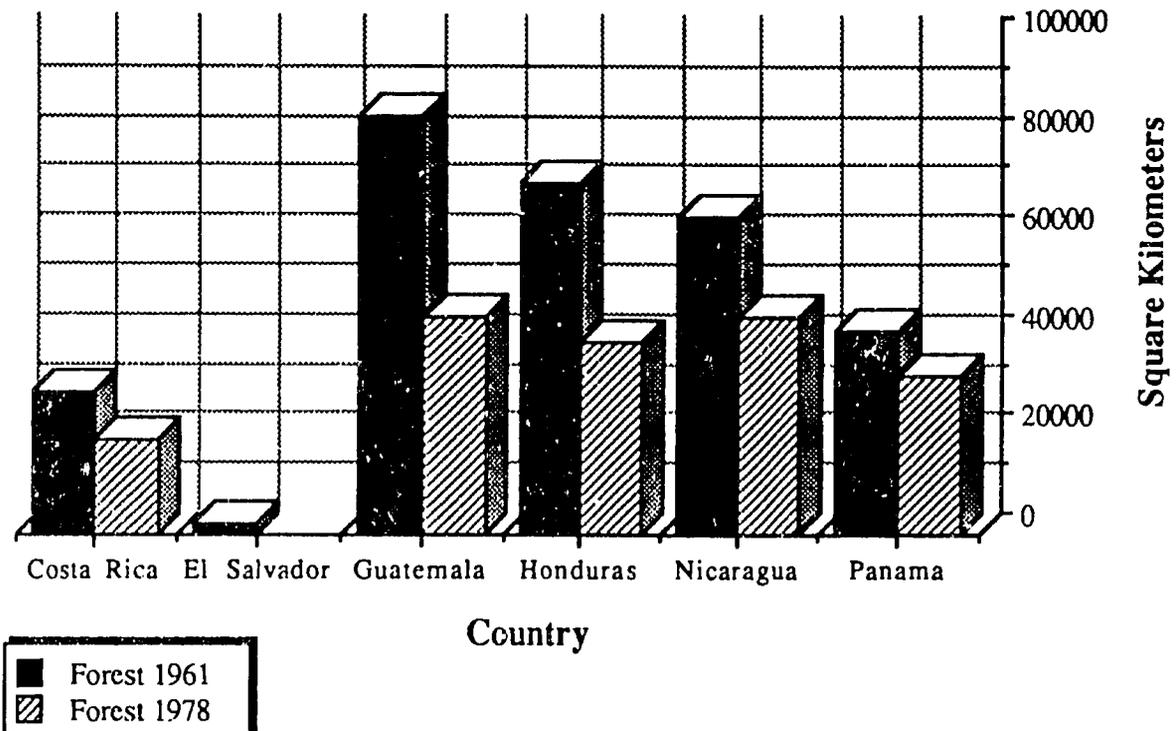
*Adapted from Myers 1981b.

In a similar vein, Partridge (1984:76) notes that population growth is particularly poorly suited as an explanation of the rural-rural migration characteristic of settlement. Partridge observes that the bulk of recent population growth may be accounted for by urban populations which, due to improvements in health care and sanitation, have begun to reproduce themselves over and above whatever urban population growth may result from rural-urban migration. Thus, reference to population growth does little to illuminate processes of social change in rural areas responsible for the clearing and settlement of additional forest areas. Both Durham and Partridge argue that we must look at the distribution of land and other productive resources, and at the workings of institutions that regulate access to these resources.

Increase in Pasture Area, 1961-1978



Decrease in Forest Area, 1961-1978



9a

Using the evidence from South America as a guide, we can expect to find that smallholder settlement is driven by a lack of economic opportunity in the settlers' home communities (cf. Blanes et al. 1984; Collins 1984). This suggests that if we wish to understand the driving forces behind settlement and deforestation in Central America we cannot confine our inquiries to the settlement zones themselves, but must understand how resources are distributed and access to them regulated in the settlers' areas of origin. Furthermore, based upon cases in which smallholder settlement has been linked to environmental destruction (cf. Hiraoka and Yamamoto 1980; Moran 1981), we may expect to find that this arises from settlers experiencing difficulties in satisfying immediate consumption needs due to state policies that provide few incentives for sustained land use and unfavorable resource competition with other social classes. Settlers sacrifice long-term management of the land in order to achieve short term production needs (Collins 1986).

When settlement and deforestation are viewed in the light of these kinds of processes, it becomes necessary to question whether or not population growth may properly be considered an explanatory variable at all, or whether like environmental destruction, it is symptomatic of more fundamental social processes which increasingly restrict access to the resources needed for production. When economic hardship creates pressures on poor populations to increase production, they frequently are able to do this only by intensifying the use of their own labor. Population growth may be a long-term response of poor populations to labor scarcity.

The transition from small farms to cattle ranching raises a second set of questions. These involve the "inevitability" of the process and the nature of the interaction between settler groups that it implies. The processes by which ranchers take over in a region vary. According to some authors, the transition is an ecological inevitability where soils and other aspects of the tropical environment are not conducive to annual cropping. Despite the intention of the families involved to remain on the land:

...after one or two crops of maize, rice or manioc are harvested from the forest clearing, declining soil fertility, invasive weeds and noxious insects combine to force the colonists to sell out to a second wave of settlers or speculators who follow behind, consolidating small holdings into larger ones for the exclusive purpose of raising beef cattle (Parsons 1980).

Rather than allowing the land to fallow in the face of declining fertility and invasive pests, settlers seed the land in pasture, sell it, and move elsewhere. Heckadon (1982a) interprets this pattern as arising from smallholders' lack of financial resources, constraining them from making the necessary investments in capital inputs and labor to maintain the land, and from a concomitant pressure to sell out exerted by wealthier interests who move into areas behind the original settlers. This view is consistent with that of most social scientists who have done research on the moving cattle frontier.

Sewastynowicz (1986) provides an alternative interpretation, which views the movement of settlers to new zones as part of a two-step upward mobility strategy. According to this argument, settlers move into an area, work for a few years to improve the lands they claim, and then sell them at a profit, using the funds they acquire as capital to establish themselves permanently in another area. While this view is an interesting one, it must be approached with caution, as Sewastynowicz bases his argument on data collected in southwestern Costa Rica, near the Pacific coast, in an area that was settled primarily in the 1940s and 1950s. The migrants in Sewastynowicz' study stayed in their first settlement area for about ten years before moving. Smallholders on present-day cattle frontiers remain on their land for a much briefer time, rarely more than five years, before moving. Sewastynowicz' findings are also problematic in that they are based on personal history interviews with migrants of the 1940s and 1950s who remain in the region today. The longevity of these family enterprises presumes some measure of success, and there is no way of knowing how many less successful migrant families have entered the region and moved on.

In many areas, the first wave settlers attempt to undertake cattle production themselves. As they clear land--or as it degrades under cultivation--they create pasture, while attempting to obtain sufficient cash or credit to purchase cattle, or to arrange to transport them from their former homes. If their efforts to obtain stock fail, they retain the option of selling the "improved" lands and thus obtaining some remuneration for the hard work of pasture formation. A study conducted in the province of Darién in Panama found that while only four members of one colonist community had cattle, 30 or more had begun formation of pasture (Heckadon et al. 1982:94).

Another common pattern involves the loaning or renting of land to small producers by prospective ranchers. Peasants who have depleted their subsistence plots through annual production, and who find it difficult to acquire more land due to rising prices or the lack of availability, frequently rely on this option. They cultivate the loaned or rented land and are expected to return it cleared and in pasture at the end of a specified period. Depending on local conditions and practices, they may have also been required to provide some portion of the harvest to the landlord during the period of cultivation (Heckadon 1982a). A variety of legal devices, including debt peonage, may make it easier for landlords to enlist cultivators in such arrangements (Partridge 1984:77).

Finally, where ranchers are in a hurry to begin operations, they may simply hire poorer settlers to cut and burn the rainforest and plant pasture grasses. These settlers divert labor from their own enterprises, which may not be producing enough to support them (JRB Associates 1982:84). Peasant families of Darién province in Panama have been known to migrate into national forests, where they cut and burn vegetation and plant grass for ranchers, many of whom reside permanently in Panama City (Chapin 1980; Heckadon 1982a).

The widespread and rapid transition to cattle ranching in settlement areas raises questions of land use capability and the relative economic returns to various enterprises on the frontier. Where cattle enter a region, labor dynamics are altered and land values have been known to increase by as much as 1000 percent (Heckadon 1982a; Barlett 1982; Partridge and Brown 1982). The introduction of cattle ranching has been shown to be clearly associated with increased social stratification and out-migration (Meehan and Whiteford 1985).

There is no doubt about the pervasiveness of the pattern described. However, there is little evidence to suggest that livestock ranching is economically viable over the long term in tropical forest regions. Nations and Komer (1983:15) argue that without appropriate investments in inputs and improved range management techniques, overgrazing and torrential rainfall will erode pasture in most areas of Middle America within 7 to 10 years. Based on an exhaustive study of nutrient cycling in soils that had been converted to pasture in the Brazilian Amazon, Hecht (1985) has found government reports to be overly optimistic regarding the sustainability of livestock ranching in the region. Even in areas where ranching is not directly destructive of soils, there is evidence that it may not be the most economically appropriate allocation of land resources. As Leonard has noted:

...as much as two-thirds of the best agricultural lands in Central America are today being utilized for extensive cattle grazing, at an economic return far below that which they could produce in cultivation of either export or food crops (1985:6).

Descriptions of the transition from forest to pasture and its harmful effects are abundant in the literature, although they are based on a relatively small number of field-based studies whose findings have been frequently repeated. Subsequent sections of this paper will examine this literature in order to begin to identify the variables that seem to influence producers to undertake livestock enterprises. If the factors that lead families to begin the process of converting to pasture are identified, it may be possible to begin restructuring them toward more sustainable and economically viable options. Developing an understanding of the way in which features such as labor availability, land tenure, and access to services operate to condition decisions in frontier areas will also provide a basis for future research on alternative forms of production in settlement zones.

Labor Availability

Issues of labor availability in frontier areas are intimately tied to the production system that is in place and thus to the stage that has been reached in the forest-to-pasture transition. In early stages, when forest is being actively cleared, labor requirements are very high. Heckadon (1982a:40) reports that it takes 80 to 100 days of labor to clear and cultivate one hectare of primary forest, and 40 to 50 days to clear a similar amount of secondary growth. Comparative data from other regions suggest that these estimates are reasonable to modest. They also demonstrate significant variation from one crop to another and between crops and pasture. Table 2 presents labor inputs from various settlement zones in the Peruvian high selva.

For small farmers settling a new area, there is little to do but resign oneself to the intensive and hard work these figures imply over the first few years. In doing so, it is necessary to strike a balance between the amount of land that can be cleared and the amount that can be maintained clear for productive purposes. Data from Bolivia suggest, for example, that with limited use of chain saws families can clear by hand a mean of approximately 3.5 hectares per year, but can maintain only about 0.6 hectares cleared for cultivation due to weed invasion (Painter 1987).

Land that is opened is generally used for cultivation of food crops until soil fertility begins to deteriorate. Once production declines, settlers must choose whether to allow the land to regenerate to forest or to convert it to pasture (Heckadon 1982a:39-40). The frequency with which they choose the latter course is one of the major features distinguishing the slash and burn practices of settlers from those of groups native to the regions that they enter (July 1982:67).

The decision to convert to pasture is based on a number of factors. The first is related to the lower investments of labor that this strategy requires. After having faced the hard work of clearing land, many families are reluctant to allow it to return to forest. Even for those who have practiced some form of shifting agriculture in their home communities, the clearing of heavy forest growth seems a great burden. As the data in Table 2 reveal, retaining land in pasture requires amounts of labor equivalent to those that Heckadon suggests are necessary for clearing secondary growth. Forming pasture thus seems to be a way of protecting an initial investment of labor (Heckadon 1982b).

A second factor that may lead settlers to choose to convert to pasture is the vision of forest land that is not under cultivation as "empty," and thus fair game to be claimed and utilized (July 1982). This is a perception that settlers from more densely populated regions frequently share with government planners and bureaucrats. Even when settlers themselves understand well that regeneration is an important part of the practice of tropical forest cultivation, they fear that fallowed forest is fair game for reclamation by the government or invasion by new waves of settlers who perceive the forest as empty. This is especially true where titling is ambiguous or non-existent.

Table 2
 Labor Invested in Crops and Pasture. Peruvian High Selva.^a
 (Derived from Martínez Avilés 1984:99-103)

<u>Annuals:</u>	<u>Crop</u>	<u>Days Labor</u>
	rice	100 - 135
	beans	60 - 88
	corn	52 - 85
	plantains	70 - 114
	soybeans	38 - 70
	yucca	74 - 147
<u>Perennials:</u>	cacao	85 - 140
	coffee	90 - 124
	citrus	56 - 126
<u>Pasture</u>		41 - 55

^a These figures represent only field labor and do not include building of necessary storage facilities or fences, care of seedlings, communal work, etc. Values in the table were obtained by averaging the labor involved in clearing and cleaning plots over the number of years they can be used.

Finally, the creation of pasture is perceived as an investment, even by families who do not yet own animals. In a form of small-scale land speculation, settlers recognize that once a region is opened, and especially after a road is built, land values will rise rapidly.² Simply holding onto the land for a few years will increase its value; sowing it in pasture compounds the profit that can be taken. While there is evidence that most settlers intend or hope to use the pasture for livestock of their own, they believe it to be a good investment even if this is not possible.

For settlers who enter a region with little capital, the early, labor-intensive stages of the settlement process are both a hardship and an opportunity. The opportunity lies in the fact that families are able, by investment of little more than their own labor, to establish a "stake" for themselves. The investment of large quantities of unpaid family labor is a frequent strategy of small farmers. It has long been recognized that it is this practice that permits smallholders to keep on producing in

² Stearman (1985) documents this process for the case of the Yapacaní settlement area in eastern Bolivia. In this example, an economically moribund area experienced a burst of economic activity as the result of road improvements and the construction of a bridge. Many original settlers left the area, selling out to buyers from regional urban centers who had acquired an interest in the area.

areas, or under conditions, where capitalist firms would go bankrupt (Chayanov 1966, Sahlins 1972; Taussig 1978).

Where heavy investments of labor result in the establishment of a viable household enterprise, frontier settlement does provide families with a new area of economic opportunity. The majority of farmers who enter a settlement area, however, are not able to establish stable enterprises. When families cannot develop sustainable and economically viable cropping systems or obtain cattle of their own, they tend to be "expelled" from regions as land values rise and competition for resources increases. They may return to their home communities, if they have retained land there, or move on to more recently opened frontiers. Those who follow the latter path frequently become "professional" land clearers, opening the way for larger enterprises (Heckadon 1982a; Nations and Komer 1983; Malleux 1983; Ledec 1983). Whether they work directly for prospective ranchers or continue to claim and sell land, they rely on a strategy of intensive investments of labor, rather than seeking to develop more sustainable and profitable combinations of labor with other resources.

A final issue related to the availability of labor for small producers is the depletion of household labor resources due to the need to work off-farm. This practice has been documented for a wide range of settlement areas, even during the early stages, when a family's labor requirements on their own plot are quite high. Harrison et al. (1981) have described the efforts of small-scale migrant farmers to combine independent production and wage labor on banana plantations in the district of Guacimo in north coastal Costa Rica. Forty percent of small farmers in this region possess between one and ten hectares of land. Approximately 30 percent have plots of only one-quarter to one manzana⁴ and find it necessary to rent additional land to farm or to sell their labor for wages. At the time of the study, a large proportion of farmers were attempting to maintain annual cropping systems that included corn, yucca, beans and vegetables, in combination with a few perennials and animals. They recognized, however, that intensified land use and an overemphasis on corn were badly depleting the soil and many families who could afford to do so had begun a shift to a greater emphasis on pasture and livestock. The report notes that "for those whose land or production is marginal, access to banana work ... literally makes continuance on the land possible."

Durham (1979) has noted that in Honduras and El Salvador families with less than two manzanas tend to have members who work off-farm. A recent assessment of the agricultural sector in Panama indicates that nearly 70 percent of farmers on lands of less than three hectares rely upon outside income to support their families (Conklin 1986). Heckadon (1982a:31) describes the need of smallholders in Panama to send members outside the settlement region to seek a wage.

⁴One manzana = .69 hectares, or 1.7 acres.

When labor resources are the primary source of productive investment, off-farm work may have serious consequences for the management of newly opened lands (Collins 1984, 1986). Recent research has pointed to this problem on lands that are susceptible to erosion due to their steep slope. Posner and McPherson (1982:347) have observed that "being less poor, farmers will also have more resources, including labour time, to adopt soil conservation practices and invest in productivity-improving technology." Posner et al. (1982:278) argue that seeking a major portion of family income from off-farm employment places serious constraints on the availability of labour for farm tasks. There is evidence that many families in settlement zones continue to work off-farm even when pasture is established and animals procured. The unimproved pastures commonly used in most of Central America can rarely support one animal per hectare. Heckadon (1982a:31) has shown that extensive ranching of the type practiced in Panamanian settlement zones is of such low productivity that it is not capable, by itself, of supporting a family.

Labor availability is also a serious constraint from the perspective of ranchers or investors in other cash crops during the period of establishment in a new region. As long as land is easily accessible, settlers tend to devote their attention to their own enterprises and exhibit little willingness to clear land for others. The difficulties for commercial farmers or maintaining a work force on an "open frontier" have been described in the settlement literature from South America (cf. Aramburú 1982; Bedoya 1982).

For ranchers and large farmers facing this problem, however, time is an ally. Smallholders sell pasture or begin to work for a wage off-farm when they begin to experience short-term deficits in household income. Such deficits result when production of food crops begins to decline on poor soils, when savings brought from the home community are exhausted, when debts for inputs cannot be repaid, when crops are wiped out by weather or plague, or when a family member becomes ill. Such events are not an inevitability for settlers, and some possess the resources to overcome them independently. But they create serious difficulties for a sizeable proportion of those who move to the frontier. Larger holders can take advantage of these conditions by hiring the labor of those in need of quick cash or by purchasing their cleared lands.

In the latter stages of settlement, once cattle ranching has been firmly established in a region, labor dynamics shift markedly. Relatively small amounts of labor are required to maintain land in pasture and to care for animals. As Meehan and Whiteford have emphasized:

Cattle require rotation from field to field and vaccinations and spraying for pests, and pastureland must be periodically weeded. Yet labor requirements are low. As more land is converted to pasture, large landholders are able to achieve higher returns from their land with only a minimal diversion of their new income stream to laborers in the community (1985:186).

Heckadon (1982b) reports cases of families in the settlement zone of Tonosí in Panama who have 80 to 100 hectares in livestock but do not fully employ their own members. Citing a wide variety of sources for Latin America, Partridge (1984:78) concludes that "mixed farming systems which include both crop and livestock production employ more labor...than humid tropics cattle ranching." According to Margolis (1980:233) the labor extensiveness of cattle production is expressed in the saying: "where cattle enter, men exit."

It is this third stage of consolidation of cattle ranching that Heckadon (1982a) identifies with the expulsion of small-scale settlers from the frontier. "In the expulsive stage," he notes:

important changes in land tenancy and class structure occur. A greater concentration of land in the hands of a smaller number of owners is observed, but at the same time a rapid growth in the number of minifundia and a surge in the number of peasants without lands. Many peasants find that it is no longer economically viable to remain in the area they have colonized and opt to sell their farms already made into pastures in order to move on to new colonization frontiers where, in all likelihood, the cycle that has expelled them will expel them once again (authors' translation).

Settlement zones throughout Central America are characterized by this pattern, where farmers without capital first apply their labor in an intensive manner to the land, and where their failure then provides a basis for more labor-extensive enterprises to take over the lands they have cleared. Failure is related, not to the inherent incapacity of settlers for tropical forest production, but to the normal difficulties of starting a new enterprise, the lack of knowledge of appropriate land uses for the area settled, and the presence of predatory landholders standing ready to acquire their land. Economically, neither the labor intensive production of the early stages, nor the labor extensive methods of the later ones represent an optimal combination of the resources available on the frontier. Neither relies on an understanding of appropriate land use. Both are environmentally destructive and fall short of social goals by failing to provide a sustainable living for land poor families from other regions. In the last instance, peasant farmers provide inexpensive or free labor in clearing lands for cattle ranchers (Ledec 1983)-- contributing to the establishment of a land use that cannot absorb their labor.

Land Tenure and Access in Settlement Areas

The dynamics of land ownership in settlement zones revolve around three issues: the amount of land available (degree of concentration of holdings); changes in the market value of land (and processes of land speculation); and security of tenure. In the settlement zones of Central America, as elsewhere, landholdings have a tendency to become more unequal as time passes. This trend cannot easily be separated from the tendency

toward investment in cattle in these regions. Cattle ranching is an activity that by nature requires relatively little labor and is extensive in its use of land, particularly on the unimproved pastures that predominate in Central America. Thrupp (1981) argues that land consolidation in ranching areas is promoted, not only by the need for large amounts of land and capital, but also by: a) the low labor requirements of ranching; b) difficulties experienced by small farmers in purchasing new land and expensive fuels and fertilizers; and c) the relative difficulty small farmers encounter in seeking credit and capital. For all of these reasons, cattle ranching is related not only to the consolidation of landholdings, but to a more general increase in social stratification in regions where it enters (Meehan and Whiteford 1985).

The actual pattern of distribution of landholdings depends greatly on the history of a region's settlement. In areas where recent migrants encounter a settled population with a mixed livestock/agricultural productive base, they may assimilate to this pattern rather than becoming involved in the cycles of land consolidation and expulsion just described. Boyer (1980) found that while approximately 18 percent of the population had arrived in an Atlantic coastal region of Costa Rica during the five years before his study was conducted, in no community did "precaristas" or semi-transient slash-and-burn farmers constitute more than 10 percent of the population. These individuals tended to be those who arrived with very few resources, and no means of seeking support among the local population (pp. 17-18). Approximately half of the in-migrants were adopting the settled pattern of mixed agriculture and animal husbandry practiced by earlier inhabitants.

Joly (1982) notes, however, that migrants from the interior of Panama to the Atlantic coastal region do not adopt the regenerative agricultural strategies of the longer-term residents of this area, but continually seek new extensions of virgin forest to clear for short-term agricultural production and conversion to pasture. Such conflicting and competing patterns of land use have also been described for the Darién region of Panama, with some authors indicating that native populations have begun to move into cattle ranching themselves and to adopt the practices of settlers (Heckadon et al. 1982:87).

Land speculation has been proven to be of tremendous importance as a factor leading to the ultimate expulsion of smallholders from settlement zones. Hecht has noted that programs promoting cattle production in the Brazilian Amazon caused land values to increase at a rate of 100 percent per year through most of the 1970s. Under these circumstances, Hecht (1985:377) reports:

"the nature of land in the Amazonian economy began to change in a fundamental way. Land itself, not its product, became a commodity, since even lands whose productivity was declining were increasing in value because of this speculation. What became crucial at this juncture was the emphasis on the exchange rather than the use value of lands.

The processes of speculation described for the Amazon were driven only in part by the hope of future returns, or the future value of resources. More important was the role of land designated for cattle production in capturing various kinds of state subsidies. Where such subsidies (preferential terms of credit, access to technical assistance, tax incentives) exist in Central America, similar processes of speculation and rising land values have been noted (Partridge 1984).

Issues of land titling in settlement zones are not easily resolved. Titling may be beneficial in some circumstances in assuring the small producer's rights to land. It may provide the security necessary to avoid conversion to pasture as proof of ownership, as described above. A number of recent social and institutional analyses, however, have suggested that titling may also, under certain circumstances: a) increase land values, making sales of land to those in the process of consolidation more likely; b) legitimize large consolidated holdings; and c) make it more difficult for farmers with small plots to obtain more land (Boyer 1980; Seligson 1980a).

In some nations, such as Panama, only 34 percent of all agricultural land is titled; Seligson (1980b) suggests that 91 percent of land in the more remote areas of Costa Rica is untitled. The tasks of providing certificates of title under these circumstances are enormous, and it is not clear that titling alone would ameliorate the conditions that cause smallholders to be expelled from settlement zones. In some areas title is required as a precondition for credit, creating difficulties for small producers (Seligson 1980b). In cases where lack of titling poses an obstacle to productive investment it becomes necessary to assess whether it would be more beneficial to change the conditions of credit or to undertake titling programs.

Roads as a Policy Tool

In his study of tropical land settlement in Latin America, Nelson (1973) found poor market access resulting from inadequate roads to be a major constraint on the economic success of spontaneous settlers. Subsequent studies have elaborated on Nelson's appreciation of roads and underscored the preponderant role they play in shaping the course of development in settlement areas (cf. Rudel 1983; Stearman 1985; Wennergren and Whitaker 1976). Wennergren and Whitaker found the impact of roads to be so dramatic in eastern Bolivia that they recommended that the state focus public investment almost exclusively on building and maintaining roads into areas earmarked for spontaneous settlement. With adequate market access, the authors felt that the settlers would be able to earn money from their farms and invest these in providing themselves with basic services in a more cost-effective manner than these could be provided by outside agencies.

Stearman's (1985) experience in the Ypacani settlement area, which lies within the eastern Bolivian region studied by Wennergren and Whitaker, confirms the dramatic impact that good road connections can have

upon economic growth. The Ypacaní area grew dramatically after a road and bridge linking it with regional urban centers were constructed. However, this growth came at the price of widespread land speculation which led many settlers, particularly poorer ones, to sell their land and use the money earned to establish themselves elsewhere. Based upon similar observations in eastern Ecuador, Rudel (1983) has argued that if stable, sustainable production systems are a development goal roads should follow settlement rather than precede it. Economic growth will be slower; but, the author argues, it will not come at the expense of land speculation that results in poor settlers selling out to more powerful interests and then moving on to clear new areas of forest.

The opening of roads as a stimulus to settlement in Central America is an issue that emerges clearly in the literature. The impact of logging roads has been previously described. Other types of roadbuilding have also been implicated, however. ISTI (1980:27) has noted:

In the eastern region of Panama, the greatest danger to the areas of tropical forest is the construction of the Pan-American Highway, which serves as the principal route of penetration for colonists of the headwaters of the Bayano River and of the region of Darién. All along the Cañitas Highway, from Chepo to Santa Fe, in the province of Darién, one finds large extensions of forest that have been cut and burned. The migrating peasants were following the tracks or paths of the highway construction team (authors' translation).

At times roadbuilding appears to have been used as a tool by government for channeling settlers into relatively underpopulated regions:

Government agencies contribute directly or indirectly to the colonization of the tropical moist forests that still exist. Their participation in the distinct fronts of colonization may be direct, as in the case of the Proyecto Coclesito of the National Guard, in which the Guard constructed roads, built houses, and brought volunteers to cut trees. Frequently the government plays an indirect role, as when, for example, the Ministry of Public Works builds a new road to connect isolated communities, facilitating access to forested areas previously isolated and lightly populated (ISTI 1980:34; authors' translation).

The construction of the maintenance road that runs parallel to the oil transshipment pipeline between Puerto Armuelles and Chiriquí Grande has proven to be a conduit for settlers into previously inaccessible areas of the Talamanca Mountains (Moore 1985). Joly (1982:77) has noted that while the construction of roads is frequently explained as necessary for the transport of product out of a region to urban markets, particularly where cattle production is in the process of being established, a concomitant impact is to facilitate entrance by large numbers of new colonists. According to Heckadon (1982a) this second wave of settlers is largely constituted by speculator/ranchers with some capital, and landless

peasants who are more impoverished than those of the first wave and more likely to become dependent on wage work or speculative clearing. Stipek (1978:15) argues that while farmers will sell out to ranchers whether roads are built or not, they will do so faster where there are roads.

The fact that a dramatic correlation exists between roadbuilding and settlement is clear from the literature. While the results of this connection have most frequently been negative, it is also true that roadbuilding itself may come to constitute an important environmental policy tool. In combination with good land use capability studies, the building of new roads may be used to encourage settlement of appropriate regions and their absence may be used to discourage entrance into others. Considerations of the impact of access roads have already formed an important element of planning in projects such as the Rio Plátano Biosphere Reserve in Honduras (Glick and Betencourt 1983).

Land Use Capability: Government Services and Settler Strategies

Effective development of natural resources in any nation is contingent on knowledge of appropriate uses for soils and other aspects of the productive environment. None of the nations of Central America have in place a system for identifying and mapping land use capabilities which would allow them to designate particular lands as appropriate for agricultural forestry or protective functions, or to specify the constraints and special conditions under which particular lands could be used for agriculture or ranching (Leonard 1985:20). This would seem to be a high priority. The existence of such a system would aid not only in the planning or management of settlement, but also in the location of infrastructural projects such as reservoirs, roads and urban expansion. It should ideally be binding on all institutions with land management functions (JRB Associates 1982:9).⁵

Assessment of land use capability requires adequate soil studies conducted at an appropriate scale to encompass inter-regional variability (Moran 1986). It also requires a creative approach to the use of forest resources, which considers the value of naturally occurring plants and animals (Ewel and Poleman 1980)⁶; minimizes waste in the use and clearing of trees (Leonard 1985:7); considers incorporation of small-scale processing with the production of timber or food crops (Guess 1979,

⁵ For a discussion of the enforcement issues this raises see JRB Associates (1982).

⁶ Leonard (1984:8) notes that: "deforestation may be eliminating plant species that may some day prove to be valuable for pharmaceuticals, plant hybrids or pesticides. About a quarter of the world's medicines now produced commercially in the U.S. are derived in whole or in part from tropical plants. Collecting, screening and commercializing tropical plants is still a fledgling pursuit in Central America."

Malleux 1983); and promotes diversified production strategies (Partridge 1984:78).

Lack of such land use capability assessments has contributed to the poor economic performance of the agricultural and natural resource sectors in most Central American nations. According to JRB Associates (1982:53-4) in Honduras:

only about one third of the land classified as adequate for annual crops is utilized in this manner. In contrast, much land that is utilized for annual crops is only classified for forestry or extensive uses such as wildlands or cattle farming. These apparent paradoxes are caused principally by the existence of large holdings using good soils extensively for cattle or reserve lands, while small holdings on steep slopes and/or poor soils are utilized intensively by a dense population. For example, livestock grazing on alluvial soils of the Caribbean lowlands may be economically viable, but certainly represents an underutilization of the land resources.

Addressing issues in the allocation of land to various uses can resolve problems of appropriate resource management in settlement areas. These accounts also suggest, however, that it can help to alleviate the flow of migrants to urban and frontier areas from regions where allocation is poor.

Once an area is opened to settlers by roadbuilding or other measures, knowledge of its capabilities is a prerequisite to settler success. While much has been written about the adaptability of small-scale producers, adaptation in their home environment is based on long knowledge of and experience with the resource base at hand. In a new area, settlers require the advice and guidance of technical personnel who can assess the potential of a region for various uses.

Knowledge alone, however, is insufficient. The services made available in a particular region need to be consistent with the land use recommendations that have been made. If perennial cropping or selective small-scale logging are indicated, credit and technical services must be available for these purposes. If naturally occurring forest products can be exploited (such as barbasco in Mexico) then marketing channels must exist. There are virtually no tropical soils that can be cropped for any length of time without fertilization (cf. Manrique 1986). Appropriate fertilizers must be made available where cropping strategies are to be encouraged.

The gains that have been made in agro-forestry and related systems in recent years have been impressive. Multi-tiered cropping systems involving perennial tree crops, and silvo-pastoral and living fence post systems which contribute to the nutrient content and longevity of pastures have shown great potential for success in Central American environments (McGaughey and Gregorsen 1983). Development of compensatory forest plantations for wood supply, and retention of catchment areas with tree

crops have proven useful in other parts of the world (Spears 1983). Use of these techniques requires training and incentives, as well as careful planning to insure that the farming/cropping system of which they form a part is capable of supporting settler families given available infrastructure and market conditions.

The current situation in settlement areas provides ample evidence that farmers respond to incentives and service availability. Cattle ranching is an attractive option because of the high prices it brings on national and international markets, and because it is relatively easy to transport to markets. For the small producer, it is also important that cattle, unlike crops, do not have to be harvested, stored and sold at a particular time, but can be saved and fattened or liquidated quickly depending on the economic situation. Nevertheless, these are not the only, nor even perhaps the predominant reasons why settlers turn to cattle production. Cattle ranching frequently makes it possible to obtain credit and technical assistance that would not otherwise be available. In the case of Panama, Heckadon (1982a:40) has noted:

Another factor that influences the peasant to opt for ranching is the manner in which agricultural credit is handled in Panama. The institutions that loan most frequently to peasants, such as the Agricultural Development Bank, generally discriminate against shifting agriculture at the same time that they have many credit programs to facilitate the expansion of herds....We have a typical example in the case of the Canal Basin. In the last five years, the Agricultural Development Bank and the National Bank of Panama have loaned, in the western sector, some two million balboas to peasant producers. Of this sum, 98 percent was for livestock loans (authors' translation).

Similar patterns of credit allocation have been described by ISTI (1982) for Panama as a whole, and by JRB Associates (1982:67) for Honduras. The preferential provision of credit to livestock enterprises is not just a national policy, but is also linked to the lending policies and priorities of multi-lateral and bilateral institutions (July 1982:74; Feder 1978; Spielmann 1977). Were similar resources to be made available for appropriate systems of crop production or other tropical forest enterprises, there is every reason to expect that the productive strategies of settlers would shift accordingly.

Conclusions

Although the literature on settlement and deforestation in Central America is sketchy compared to what is available for South America, it does provide a basis for beginning to discuss general processes of change that create the pressures to clear and settle new areas of tropical forest, and to point out specific themes on which additional research is needed. Settlement and deforestation in Central America have often been by-products or side-effects, as states have pursued other interests, such as supporting elites in maintaining and extending their control over land,

or supporting the expansion of beef production for export. In some ways, this makes the problems that are posed by settlement and deforestation particularly difficult to address in Central America, because they are never defined as issues to be addressed. Since in many cases states have not been explicitly promoting settlement, they are reluctant to take measures that will bring them into conflict with powerful sectors of their populations in order to improve settlement's record as a development tool.

The most studied aspect of settlement and deforestation in Central America is the conversion of forest to pasture associated with the expansion of the beef cattle industry, and the role that smallholders play in facilitating that process. Cattle ranching is attractive to smallholding settlers because, once a ranch has been established, it requires relatively small amounts of labor to maintain and cattle provide a convenient means of storing and accumulating wealth. However, few smallholders are able to complete the entire process from clearing forest to acquiring cattle. Either they lack the labor to establish pasture, or they so decapitalize themselves in the process that they have no money left to purchase cattle. As a result, settlers frequently wind up being an unremunerated labor force for wealthier interests that follow them into an area and buy them out or force them off the land once the forest has been cleared. Even when settlers receive a profit from the sale of their land, this seldom bears any relationship to the labor they invested to "improve" it.

Central American states are also attracted to ranching because prevailing wisdom holds that is the only use to which tropical forest areas have been put that has proven itself to yield long term profits. This argument is particularly persuasive because the profits come in the form of "hard currency" export earnings from beef sales. However, the literature on Central America raises a number of questions about the sustainability of cattle ranching over the long term which suggest that the profits earned by the industry may be illusory. Circumstantial evidence suggests that the "profitability" of ranching may be a product of land being undervalued, and that the entire industry may depend upon ranching being able to expand the area dedicated to cattle raising rather than being forced to invest the money necessary to maintain existing grazing areas. Studies indicate that few areas of Central America currently experiencing settlement pressure can support the sustained production of pasture or any other crop in the absence of substantial fertilizer application. To date, however, studies examining the long-term economic and ecological viability of ranching in the region are lacking.

As noted above, land tenure is a central issue underlying settlement and deforestation because both settlers and ranchers depend upon the availability of cheap land as the basis for their production systems. The fact that most of the land in the areas of the Central American countries experiencing heavy settlement pressure is untitled has a number of development implications. First, neither the settlers nor those who buy them out pay anything resembling a market price for the land, that is a price that reflects either the value of the labor expended to bring it into production or the potential value of the commodities to be produced

on it. Second, it is difficult to separate cases in which settlers are actually bought out from cases in which they are forced off the land by physical intimidation or other extra-economic means. This further obscures the factors that push settlers ever deeper into forest areas. Third, insecurity of title discourages landowners, particularly small, politically powerless ones from investing in the long-term conservation and improvement of their holdings.

These factors make it tempting to recommend that development efforts focus on land titling and the establishment of a land market as an instrument for reducing pressures in favor of continuing settlement and deforestation. Unfortunately, the Central American literature provides evidence that such measures would either be ineffective, or worse, that they would be counterproductive. In areas where the impacts of titling have been assessed, for example, the results have included forcing up land prices and encouraging speculation. A speculative climate tends to favor the consolidation of large landholdings by those with enough money to buy out their neighbors. The short term result in such cases may be that the pressures on settlers to abandon existing holdings in favor of new ones deeper in the forest are heightened; while the long-term result may be that the inequitable distribution of land, where many of the pressures for settlement and deforestation originate, may be exacerbated. Additional research is needed to indicate under what conditions more efficient land titling and the establishment or strengthening of land markets will help stabilize a situation and under what conditions they will accelerate the destruction.

One of the more problematic issues to be addressed in connection with settlement and deforestation is the construction of roads. Improved roads and transport facilities are commonly viewed as essential for almost any rural development effort to succeed, as farmers and ranchers seek to sell their production under more favorable terms by virtue of the improved market access that roads may provide. However, the Central American literature clearly indicates that where new roads penetrate settlers quickly follow, bringing with them the complex of problems and processes described in this paper. The concept of road planning as it is practiced in the region needs to be expanded so that it considers what areas are not appropriate for settlement and cultivation, and so that road construction is carried out in order to lead people away from areas that need to be protected and toward others that are less environmentally vulnerable.

The issues discussed here suggest two areas in which development agencies interested in curbing the environmental destruction associated with settlement in Central America could profitably concentrate their resources. First, they can provide support for conducting detailed land use capability studies in all countries of the region. It is unrealistic to expect that settlers will enjoy economic success and manage soil and water resources well in their new homes in the absence of technical support from specialists who are well informed about the production potential of the settlement areas. At present the basic technical information needed to provide this service is lacking for most of Central America.

Related to the need to realistically assess the qualities and capabilities of tropical forests and soils is the search for economically attractive technical and institutional alternatives to the cattle ranching regimen that currently dominates the region. At one level this means that we begin to look systematically at the production systems of agricultural populations with long-time residence in tropical forests. Research should focus on establishing how sustainable such systems really are, the possibilities of making traditional systems more economically attractive through more efficient and intensive use of labor and capital inputs, and the institutional arrangements whereby access to key productive resources are regulated.

Second, development agencies can work with relevant state institutions in order to identify agricultural credit policies, land tenure arrangements, and other factors that may be designed or re-designed in order to provide incentives for settlers to practice the sustainable land uses that are identified by research. The example of cattle provides clear evidence that small and large landowners alike are responsive to such measures. What is required is the political will to restructure current incentives in ways that will foster the most advantageous uses of land. For smallholders it seems clear that this will imply the encouragement of relatively diversified regimens that include food crops, animals, the collection of forest products, and logging rather than a focus on a single export crop or animal. It is clear that land use questions are embedded in broader web of social factors related to access to land, markets, and other productive resources.

The search for alternatives to cattle ranching needs to turn attention to how price policies, land tenure arrangements, and other elements of state agricultural policy intended to benefit ranching also inhibit economic growth in other areas of the agricultural economy. The research done thus far clearly indicates that state policy has played a major role in creating or legitimizing the inequities in resource distribution that are a major force driving settlers into new forest areas. However, this understanding remains at a very general level, and the relative importance of different kinds of policy measures in creating conditions conducive to settlement and extensive land use practices remains poorly understood. If the relationship between ranching and destructive land use is to be broken without repressive measures against smallholding settlers, on the one hand, and without crippling an industry responsible for generating important export earnings for impoverished states, on the other, success in encouraging alternative productive activities and ways of organizing them is critically important.

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