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LIVESTOCK AND DEFORESTATION IN CENTRAL AMERICA IN THE 1980s AND 1990s: A POLICY PERSPECTIVE

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ABSTRACT

This study analyses seven factors used to explain the conversion of forest to pasture in Central America between 1979 and 1994: 1) favorable markets for livestock products, 2) subsidized credit and road construction, 3) land tenure policies, 4) limited technological change in livestock, 5) policies which reduce timber values, 6) reduced levels of political violence, and 7) characteristics specific to cattle which make it attractive.

Deforestation rates in Central America declined in the 1980s, but continued to be high. After expanding rapidly, cattle population and pasture area have stagnated, although they continue to expand on the humid tropical frontier.

Strong markets for beef and dairy products stimulated livestock expansion and deforestation in the 1960s and 1970s. After that, markets for livestock products became less favorable, which led to lower investment.

During the 1960s and 1970s large government subsidies for cattle raising increased forest conversion. Since then, credit subsidies have been reduced, but subsidized public road construction continues, causing widespread deforestation. Land speculation is another reason why pasture expansion has continued in agricultural frontier areas.

There is little evidence that technological progress in livestock production reduces deforestation. Nor is it clear that removing policies which discriminate against forest production would have a major positive effect in this regard.

The author proposes: 1) restrictions on road construction and livestock credit in agricultural frontier areas, 2) increased enforcement of land use restrictions in protected areas, 3) the expansion of land rights for indigenous peoples, 4) stronger restrictions on the titling of natural lands by large landholders, 5) pilot efforts to establish local land taxes with higher rates for pasture and crop lands than for forest, 6) economic incentives for secondary forest regeneration, and research on pasture degradation in Central America.

CONTENTS

LIVESTOCK AND DEFORESTATION IN CENTRAL AMERICA IN THE 1980s AND 1990s: A POLICY PERSPECTIVE*

David Kaimowitz**

1. INTRODUCTION

The most important change in land use in tropical Latin America in the last 30 years has been the widespread conversion of forest to pasture. Between 1981 and

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1990, the region lost 75 million hectares of forest, the majority of which became grass lands (FAO, 1993).

In some cases these changes were justified. But in many others, the social costs of deforestation outweighed the benefits (Ledec, 1992). Large amounts of wood and non-timber forest products were wasted. Soil degradation and siltation increased. Valuable genetic resources were lost. Carbon dioxide released by burning forests contributed to global warming. Moreover, many of the new pastures can only sustain their nutritional value for cattle for a few years under current practices.

The benefits of any future deforestation will probably be even lower and the costs higher. The remaining forests tend to be on marginal lands with excessive rains and poor soils or steep slopes. Cattle raising or crop production in these areas generates low levels of income per hectare. At the same time, forests in very humid or mountainous areas are likely to have high value for biodiversity conservation and watershed protection, and as the total area in forest declines the "existence value" which society places on forests may increase.

Deforestation is especially problematic in Central America because, unlike the Amazon, most remaining forest could disappear in the next few decades. Because of its role as a biological "bridge" between North and South America and its great diversity in climates, soils, and altitudes, the region has one of the highest levels of biodiversity per square kilometer in the world (Reid and Miller, 1989). And given the low levels of value added which could be generated by livestock and cropping on currently forested land (typically below 50 dollars per hectare), environmental

services provided by forests do not have to be very high to outweigh the benefits of agricultural production on those lands.[1]

Seven explanations for why pasture has expanded at the expense of forest can be found in the literature (Godoy and Brokaw, 1994):

- Favorable markets for livestock products (Myers, 1981; Nations and Komer, 1983).
- Government subsidies for livestock credit and road construction (Binswanger, 1991; Majar, 1989).
- Land tenure policies that promote deforestation to establish property rights (Jones, 1990).
- Slow technological change in livestock that favors extensive production systems (Serrao and Toledo, 1993, 1992).
- Policies which depress timber values and make forest management unprofitable (Kishor and Constantino, 1993, Stewart and Gibson, 1994).
- Reduced violence, which has lowered the risk of ranching in isolated areas (Maldidier, 1993).

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[1] The fact that carbon sequestration and biodiversity conservation offer substantial "spill over" benefits to countries outside Central America, which may even be higher than the benefits these environmental services provide the region itself, undoubtedly raises the issue of international compensation for the incremental costs of these national conservation efforts. However, this issue is beyond the scope of this paper.

- Characteristics of cattle such as their low labor and supervision requirements, transportability, limited risk, prestige value, limited use of purchased inputs, and biological and economic flexibility (Hecht, 1992).

Some of these explanations also apply to forest clearing for crops, and indeed large areas have been deforested for crop expansion. Nevertheless, because of the specific advantages of cattle captured in the last explanation, land owners have often chosen to convert their land to pasture rather than crops.

Depending on which factors one believes to be more important, the prognosis and policy recommendations emerging from the analysis are different. This study uses the Central American experience during the last fifteen years to put forth some hypotheses about how each of the seven factors listed above has influenced the conversion of forest to pasture in that region and about how effective policies designed to address these issues have been or are likely to be. Because of the diversity of situations within and between countries, Central America constitutes an excellent "policy laboratory" from which valuable insights can be drawn about these issues which may be relevant for other regions of tropical Latin America.

The Central American case is particularly interesting because the region has gone through both a cattle boom and a period of decline. This allows one to look not only at the processes which fuel cattle expansion and deforestation, but also to examine to what extent these processes can operate in reverse.

The study's analysis covers all of Central America, except El Salvador, which has little remaining natural forest and where changes in forest cover have been only marginally related to trends in the livestock sector in recent years.[2]

The study concludes that falling beef and dairy prices are likely to only moderately reduce the extent of forest clearing for pasture and are likely to lower cattle population and pasture area in traditional cattle grazing regions more than on the agricultural frontier. The promotion of technologies favoring livestock intensification and the elimination of policies which lower timber prices will probably not be very effective since their effect on deforestation comes through similar relative price shifts as those associated with changes in beef and dairy prices. Moreover, technological changes in livestock production in Central America are unlikely to significantly affect beef prices, which are largely determined on the international market, and lower timber prices can reduce pressure for timber removal from unmanaged forests. On the other hand, changes in road construction, land tenure, and land use policies have the potential for major reductions in forest clearing for pasture, although they are unlikely to eliminate it entirely. At present, livestock credit is not a major cause of forest clearing, but should be restricted in agricultural frontier regions with high rainfall. Incentives which promote the permanent conversion of abandoned pastures to secondary forests may also be effective, and may be more efficient and justifiable than subsidies for reforestation in situations where trees with commercial value are likely to rapidly grow back on their own.

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[2] For purposes of this study, Panama is considered part of Central America.

Additional research is required on pasture degradation so that some negative consequences of forest clearing, such as soil degradation, can be reduced in areas where deforestation has already occurred.

Deforestation rates in Central America as a whole in the late 1980s were lower than ten years earlier, but continued to be high and in some cases may once again be rising due to reduced violence, continued public support for road construction in forest regions, and the increasing political power of cattle ranchers.

The information for the study has come mostly from secondary sources. Given the great deficiencies of available statistics at the national level, an effort was made to complement this information with evidence from local-level studies. Limited field work was also carried out by the author in September, 1994, in Peten and Alta Verapaz, Guatemala, including interviews with forty-five ranchers and other key informants.[3] In addition, the author has benefitted from the preliminary findings of two masters students he is supervising at the National University (UNA) of Costa Rica, Rosario Ambrogio and Rosalba Ortiz, who recently interviewed 25 and 32 ranchers respectively about these issues in Boaco, Chontales, and Nueva Guinea in Nicaragua and in the San Carlos region of Costa Rica.

The study has nine sections. The first looks at what has happened with land use and cattle in Central America over the last fifteen years. These are, if you will, the dependent variables which need to be explained. The second describes the major types of livestock ranches in Central America and their relative importance. Then

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[3] The full Guatemala study has been written up in Kaimowitz (1995).

come six sections which analyze how each of the factors listed above has affected the observed tendencies and the final conclusions and policy recommendations.[4]

Finally, it should be stressed that the study's almost exclusive focus on the role of livestock in deforestation in Central America in no way implies that pasture expansion is the only cause of deforestation in the region. Currently available information is not comprehensive or accurate enough to determine what percentage of deforestation in the region can be attributed to pasture expansion except to say that it is probably more than half. Undoubtedly, however, deforestation for expanding crop lands, timber removal (particularly in pine forests), and other purposes is also very important and may be caused by factors different from those causing pasture expansion. The fact that the paper only marginally touches on these issues reflects its limited scope, not that the other causes of deforestation are irrelevant.

2. FORESTS, CATTLE, PASTURES, AND CROPS

Any discussion of deforestation and livestock in Central America must acknowledge the serious limitations of the data on which the conclusions are based (Grainger, 1993). Available statistics are often contradictory, use different definitions of forest cover and pasture, and vary widely in accuracy and timeliness. Reliable

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[4] The discussion of the specific characteristics of livestock has been incorporated into the section on the types of livestock ranches.

estimates of recent deforestation rates exist only for Costa Rica and the Peten, Guatemala (Lutz et al, 1993, World Bank, 1993, Mario Rodriguez, personal communication). Honduras and Panama are the only countries with recent census data on livestock. In the remaining countries the statistics on deforestation and pastures and cattle population are out of date and/or of questionable reliability.[5] Nevertheless, a compelling argument regarding the general trends can still be pieced together.

A second caveat concerns the definition of deforestation. As used in this article, the term implies "more or less permanent removal of most of the natural tree cover from an area" (Ledec, 1992:20). Lumber companies or cattle grazing in pines forests often seriously degrade forests without "deforesting" them, as the term is used in this study. Those processes are not analyzed here. On the other hand, typically when forests are cleared for pasture expansion small numbers of trees are left for shade or other purposes. Generally, however, little enough tree cover remains in these areas so that they could be considered "deforested" under the above definition.

An additional problem with deforestation statistics is that they rarely specify whether they refer to gross or net deforestation. It is unclear to what extent they reflect net changes in total forest cover (including new forest as well as forest losses) or only forest clearing. Until recently the difference between these two indicators

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[5] The most recent available estimates of deforestation in Central America based on aerial photographs or satellite images cover the following periods: Costa Rica (1987-1992), Guatemala (Peten only) (1976-1993), Honduras (1962-1989), Nicaragua (1972-1986), and Panama (1970-1987).

was marginal, but it is now significant thanks to the growth of secondary forests and, in Costa Rica, reforested areas.

Livestock statistics are frequently biased upwards or downwards, depending on ranchers' incentives to report owning more or less cattle, and this has undoubtedly affected the data presented below. When agrarian reform policies are in effect large ranchers tend to report having less land and fewer cattle. However, when higher cattle export quotas are allocated to ranchers with larger herd size, as was often the case in Costa Rica during the 1970s and 1980s, ranchers may claim to have more cattle than they really do (Edelman, 1992).

DEFORESTATION

Table 1 provides information on forest area in each Central American country for selected years between 1950 and 1986 and two distinct estimates for 1990. From the Table it is clear that deforestation has been rapid during the entire period. The majority of deforested land has been transformed into pastures, either directly or after being used for crops, with most of the remainder being used for annual crop production by small producers (Ledec, 1992; Nations, 1992, Walker et al, 1993). (See Maps 1 and 2).

Table 2 provides a sample of recent estimates of the deforestation rate for each country. These estimates show a total deforestation rate for the region of between 324,000 and 431,000 hectares per year. Nevertheless, most of them probably

Table 1--Forest area for selected years in Central America (excluding El Salvador) (millions of hectares).

	1950	1970/80	1990 (Utting)	1990 (FAO)
Costa Rica	2.7	1.6 (1977)	1.4	1.4
Guatemala	7.1	4.4 (1980)	3.7	4.2
Honduras	6.8*	5.1 (1986)	4.7**	4.6**
Nicaragua	7.0	4.5 (1980)	4.1	6.0
Panama	5.2	3.9 (1974)	3.2	3.1
Total	29.0*		17.1	19.3

Sources: For 1990 all countries: FAO, 1993, Utting, 1993. For previous years: Costa Rica: Sader and Joyce (1988); Guatemala: 1950: OAS (1991), 1980: CONAMA (1992); Honduras: Daugherty (1989); Nicaragua: 1950: MED/IRENA, (1993); 1980: Leonard (1987); Panama: Ledec (1992).

Notes:

* A 1962 figure was used for Honduras since none was available for 1950.

** These figures are probably too low, as recent interpretations of 1989 satellite images found 5.7 million hectares of forest in Honduras (Silviagro, 1994).

Table 2--Recent estimates of annual deforestation in Central America (excluding El Salvador) (thousands of hectares)*

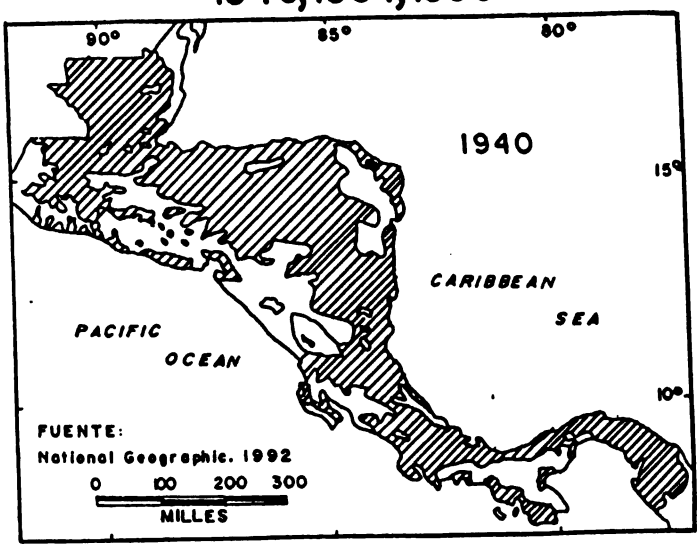
	Grainger	Nations & Kimer	WRI	FAO	Merlet	Utting
	(76-80)	(82)	(81-85)	(81-90)	(91)	(90)
Costa Rica	60	60	50	50	40	50
Guatemala	na	60	90	81	90	90
Honduras	53	70	90	112	108	80
Nicaragua	97	100	121	124	125	70
Panama	31	50	36	64	41	34
Total	na	340	402	431	394	324

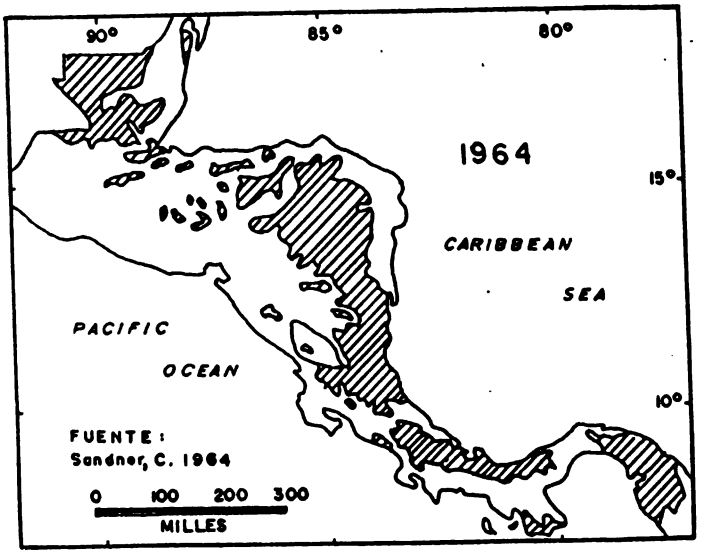
Sources: FAO, 1993; Grainger, 1993; Merlet et al, 1993; Nations and Komer, 1983; Utting, 1993, WRI, 1992.

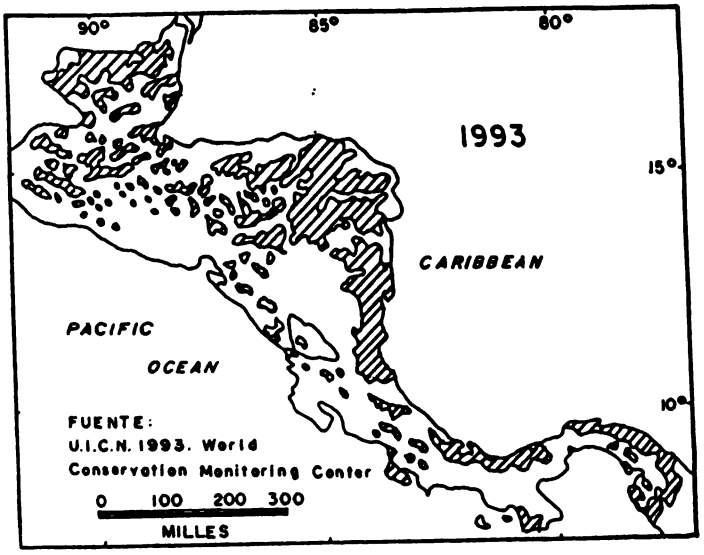
* The years in parenthesis are the years for which the figures supposedly apply. However, all the figures are based on studies carried out in the mid-1980s or earlier.

MAP #1

FORESTED AREAS OF CENTRAL AMERICA
1940, 1964, 1990

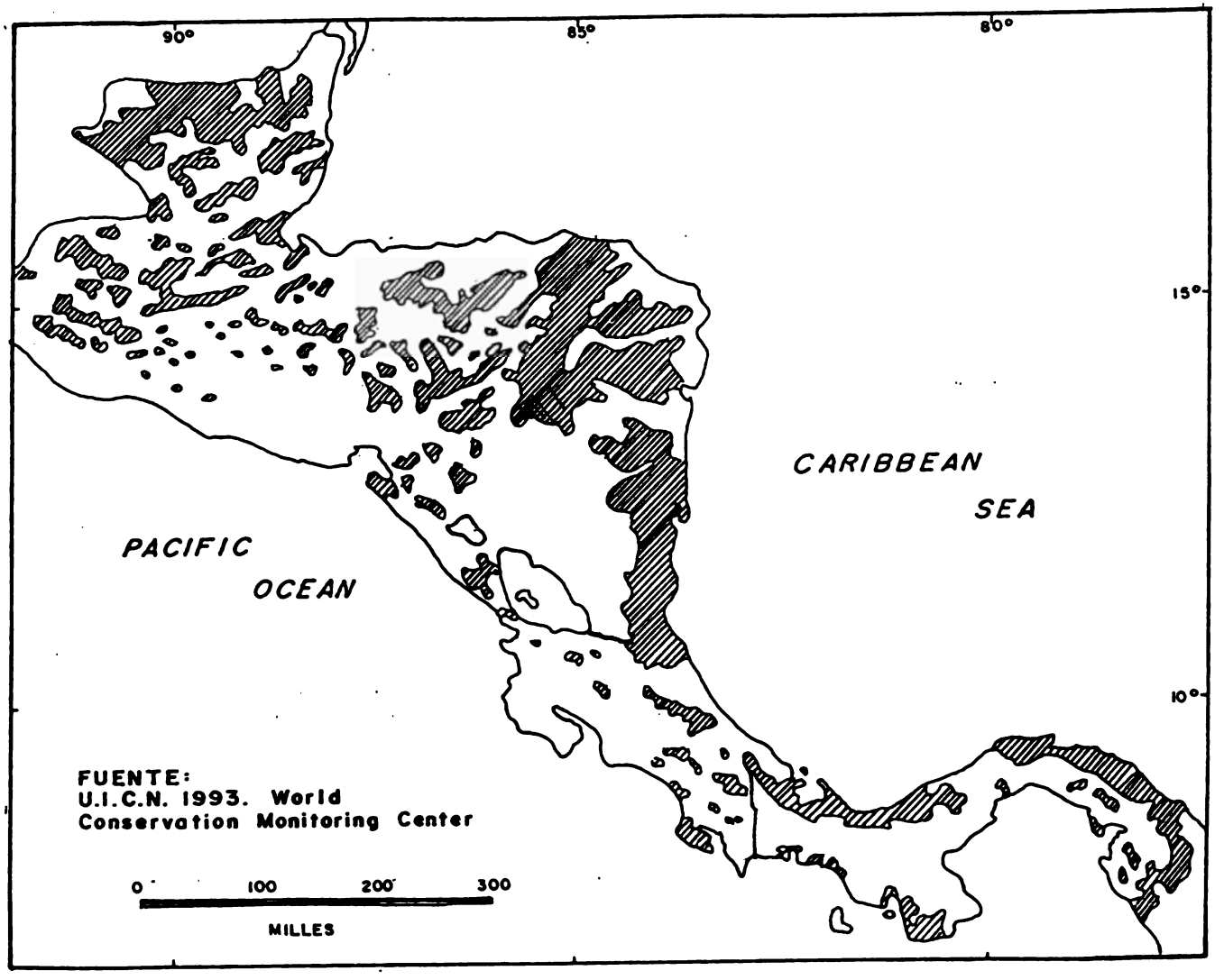






MAP #2

FORESTED AREAS OF CENTRAL AMERICA
1990



either overestimate deforestation during the period covered or are no longer applicable, since deforestation has declined since the original studies were made.

The most recent available evidence for deforestation in each country shows the following:

Costa Rica

Annual deforestation fell from between 40,000 and 60,000 hectares in the late 1970s and early 1980s to 18,000 hectares between 1987 and 1992, and more recently to only 8,500 hectares (Lutz et al, 1993; Nuñez, 1993; World Bank, 1993).

Guatemala

Thirty thousand hectares per year were deforested in Peten between 1976 and 1987, and 42,000 hectares of medium and dense forest were cleared annually between 1987 and 1993 (AHT-APESA, 1992, Mario Rodriguez, personal communication). Given that land clearing in Guatemala in this period was concentrated in the Peten, the deforestation rates in Table 2 are probably too high. Based on comparisons between recent estimates of total national forest coverage and estimates from the mid 1970s it appears that annual deforestation over the last twenty years has been between 50,000 and 60,000 hectares, rather than the 80,000 or 90,000 hectares mentioned in most studies (Cabrera, 1992).

Honduras

Reliable estimates of forest coverage only exist for 1962 and 1989. Based on the difference in forest cover in these two years, net deforestation during the period

averaged 53,000 hectares per year, a figure much lower than most recent estimates (Silviagro, 1994).

Nicaragua

The figure of approximately 120,000 hectares of annual deforestation comes from a study conducted by the Nicaraguan government in 1986, using aerial photos to compare forest cover in that year with forest cover in 1972-1974 (personal communication Cesar Aviles, 1994). Nevertheless, most experts agree that deforestation declined substantially in Nicaragua between 1983 and 1989, and then began to increase again with the end of the military conflict (Maldidier, 1993).

Panama

Government statistics show that deforestation fell from 46,000 hectares per year between 1970 and 1980 to 35,000 hectares per year between 1980 and 1987 (IICA, 1993).

After reviewing the available evidence, this author estimates that total deforestation in Central America probably diminished from around 400,000 hectares per year in the late 1970s to some 300,000 hectares in 1990. This decline is no cause for comfort, however, since even at the current rate of deforestation Central America would lose all of its remaining forest in less than sixty years. Deforestation declined in Costa Rica, Nicaragua (during the 1980s), and Panama. On the other hand, it increased in Petén, Guatemala and Nicaragua (since 1990). Deforestation is currently concentrated in the Petén and the Northern Transversal Strip in Guatemala; Atlántida, Colón, Olancho, and Gracias a Dios in Honduras; Zelaya,

Jinotega, and Rio San Juan in Nicaragua; and the provinces of Panama, Bocas del Toro, and Darien in Panama.

CATTLE POPULATION AND PASTURE

Table 3 shows the evolution of the cattle population in Central America since 1950. Between 1950 and 1978, the region's cattle herd more than doubled. After that it stagnated, and in 1992 the region had fewer cattle than fourteen years earlier.

Cattle expansion in Honduras started later but continued into the nineties. Nicaragua lost much more of its cattle herd than any other country.

Changes in national pasture areas followed closely the changes in cattle population. (See Table 4). Although the figures show that pasture expanded in Costa Rica despite a decline in cattle population and fell in Honduras despite a rise in livestock numbers, this may reflect statistical errors and lags, rather than real trends.

These national statistics, however, hide major differences among regions within each country. At the same time pastures expanded in certain areas, they declined in others.

Pasture expansion in the last fifteen years has occurred in different regions and ecosystems than in the period between 1950 and 1979. (See Figure 1). During the earlier period, 60% of pasture expansion occurred in tropical dry areas where fire

Table 3--Cattle population in Central America in 1950, 1970, 1978, and 1992 (excluding El Salvador) (million head)

	1950	1970	1978	1992
Costa Rica	0.6	1.5	2.0	1.7
Guatemala	1.0	1.5	2.1	2.2
Honduras	0.9	1.2	1.8	2.1
Nicaragua	1.1	2.2	2.8	2.2
Panama	0.6	1.2	1.4	1.4
Total	4.2	7.6	10.1	9.6

Sources: For 1950 all countries: Leonard (1987). For other years: Costa Rica: 1970 and 1978: FAO (1980), 1993: Consejo Nacional de Producción, unpublished data; Guatemala: 1970 and 1978: Banco de Guatemala (1981), 1992: Banco de Guatemala, unpublished data; Honduras: 1970 and 1978: based on extrapolations from the 1965 and 1974 censuses, 1992: (SECPLAN, 1994); Nicaragua: Holman (1993); Panama: Dirección de Estadística y Censo (1992).

Table 4--Pasture area in Central America in 1950, 1970, 1978, 1983, and 1991 (excluding El Salvador) (millions of hectares)

	1950	1970	1978	1983	1991
Costa Rica	0.6	1.3	1.7	2.2	2.4
Guatemala	0.8	1.0	1.1	1.3	1.4
Honduras	0.8	1.2	1.3	1.6	1.5*
Nicaragua	0.8	2.3	3.4	4.0	2.7
Panama	0.5	1.1	1.3	1.4	1.5
Total	3.5	6.9	8.8	10.5	9.5

Sources: Costa Rica: 1950, 1970, and 1978: Rodriguez and Vargas, (1988); 1983: Van der Kamp, (1990); 1991: Segura: (1992); Guatemala: 1950 and 1978: RUTA (1993); 1970: extrapolation by the author based on the 1965 census and a 1974 livestock survey (Dirección General de Estadística, 1976); 1983: FAO, (1990); 1991: FAO (1991); Honduras: 1950 and 1970: Slutsky (1979); 1978 and 1983: SRN (1991); 1991: 1993 census (SECPLAN, 1994); Nicaragua: 1950: FAO (1966); 1970: Warnken (1975); 1978 and 1983: CIERA (1983); 1991: Holman (1994); Panama: 1950: Heckadon (1984); other years: Censo Agropecuario (1991).

could be easily used in the Pacific and central regions, with less than 2,000 mm of annual rainfall and/or more than three dry months (Toledo, 1992). Since that time, however, the expansion has moved eastward towards the Atlantic plains, which generally have fragile infertile soils and too much rain for annual crops (Merlet, 1992). Pasture area in Petén, Guatemala has grown over 200,000 hectares since 1979 (AHT-APESA, 1992, Manuel Rodriguez, personal communication). In the humid tropics of Honduras it grew at least 275,000 hectares over the last 20 years (SECPLAN, 1994). Most of the 170,000 hectare growth in pastures in Panama between 1981 and 1991 was also in the humid frontier provinces (Censo Agropecuario, 1991).

At the same time, cattle population and pasture area in the traditional cattle producing areas of the Pacific and interior has declined. (See Figure 2). The very areas which were the centers of livestock expansion in the 1950s and 1960s, such as Guanacaste and Puntarenas in Costa Rica, the south coast of Guatemala, western Honduras, and western Panama were the areas where the cattle population declined the most in the 1980s. (See Map 3.)

SECONDARY FOREST AND BRUSH

The decline in cattle has led to a major increase in abandoned lands, which have become brush, wooded areas, and even secondary forest. This process is clearest in Nicaragua and Costa Rica, but is also occurring in other countries.

Figure 1--Geographical location of cattle expansion (1950 - 1993)

	1950s	1960s/1970s	1980s/1990s
Costa Rica	Guanacaste Nicoya	Alajuela Guanacaste Perez Zeledon	Alajuela Limón
Guatemala	Escuintla Jutiapa Santa Rosa	Alta Verapaz Chiquimula Izabal Quiche Peten Zacapa	Petén Izabal
Honduras	Copán, Cortes, El Paraíso, Olancho, Santa Barbara	Atlántida, Colon Choluteca, El Paraíso, Olancho, Yoro	Colón, El Paraíso, Olancho, Yoro
Nicaragua	Matagalpa Nueva Segovia	Chontales Jinotega Matagalpa Nueva Guinea Rio San Juan	Jinotega Zelaya
Panama	Coclé Chiriqui Herrera Los Santos Veraguas	Panama Colon	Panama Bocas del Toro Colon Darien

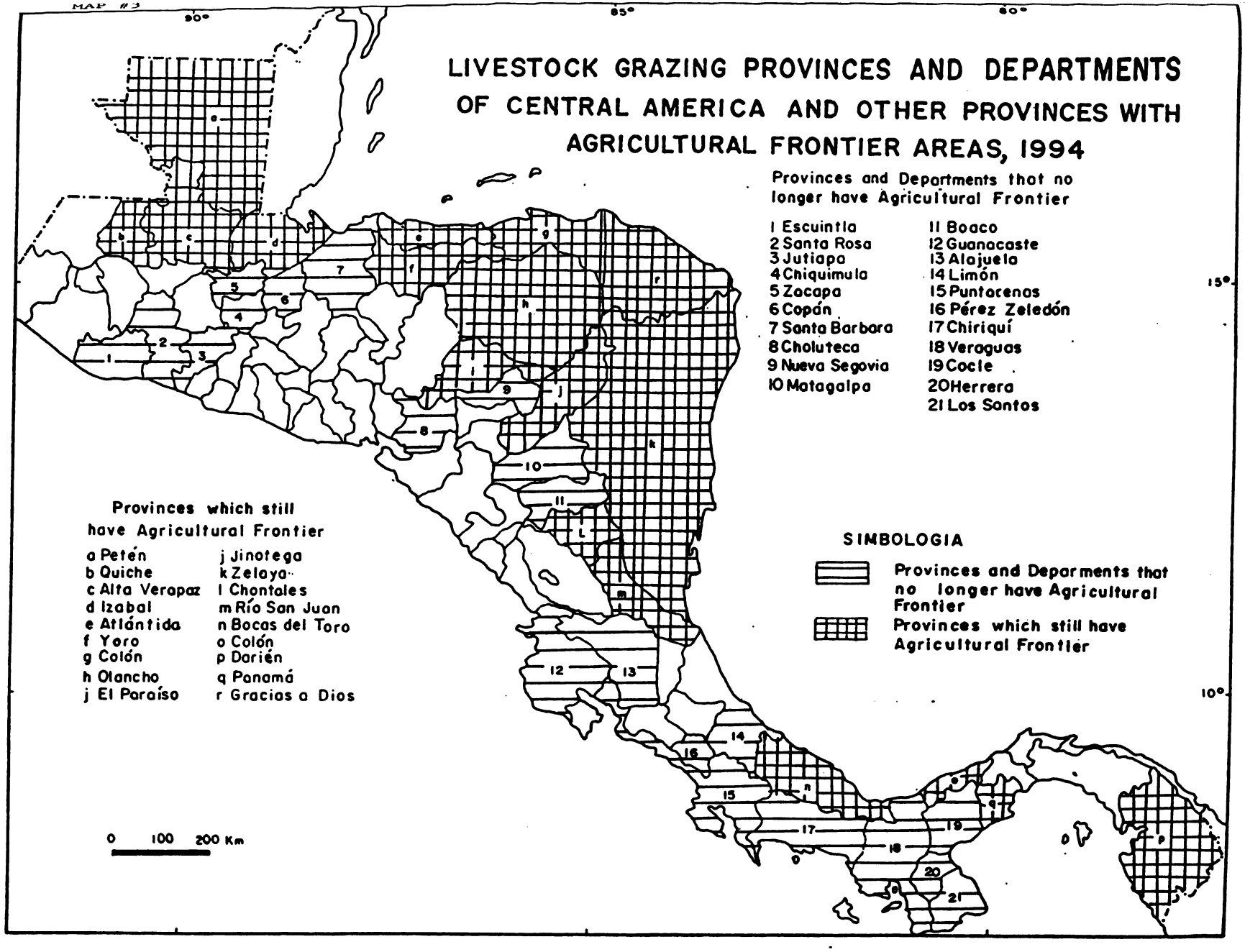
Sources: Costa Rica: Girot, 1989; Hijfte, 1989; Leon et al, 1982; Rodriguez, 1993; Guatemala: AHT-APESA, 1992; ICAITI, 1984; RUTA, 1993; Williams, 1986; Honduras: Alderman, 1973; Howard, 1988; SRN, 1991; Ventura, 1992; SECPLAN, 1994; Nicaragua: Merlet, 1992; Williams, 1986; Panama: Dirección de Estadísticas y Censos, 1992; Heckadon, 1984.

Figure 2--Geographical location of cattle retraction and stagnation (1980 - 1993)

	Retraction	Stagnation
Costa Rica*	Nicoya, Guanacaste, Central Pacific, Western Limon	"Los Santos" (Dota, Pursical, Acosta, Mora, Turrubares, Tarrazu, Leon Cortes)
Guatemala	Escuintla	Retahuleu, Suchitepeqeuz
Honduras	Choluteca, Cortes, Santa Barbara	
Nicaragua	Entire country until 1989	
Panama	Chiriqui, Veraguas	Cocle, Herrera, Los Santos

Sources: Costa Rica: Fallas and Morera, 1993; Huising, 1993; Lehman, 1991; Rodriguez, 1993; Guatemala: RUTA, 1993; Honduras: SECPLAN, 1994; Nicaragua: Cajina, 1986; Holman, 1993; Panama: Censo Agropecuario, 1991.

* The information for Costa Rica, except for western Limón, was taken from the 1984 agricultural census, and hence only reflects stagnation and decline in the first half of the 1980s.


MAP #3
90°
85°
80°
15°
10°
LIVESTOCK GRAZING PROVINCES AND DEPARTMENTS OF CENTRAL AMERICA AND OTHER PROVINCES WITH AGRICULTURAL FRONTIER AREAS, 1994
Provinces and Departments that no longer have Agricultural Frontier
1 Escuintla
2 Santa Rosa
3 Jutiapa
4 Chiquimula
5 Zacapa
6 Copán
7 Santa Barbara
8 Choluteca
9 Nueva Segovia
10 Matagalpa
11 Boaco
12 Guanacaste
13 Alajuela
14 Limón
15 Puntarenas
16 Pérez Zeledón
17 Chiriquí
18 Veraguas
19 Cocle
20 Herrera
21 Los Santos
Provinces which still have Agricultural Frontier
a Petén
b Quiche
c Alta Verapaz
d Izabal
e Atlántida
f Yoro
g Colón
h Olancho
j El Paraíso
j Jinotega
k Zelaya
l Chontales
m Río San Juan
n Bocas del Toro
o Colón
p Darién
q Panamá
r Gracias a Dios
SIMBOLOGIA
Provinces and Deparments that no longer have Agricultural Frontier
Provinces which still have Agricultural Frontier
0 100 200 Km

Nicaragua now has some 1.1 million hectares of "scrub forest", defined as "areas where there is a predominance of woody species lower than five meters, often combined with extensive livestock", and an additional 900,000 hectares in "forest fallow", defined as "woody vegetation that appears after the clearance of natural forests for migratory agriculture" (INTECFOR, 1993). Most of the scrub forest is located in the drier traditional cattle producing regions, whereas the forest fallow is concentrated in the more humid areas of eastern Nicaragua.

In Costa Rica, the area in secondary forest grew from 229,189 hectares in 1984 to 388,341 in 1989, with most of this growth coming from abandoned pastures (TSC/WRI, 1991). Recently, the Tropical Science Center estimated the area in secondary forest to be 425,000 hectares (Nuñez, 1993).[6] These trends in the national statistics have been corroborated by two recent regional studies of land use changes in Guacimo-Rio Jimenez-Siquirres in Limon and Arenal - Tempisque in Guanacaste, both of which show a decline in pasture area, greater presence of shrub vegetation within pastures, an increase in secondary forest, and a growth in crop lands (Fallas and Morera, 1993; Huising, 1993). The area reforested in Costa Rica in forest plantations has also grown 76,465 hectares since 1990, from 35,114 hectares to 111,579 hectares (MIRENEM, 1994).

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[6] The General Forestry Directorate (DGF) of the Costa Rican government, however, estimates that the area in secondary forest is only 200,000 hectares. The difference between these two estimates may be due to the definitions used (Nuñez, 1993).

The recent 1993 Honduran Agricultural Census found that fallow lands and secondary forest had increased 110,000 hectares since 1974 (SECPLAN, 1994). Similarly, satellite images from the Peten in Guatemala show that there were 111,000 hectares more of "abandoned crop lands" in 1993 then in 1987 (Mario Rodriguez, personal communication). By 1991, Guatemala had some 360,000 hectares of secondary forest (Cabrera, 1991).

Another indicator of the growth of abandoned lands is the increase in the category of "other land uses" registered in the FAO land use statistics. (See Table 5). According to FAO, this type of land use grew from 9.1 million hectares in 1976 to 12.1 million hectares in 1991 (FAO, 1992).

CHANGES IN LAND USE FOR CROPS

To complete the analysis of land use trends in Central America, it is worth mentioning that the area in annual and perennial crops has remained almost constant. FAO statistics show the same area in crops in 1991 as in 1978 (FAO, 1992, 1979). There were slight increases in Guatemala and Panama, but these were compensated for by a small decrease in Nicaragua. (See Table 6).

Just as in the case of livestock, however, the stagnation of crop lands is actually the product of two contradictory processes which tend to offset each other. Growth has continued in the area in crop lands on the agricultural frontier, particularly in Peten, Guatemala and eastern Honduras and Nicaragua. In these

Table 5--Area in "Other Land Use" in Central America in 1976 and 1991 (excluding El Salvador) (millions of hectares)

	1976	1991
Costa Rica	0.7	0.6
Guatemala	3.0	3.9
Honduras	2.8	3.6
Nicaragua	1.1	1.9
Panama	1.5	2.1
Total	9.1	12.1

Source: FAO, 1992.

Table 6--Area in annual and perennial crops in Central America in 1978 and 1991 (excluding El Salvador) (millions of hectares)

	1978	1991
Costa Rica	0.5	0.5
Guatemala	1.8	1.9
Honduras	1.8	1.8
Nicaragua	1.5	1.3
Panama	0.6	0.7
Total	6.2	6.2

Source: FAO, 1979, 1992.

areas there has been a substantial increase in maize production in particular. There area in coffee in Honduras also grew 75,000 hectares between 1979 and 1987, and much of this growth may have come at the expense of forest (Baumeister, 1994). But at the same time the area planted in cotton in the pacific regions declined by 440,000 hectares between 1977 and 1992, and a large portion of these former cotton lands were abandoned or converted to pasture, rather than other crops (Gil, 1993).

Significant shifts back and forth have taken place between crop land and pasture, but these are impossible to quantify with the available information. In many areas maize is grown after an area is deforested and before pasture is planted either because large land holders give small farmers access to land to plant annual crops in return for clearing it and later planting pasture or because small farmers sell the land they have been planting annual crops on to large farmers who then convert it to pasture. On the other hand, thousands of hectares formerly in pasture in Costa Rica are now being used for producing oranges, rice, sugar cane, and other crops, and there may be similar cases in the other countries (Edelman, 1992).

3. THE DIFFERENT "LOGICS" OF LIVESTOCK PRODUCTION

The Central American livestock sector has distinct types of producers, who respond differently to changes in policy, markets, and technology. The relative weight of these producer types varies by region and country, and this is one major reason why these regions react differently to similar contextual changes.

For purposes of this study, four major types of livestock producers have been identified: 1) "traditional" medium and large ranchers, 2) "investment" ranchers without historical ties to cattle ranching, 3) medium and large ranchers on the agricultural frontier, and 4) small farmers with a few cattle. This section characterizes these producer types and provides information regarding their relative importance in each country and region.

TRADITIONAL MEDIUM AND LARGE RANCHERS

These are cattle ranchers whose families have been in the business since before 1950, and often since the colonial period. Although some of their land has been purchased during recent decades, much of it is inherited or was obtained at minimal cost by making claims on public lands and hence, while it has opportunity costs, does not represent a cash outlay for cattle production. As a result, these ranchers may base their decisions more on the short-term cash flows offered by livestock than on full - cost calculations of profitability.

The traditional cattle families can be found throughout the dry and semi-humid areas of Central America, but they are especially associated with towns such as Cañas and Liberia in Costa Rica, Escuintla and Retalhuleu in Guatemala, Catacamas, Choluteca, Comayagua, Danlí, and Quimistán in Honduras, Grenada, Juigalpa, Rivas, and Matagalpa in Nicaragua, and David, Santiago, and Sona in Panama. Some live in their countries' capital cities, but many continue to live in these provincial towns.

Most of these families have investments besides just cattle. What separates them from the group which follows, however, is their traditional association with livestock and the fact that they inherited important portions of their land and cattle. These ranchers may also have a "cattle culture", in which livestock and land has substantial prestige value above and beyond their immediate economic worth (Graciela, 1989; Heckadon, 1984; Ledec, 1992; Thrupp, 1992).

Some of these families have ranches in more humid areas near the agricultural frontier. Those ranches, however, tend to play a secondary role in their cattle operations and are used mostly to feed cattle during the dry season.

"INVESTMENT" RANCHERS

After 1950, capitalist entrepreneurs, both domestic and foreign, began to view cattle ranching and meat packing as an attractive sector to invest in. They were enticed by the potential profits in steer fattening, beef processing and exporting, rising land values and government land grants, the availability of subsidized credit, limited supervision requirements of cattle operations, and, in some cases, interesting tax breaks. Most of these investors had little, if any, experience in cattle production, and few lived on the ranches they owned. Some went into business on their own; others sought out joint ventures with established cattle ranchers (Edelman, 1992).

Many of those involved in this type of investment were wealthy businessmen and large companies. Others were simply well-off professionals, government officials,

and merchants, who saw cattle ranching as a good area to invest their savings in (Kaimowitz, 1995).

The regions associated with this type of investment include: Guanacaste and, more recently, northern Alajuela in Costa Rica, the North Coast of Honduras, Izabal and Petén in Guatemala, and Chiriqui, Los Santos, and Veraguas in Panama (AHT-APESA, 1992; Alderman, 1973; Aguilar and Solís, 1988; Banco de Guatemala, 1981; Edelman, 1992; Ledec, 1992). Similar types of ranchers also existed in Nicaragua, but many of them had their lands expropriated during the agrarian reform of the 1980s. Often, investment ranchers prefer farms which are very accessible, as this allows them to visit the ranch and return the same day or the following day.

The great majority of investment ranchers live in urban areas. For example, in the early 1970s over 80% of the members of the principal ranchers association in the north coast of Honduras had addresses in the city of San Pedro (Alderman, 1973). Of the 54 ranchers in northern Guatemala who received loans from the World Bank Livestock Development Project (PRODEGA) in the 1970s, 69% lived off the farm and 37% reported their primary occupation as some thing besides farming (World Bank, 1978).

Military officers constitute a particular sub-group within this type of ranchers. Some officers purchased their lands; others simply laid claim to forest areas or small farmers' lands and obtained government titles for them. Compared to the other investors, military officers are more likely to own land in isolated areas where land tenure is insecure and their access to military force places them in a privileged

position to defend their claims to land. Areas which are generally associated with military land ownership include parts of Alta Verapaz and Peten in Guatemala, Olancho in Honduras, and northern and eastern Nicaragua (Maloney, 1981; Richards, 1994; Schwartz, 1990).

The "investment ranchers", both civilian and military, tend to concentrate their attention on steer fattening and meat processing. These investments provide the quickest returns, are less risky, and in the case of steer fattening require less management and supervision than calf raising or dairy production.

Some investment ranchers seem to base their decisions on short term profit margins (including the opportunity costs of money invested in land and cattle), have low "barriers to exit" from cattle production, and tend to sell their land or reduce their cattle stock when business is poor. Others, however, apparently view cattle raising as a long-term, low risk activity to invest their savings in and tend to react more slowly to changes in market conditions.

MEDIUM AND LARGE AGRICULTURAL FRONTIER RANCHERS

These ranchers can be distinguished from the first two groups by their physical residence in or near agricultural frontier areas and their generally more humble origins. Few individuals with substantial economic resources are willing to reside in agricultural frontier areas. This group is less likely to have major investments outside the region they live in, although many of them engage in commerce, transport activities, and lumber extraction, in addition to cattle ranching. Geographically, this

group is concentrated in eastern Honduras, Panama Province and eastern and northern Nicaragua.

Frequently, these are families who first moved to the agricultural frontier to cut lumber or to trade, but were later able to claim or purchase large areas of land. They tend to have been among the first families to arrive in the areas where they live and to have come with some initial capital resources (Hernández, 1987, Merlet, 1992, Maldidier, 1993). Some of these families have substantial incomes by local standards, but due to their relative isolation they tend to maintain more rural cultural attributes.[7]

For ranchers on the agricultural frontier, cattle offer the critical advantage of being easy to transport. In some cases, they even walk to market themselves. Moreover, once annual crop yields begin to fall due to declining fertility and weed infestation, conversion to pasture is often the only economically viable use for frontier land (Hecht, 1992).

COMMON FEATURES OF THE MEDIUM AND LARGE RANCHERS

Traditionally, all three groups of medium and large ranchers obtained a substantial amount of their labor through systems of "colonato" or labor rents (Hernández-Mora, 1994). In these systems, poor rural families were provided (often

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[7] High incomes by local standards may still be low by international standards. For example, a recent survey of 340 ranchers in Nueva Guinea, Nicaragua found that even the most wealthy 5% of those surveyed, who had an average of 110 hectares of land and 90 head of cattle, only earned average gross annual incomes of $8,000 (Pijnenburg and Martinez, 1992).

forested) land to plant corn or other annual crops, but in return had to do occasional jobs for the landowner leave the crop residues for the rancher and after a few years plant grass and move to another plot. Through this system ranchers were able to convert large areas of forest to pastures at minimal cost.

In recent years, however, many large ranchers seem to have shifted to the use of wage labor and labor contracts to convert forest to pastures (AHT-APESA, 1992, Banco de Guatemala, 1981, Ledec, 1992b, Pijnenburg and Martínez, 1992). These ranchers prefer wage labor because it allows them to obtain pasture quicker (without passing through the stage of maize production) and in sparsely populated areas is often the only way to attract sufficient labor. The widespread use of chain saws, which have tended to replace axes, made it easier to clear forested areas and reduced the need to use labor rent systems for that purpose (Davila and Castro, 1990). A particularly innovative system reported by Richards (1994) in Honduras is for ranchers to offer chain saws to small farmers in exchange for land or to lend them the money to purchase chain saws, both of which help accelerate the land clearing process.[8]

The size and relative importance of large and medium size ranchers varies depending on the country. Large ranchers are most important in Guatemala, where in 1979 some 300 ranchers with more than 1,000 animals each owned one third of the national herd, while ranchers with between 100 and 1,000 head owned an

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[8] Currently, a new chain saw sells for around $1,500, much more than most small farmers can afford (IFAD, 1994).

additional third (RUTA, 1993). At the other extreme lie Honduras and Nicaragua. In the former, the 2,745 ranchers who had more than 200 hectares in 1993 owned only 24 percent of the cattle and 32 percent of the pastures; while in the latter the 687 ranchers with more than 350 hectares in 1992 owned only 12 percent of the cattle and 17 percent of the pasture (SECPLAN, 1994; Holman, 1994). Similarly, in Panama, ranchers with over 200 hectares own 31 percent of the cattle, and the 297 ranchers with more than 500 hectares each, own only 15 percent of the cattle (IICA, 1993). Guanacaste and San Carlos in Costa Rica tend to be more like Guatemala, while the rest of the country is more like Honduras and Nicaragua (Dirección de Estadística y Censo, 1987). Altogether, the region probably has 3,000 to 4,000 ranchers with more than 500 hectares, and perhaps as many as 15,000 to 20,000 with more than 200 hectares.

SMALL FARMERS

Except for farmers with prime agricultural land, the first thing that almost any small farmer in Central America does when he/she accumulates a little land or money is to purchase cattle. The limited availability of family labor constrains the expansion of crop production, and farmers prefer to avoid the cash outlays and supervision time required to hire large amounts of outside labor. Cattle raising allows small farmers to have up to 50 hectares and still cover more than 50 percent of their labor requirements with household labor (Ventura, 1993). Cattle also have the additional advantages for small farmers of being a convenient form of low-risk

and easily convertible savings, providing regular income from the sale of dairy products, and making use of marginal or degraded lands which can no longer sustain crops (Hecht, 1992). Thus, for example, in a survey of small and medium sized ranchers in Puriscal, Costa Rica in the mid-1970s, Thrupp found that 63 percent of farmers had shifted to cattle because they required less labor, 33 percent to obtain milk for their family, 29 percent because cattle presented fewer problems and risks, 27 percent because they were more profitable, and 20 percent because land deterioration no longer permitted growing crops in those areas (1980).[9]

Most small farmers have dual purpose systems, which produce calves and small quantities of milk and occasionally permit them to sell a cow or steer (typically to the local municipal slaughterhouse). Depending on how many cows they have and their access to markets for dairy products, the sale of milk may or may not be a major source of these farmers' income. Typically, these farms have more intensive cattle systems than the large farms, with higher stocking densities and greater use of crop residues as animal feeds.

Costa Rica is the only country with an important group of specialized small dairy farmers with relatively high levels of capital intensity and productivity. Currently, the country has some 15,000 specialized dairy producers with less than 20 hectares each who fit this description.

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[9] These percentages sum to over 100% because farmers were permitted to give more than one reason for switching to livestock.

Small farmers with less than 50 hectares own 43 percent of the cattle in Honduras and one third of the cattle in Costa Rica and Panama; and farmers with less than 70 hectares own 42 percent of the livestock in Nicaragua (Dirección de Estadística y Censo, 1987; IICA, 1993; Holman, 1994; Ventura, 1993). But farmers with less than 92 hectares in Guatemala own only 30 percent of the cattle (Colchester and Lohman, 1993). In all the countries small farmers play an important role in calve and dairy production.

The high percentage of cattle in the hands of small farmers in Nicaragua is largely a result of the agrarian reform process begun in 1979. Agrarian reform and colonization programs were also important in creating groups of small dairy and dual-purpose producers on the south coast of Guatemala, in northern Costa Rica, and along the north coast of Honduras.

THE IMPLICATIONS FOR POLICY

Policy instruments which operate through livestock and forest product prices are morely likely to influence the land use patterns of investment ranchers and of ranchers in traditional livestock grazing areas than of ranchers who live on the agricultural frontier. Similarly, changes in credit policy are only likely to be relevant for those ranchers with potential access to public credit. A large portion of land and cattle in agricultural frontier areas is owned by ranchers who have low supply elasticities for the livestock production and minimal access to public credit. Poor

public enforcement of property rights gives groups with private access to means of coercion a competetive advantage.

4. THE ROLE OF MARKET FORCES IN THE CATTLE - FOREST RELATION

This section analyzes how changes in international and domestic markets for beef and dairy products have affected the supply of cattle and changes in land use patterns. It first examines the export market for beef, than looks at the domestic demand for beef, and finally discusses changes in dairy markets.

THE HAMBURGER CONNECTION

In 1981, Myers coined the term "the hamburger connection" to describe how the expanding U.S. market for Central American beef generated a cattle boom, that in turn led to widespread deforestation. Prior to the 1950s, Central American cattle exports were limited to small numbers of live cattle sold by Honduras and Nicaragua to neighboring countries. But that changed when the first export meat packing plant opened in 1957 and it became possible to export large amounts of pasture - fed "low quality" beef to the U.S. market.

During the 1960s, rising real incomes in the United States led to a 20% increase in per capita beef consumption and the rapid growth in fast food and supermarket chains generated new demands for beef imports (Williams, 1986). The demand for ground beef in particular grew even more after 1973, when rising

petroleum prices pushed up the cost of producing feed grains and fatty grain-fed beef increasingly became a luxury for U.S. consumers, leading them to shift to less expensive hamburger (Edelman, 1985).

In the early years, Central American beef producers had almost unlimited access to the U.S. market. Before 1964, there were few restrictions on U.S. beef imports, and although the US Meat Import Act of 1964 theoretically instituted a system of import quotas, no quotas were imposed between 1965 and 1968. Soon after, the Central Americans accepted a system of voluntary export restrictions, but except for a brief period around 1974 these did not pose any serious problem for exporters (Slutsky, 1979).

Central American beef exporters were also able to take advantage of high international meat prices, particularly between 1965 and 1974 (Howard, 1987). As a result, Central American beef exports rose from 9 million dollars in 1961 to 290 million dollars in 1979, and the amount of beef exported increased eight and a half times (Williams, 1986). By the end of the period, the region had fully 28 modern meat packing plants authorized to export to the United States. Costa Rica and Nicaragua were larger exporters than Guatemala and Honduras, while Panama exported only marginal amounts.

Rising international beef prices were reflected in increasing domestic prices for cattle (León et al, 1982).[10] This, in turn, undoubtedly stimulated the livestock sector as a whole.[11]

The export boom had its most direct effect on medium and large ranchers who fattened cattle for sale to the export packing plants and on the investors who owned those plants. It had much less effect on small ranchers who focused more on milk production and the sale of older cattle to local slaughterhouses. When small farmers did produce calves and steers to be fattened and exported, they typically received only a small percentage of the final export price.

After the mid-1970s, the outlook for Central American beef exports worsened. International beef prices were low between 1975 and 1977, rose for a few years, and then started falling again after 1980, from which they have still not recovered. (See Table 7.) Two reasons for this were that the European Economic Community went from being a net beef importer to becoming a net exporter and per capita beef consumption in the U.S. fell after 1977 as consumers became more health conscious and real incomes stagnated (Brockett, 1988; Howard, 1987).

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[10] Honduras was a partial exception to this. There monopsonistic control of the export slaughterhouses apparently kept ranchers from receiving many of the benefits of rising international prices (Slutsky, 1979).

[11] This does not imply, however, that without exports the livestock sector would necessarily have stagnated. Panama, for example, had minimal beef exports but one of the highest growth rates in cattle population during the 1960s.

Table 7--Real international meat prices, 1960 - 1990 (cents/kilogram, constant 1985 dollars)

1960	246
1965	282
1970	359
1975	203
1980	265
1985	215
1990	180

Source: Trejos, 1992

The effect of declining international beef prices on beef producers' incomes was aggravated by policies leading to overvalued exchange rates and government price controls. In Nicaragua, in particular, overvalued exchange rates and low cattle prices paid to ranchers by the government (which nationalized meat exporting in 1979) lowered the share of international prices that ranchers received (Biondi-Morra, 1990; Cajina, 1986). This situation improved after 1984, when the government started to purchase part of the cattle exported in dollars, but it continued to dampen local beef prices throughout the 1980s (Jarquin and Videa, 1990). Honduras' exchange rate was also increasingly overvalued through the 1980s and in Costa Rica price controls on beef imposed in the mid-1970s reduced real beef prices (Leon et al, 1982).

At the same time cattle ranchers' costs rose. In Panama, for example, the cost of ranching inputs such as wire, herbicides, vaccines, nutritional supplements, and

other items increased far more than beef prices between the mid-1970s and the mid-1980s (Heckadon, 1984). The situation was similar in Nicaragua (Biondi-Morra, 1990). Beef export taxes also rose substantially in both Costa Rica and Nicaragua (Edelman, 1994; Siles and Hernandez, 1994).

If these problems weren't bad enough, in 1979, the U.S. Congress passed a more restrictive meat import act which substantially reduced Central America's access to the U.S. market. The United States also began to strictly enforce laws prohibiting the import of substandard beef and beef with pesticide residues, leading on several occasions to the closure of the U.S. market to beef exports from Costa Rica, Guatemala, and Honduras (Banco de Guatemala, 1981b; Edelman, 1985). Between 1985 and 1993, the U.S. government prohibited meat imports from Nicaragua, first as a political sanction against the Sandinista government, and later because Nicaragua's export plants had not yet been certified by American slaughterhouse inspectors. Panama's beef exports to the U.S. were also blocked for political reasons between 1987 and 1990. On the private side, Burger King, which at one time bought 70% of Costa Rican beef exports, decided in 1987 not to buy any more Latin American beef due to criticism about the "hamburger connection" (Van der Kamp, 1990).

These growing difficulties in maintaining access to the U.S. beef market forced Central America to seek other markets for its meat. In 1980, the Guatemalan Congress authorized the export of 50,000 head of live cattle to Mexico and the following year it signed a trade agreement with Mexico which allowed Guatemala to

export $18 million worth of cattle (Brockett, 1988). At different times during the 1980s, almost all the Central American countries exported live cattle and meat to Mexico, which became a significant market and paid higher prices for beef than the United States. Recently, however, Mexico has imposed new tariffs on Central American beef and cattle exports and thanks in part to the North American Free Trade Agreement (NAFTA) an increasing portion of Mexican meat imports have come from the U.S. (Foreign Agricultural Service, 1994). It is doubtful whether Central America will continue to be competitive in the Mexican market once NAFTA goes fully into effect (Barquero, 1994).

Nicaragua began to export meat to Canada when the United States imposed its trade embargo in 1985. Canada, however, paid lower prices than the U.S. and also used quantitative restrictions to limit Nicaraguan exports (Cajina, 1986).

Thus, ultimately low international prices combined with reduced U.S. demand led to a substantial drop in exports. Between 1978 and 1985, Central American beef exports declined from 120 million metric tons to only 49 million tons, and the income they generated fell from 213 million dollars to 91 million (Torres-Rivas, 1989). After that, meat exports began to rise again, and by 1992 had reached 74 million metric tons and 135 million dollars. But in real terms they remained well below the levels of the 1970s. (See Table 8.)

Table 8--Central American meat exports, 1961 - 1991, excluding el salvador (millions of dollars)

	61	66	71	76	81	86	91
Costa Rica	2.8	5.6	21.1	41.7	79.7	68.3	71.7
Guatemala	0.8	6.1	19.1	20.0	51.1	4.8	29.6
Honduras	1.5	3.9	12.5	25.7	47.3	17.4	28.9
Nicaragua	4.0	6.7	28.9	40.5	21.3	5.6	38.7
Panama	0.1	.0	1.4	3.8	5.1	.0	12.3
Total	9.2	22.3	83.0	111.7	204.5	96.1	181.2

Source: USDA, World Agricultural Trade Indexes

The combination of low prices, weak demand, and rising costs reduced the profitability of beef production (Camacho, 1989; Leon et al, 1982; Howard, 1987; Stonich, 1989). Numerous studies in the 1980s and 1990s showed that when profitability was calculated using full opportunity costs for land, capital, and labor and without including capital gains from rising land prices, cattle production was not profitable for most ranchers during this period (Banco de Guatemala, 1981; Edelman, 1985; Holman, 1993; IICA, 1993; Jarquin, 1990; León et al, 1982; Mercado, 1993; Van der Kamp, 1990; Ventura, 1992). Nevertheless, profitability varied significantly between ranches and ranching still appeared profitable when one compared gross receipts with immediate cash outlays, without taking into account the opportunity costs of the land and cattle involved (Convenio MAG-UNA-GTZ, 1991; Didier, 1993; Hering and Jaendl, 1993; Jarquin, 1990 and 1991; Maldidier, 1993; Schwartz, 1990; Ventura, 1992).

There is also evidence that within the livestock sector, cattle fattening continued to be the most profitable activity and large ranches tended to be more profitable than small ones (AHT-APESA, 1992, Biondi-Morra, 1990, IICA, 1993, Merlet, 1994, Namdar and Levard, 1984, Van der Kamp, 1990, Ventura, 1992). The only exception to this was Costa Rica, where strong consumer demand and protectionist policies have made milk production more profitable than beef production, and there has been a major increase in dual purpose herds, at the expense of cattle fattening (Motte and Billan, 1994; Ortíz, 1994; Van der Kamp, 1990).

Ranchers responded to the profit squeeze in beef production for export in different ways, depending on their available alternatives, liquidity, and the role of livestock within their systems of production. Fewer new investors went into cattle after 1979, except for specific situations where rising land prices and available subsidized credit made ranching profitable for other reasons. Instead, these investors invested their money in non-traditional agricultural exports, tourism, short - term money notes, and commercial real estate.

When the price declines began, many traditional medium and large ranchers retained their cattle to wait for higher prices. But when prices did not improve, they were often forced to sell their cattle anyway to pay their debts (Howard, 1987; Van der Kamp, 1990). Many heavily indebted ranchers and smaller ranchers with minimal liquidity were forced out of business entirely (Escuela de Ciencias Agrarias, 1987; Maldidier, 1993; Van der Weide, 1986). Large private ranchers in Nicaragua,

who during the 1980s faced not only declining profitability but also the threat of expropriation under the agrarian reform, ran down their assets by not replacing their bulls, neglecting their pastures, or slaughtering cows of reproductive age (Biondi-Morra, 1990).

Other producers, however, changed their behavior little or even increased their investment in cattle. The influence of price changes on many smaller and more isolated ranchers was limited, since these ranchers had few viable alternatives given their labor constraints, ecological conditions, and limited market access (Hijfte, 1989). There were probably also some traditional large ranchers who did not vary their activities much. With rapid inflation in Nicaragua in the late 1980s, investment in cattle was one of the few effective hedges against inflation. This led many production cooperatives created during the agrarian reform to purchase cattle between 1985 and 1988 (Lutz, 1993). Throughout the entire period medium and large farmers continued to purchase new farms on the agricultural frontier to take advantage of the comparatively low land prices there.

While flourishing export markets for beef clearly promoted pasture expansion and deforestation in the 1960s and 1970s, the impact of reduced beef exports is less clear. As shown earlier, most of the decline in cattle population in the 1980s and 1990s was in traditional livestock regions, while pasture expansion and deforestation continued in many agricultural frontier areas. This is consistent with the idea that declining markets had their greatest effect on investment ranchers and large ranchers

located in traditional cattle zones who had more alternative uses for their land and labor and influenced ranchers on the agricultural frontier relatively little.

THE DOMESTIC DEMAND FOR BEEF

The literature criticizing the Central American beef export boom of the 1960s and 1970s frequently points to the fact that during that period average per capita beef consumption actually declined in the region (Lehmann, 1991; Nations and Komer, 1983; Stonich, 1989; Williams, 1986). Nevertheless, thanks to population growth of over 3 percent per year during that period stagnant per capita consumption did not preclude a major increase in total domestic beef consumption, which reinforced the growth in the demand for beef for export.

During the 1980s and 1990s, the situation was more complex. Declining real incomes throughout much of the region and technological changes which greatly reduced real poultry prices lowered beef consumption. For each 1 percent decline in real income in Central America, the demand for meat fell between 0.5 and 0.8 percent (Jarvis, 1986, Solera-Ruiz, 1981). At the same time, however, overvalued exchange rates and reduced access to foreign markets favored the sale of beef locally.

The net result of these contradictory tendencies varied by country. In Costa Rica, both absolute and per capita beef consumption rose, and compensated to a certain extent for the decline in exports. (See Table 9.) The percentage of Costa Rican beef production exported fell from 50-60 percent in the late 1970s to only 29

percent in 1989 (Lehmann, 1991, Van der Camp, 1990). A similar process occurred in Nicaragua during the mid-1980s (Holman, 1993).

The situation in Guatemala and Nicaragua in the late 1980s and early 1990s was different. In both countries declining real incomes led not only to lower per capita beef consumption, but also to a smaller total domestic demand for beef (Holman, 1993, MAGA, 1993). In these countries, domestic demand trends rather than compensating for the decline in beef exports made the problem worse.

Table 9--Per capita beef consumption in Central America, 1976/83 and 1984/91 (Kgs./person)

	1976/83	1984/91
Costa Rica	20.4	22.9
El Salvador	6.1	5.1
Guatemala	5.3	3.8
Honduras	8.5	6.6
Nicaragua	15.4	8.6
Panama	26.1	26.7
Total	11.9	10.2

Source: International Center for Tropical Agriculture (CIAT) *Trends in CIAT Commodities 1993*, Working Document No. 128, July 1993.

MILK IMPORTS AND EXPORTS AND THE DOMESTIC DEMAND FOR DAIRY PRODUCTS

The livestock and deforestation literature has largely ignored the trends in dairy markets. This is a mistake since a large percentage of Central America's cattle has always formed part of dual purpose livestock systems (Holman, 1993, Holman et al, 1992, Sarmiento, 1992, Vargas et al, 1991). In these systems dairy products not only provide a large percentage of total earnings, but also play a major role in maintaining a regular cash flow.

The production and consumption of pasteurized milk and other industrialized dairy products grew rapidly in the 1960s and 1970s. Between 1970 and 1981, fresh milk consumption in Central America rose 4.2% yearly (Jarvis, 1986). Dairy companies such as Borden and Dos Pinos in Costa Rica, Prolacsa, La Perfecta, La Selecta, and El Eskimo in Nicaragua, Leyden in Honduras, and Nestles and Chiricana de Leche in Panama offered ranchers secure markets and succeeded in greatly expanding milk production in the areas they purchased from (Cajina, 1986, Camacho, 1989, Ventura, 1992). At least in some specific areas, such as eastern Matagalpa and Chontales in Nicaragua and, later, northern Alajuela in Costa Rica and Atlantida in Honduras, they probably also stimulated the clearing of primary forests (S. Humphries, personal communication). Cloud forests were particularly susceptible to being cleared for milk production because dairy cattle thrive best at higher elevations.

As with beef, however, during the 1980s and 1990s many of Central America's dairy markets became less attractive for producers. The stagnation of domestic milk consumption was one reason for this, but government price controls and the flooding of domestic markets with dairy imports were perhaps even more important.

The only country where per capita dairy consumption declined significantly during the last fifteen years was Nicaragua, where it is now about half of what it was in the 1970s (Holman, 1993). In the remaining countries, per capita consumption has been stable or has slightly increased. Over time, however, milk imports have satisfied an increasing portion of domestic demand. Regional dairy imports rose from 14.8 million dollars in 1975 to 47.4 million dollars in 1990, and by 1991 accounted for 18 percent of all regional dairy consumption (Nuñez and Galetto, 1993). (See Table 10.) Milk imports were particularly high in Nicaragua between 1982 and 1988 and in Guatemala between 1986 and 1990. These imports have had an especially depressive effect on domestic milk prices because a large percentage were donations, which were often sold locally at below market prices (Garst and Barry, 1990). The only country which made a serious effort to protect its national dairy markets from foreign dumping has been Costa Rica, where milk production grew at an average annual rate of 4.8 percent between 1982 and 1994, and which went from being a net importer of dairy products to recently become a net exporter (Holman et al, 1992, Motte and Billan, 1994).

Table 10--Central American milk imports, 1970-1990, excluding El Salvador (millions of dollars)

	1970	1975	1980	1985	1990
Costa Rica	0.7	2.7	6.3	2.3	5.3
Guatemala	2.3	2.6	12.3	8.2	24.7
Honduras	2.6	4.9	10.4	13.7	10.0
Nicaragua	0.9	1.5	3.4	10.4	4.2
Panama	1.3	3.1	7.9	6.0	4.2
Total	7.8	14.8	40.3	40.6	47.4

Source: USDA, World Agricultural Trade Indexes

Domestic milk prices have also been depressed by government price controls. Costa Rica has had controls since 1973 (Camacho, 1989). Nicaragua not only had price controls during the 1980s, but the government also owned the most important processing plants and set the prices at which the plants purchased milk from farmers. In Guatemala, price controls were instituted in 1972, partially lifted in 1981, and then reimposed at different times between 1985 and 1991 (RUTA, 1993). Controls have also been used in Honduras and Panama.

The combined effect of subsidized imports, government price controls, and stagnant markets has been to reduce real milk prices. Real milk prices in Costa Rica were 11% lower on average between 1987 and 1993 than they had been between 1980 and 1986 (Camacho, 1989; Nuñez and Galetto, 1993). At the same time real

wages, land prices, and input prices rose much faster than productivity gains, leading to a sharp deterioration in dairy farmers' real net incomes (Holman et al, 1992). Real milk prices in Guatemala during the 1987-1993 period were also substantially lower than during the previous seven years (RUTA, 1993). Panamanian ranchers received the same nominal price for their milk in 1991 as they had in 1983, despite major cost increases in that period (Sarmiento, 1992).[12]

Nevertheless, in all the countries except Nicaragua milk production rose during the last fifteen years, despite declining real prices. In 1991, milk production in Honduras, Panama, and Costa Rica was 54%, 50% and 45% higher than it had been in 1981 (Nuñez and Galetto, 1993). This reflects the limited alternatives available to small and medium size ranchers in which to invest their resources and the great premium small producers place on having a steady cash flow, a relatively assured market for their production and, in some cases, credit and technical assistance provided by the milk plants.

THE IMPLICATIONS FOR POLICY

Policy instruments which lower producer prices for beef and milk such as overvalued exchange rates, measures which dampen domestic income levels, price controls, protectionist measures in beef importing countries, consumer beef boycotts in developed countries, and policies facilitating dairy imports will all discourage cattle

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[12] In Honduras, producer prices for producers dropped by one third after the government reduced milk import tariffs in April, 1993 (Nuñez and Galetto, 1993).

production and hence the clearing of forest for pasture. Only a small reduction can be expected in response to moderate policy changes, however, and pasture area may well decline in traditional cattle grazing areas which are more suited for livestock, but continue in the poor soil, humid tropic areas along the agricultural frontier. There may also be discontinuities in the response to policy changes with initial large reductions in pasture area, as investment ranchers reduce their holdings, but only minimal further declines in pasture area, as the remaining pasture lands are controlled by farmers with low supply elasticities with respect to these policy changes. Overall, these policy instruments are probably not appropriate mechanisms for controlling deforestation.

5. GOVERNMENT SUBSIDIES FOR LIVESTOCK AND PUBLIC ROAD CONSTRUCTION

This section focuses on how and why governments have used subsidies that foster forest clearing. It first looks at the role of national and international interest groups in this process, then analyzes government subsidies through credit and road construction.[13]

[13] Central American governments also support livestock through subsidized animal health services and tax incentives, but these incentives have generally been much less significant than credit and road construction.

INTEREST GROUPS FAVORING GOVERNMENT SUPPORT FOR CATTLE

Large cattle ranchers have always been among the most powerful and well organized groups in Central America. The annals of Central American history are filled with presidents, generals, ministers, and congressmen whose family wealth had its origins in large extensive cattle ranches. And ranchers associations such as the Guanacaste Chamber of Ranchers (CGG), the Nicaraguan Ranchers Federation (FAGANIC), the National Federation of Farmers and Ranchers of Honduras (FENAGH), and Panama's National Ranchers Association (AGAN) have traditionally been quite successful in lobbying to protect their interests (Guess, 1982, Edelman, 1992). These groups' major concerns have been to increase their access to subsidized credit, avoid land expropriations and squatting, limit government price controls, eliminate cattle rustling, and protect dairy producers from foreign competition.

During the 1960s and 1970s, international agencies such as the World Bank, Inter-American Development Bank (IDB), and the U.S. Agency for International Development (USAID) also supported efforts to promote beef production and exports as a central focus of economic growth (Williams, 1986). Over half of the World Bank and IDB loans to the region between 1963 and 1980 for agriculture and rural development directly supported beef production for export (Brockett, 1988). By 1985, these loans had provided 364 million dollars to finance livestock credit, slaughter houses, technical assistance and animal health services (Howard, 1987).

Central American government officials generally supported cattle production in the hopes of diversifying exports beyond the traditional mainstays of coffee and bananas and military officers often saw pasture expansion in frontier areas as a way to extend the government's effective control over the entire national territory (Heckadon, 1984).

In the 1970s, however, the cattle industry came under increasing criticism on both environmental and social grounds. The publication of an influential article by James Parsons in 1976 prompted a series of critical studies focusing on the negative effects of livestock expansion on forests (DeWalt, 1982, Myers, 1981, Parsons, 1976, Shane, 1980). The rising pressure for agrarian reform in the region also highlighted what was considered to be the underutilization of many pasture areas. In response to these pressures, the international agencies began to reduce their support for the cattle industry.

The military governments in Honduras and Panama in the mid-1970s and the Sandinista government in Nicaragua during the 1980s were also less attentive to the interests of the larger ranchers than their predecessors. With the political changes in these three countries in 1990, however, ranching interests have once again returned to major positions of power within the agricultural sector. Thus it was no coincidence that in 1994, five of the six ministers of agriculture in Central America were cattle ranchers.

LIVESTOCK CREDIT

The ebbs and flows of political support for the livestock industry have been directly reflected in the terms and availability of livestock credit. During the beef export boom in the 1960s and early 1970s, the amount of livestock credit in real terms and the percentage of agricultural credit allocated to livestock grew rapidly in all the countries. By 1970, livestock was receiving 43 percent of government agricultural loans in Honduras, 39 percent in Nicaragua, 37 percent in Costa Rica, and 22 percent in Guatemala, and this percentage tended to grow during the following three or four years (Williams, 1986).[14] These percentages were generally much higher than the contribution of livestock to total agricultural production.

Livestock credit provided during this period was heavily subsidized, went predominantly to cattle fattening, and was allocated to a relatively small group of ranchers.[15] Subsidies were provided through both below market interest rates and leniency with respect to loan recuperation. In Costa Rica, for example, real interest rates for livestock credit were negative between 1970 and 1983, at times reaching

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[14] In Costa Rica, livestock credit peaked at 58% of agricultural credit in 1974, and during most years between 1973 and 1980 more credit went to livestock than to crops (Aguilar and Solis, 1986; Place, 1981).

[15] In Honduras, for example, in the mid 1970s some 200 ranchers received 45% of all public sector livestock credit (Slutsky, 1979). In the World Bank PRODEGA livestock project in Guatemala, 232 ranchers received loans averaging $24,600 each, as well as free technical assistance which cost the project $4,823 per farm. These ranchers' average herd size was 162 head, at a time when there were only 2,511 ranchers in the country with over 100 head of cattle (World Bank, 1978, RUTA, 1993). Seventy-two percent of the credit provided by the World Bank's Third Livestock Project in Panama went to ranchers with over 150 hectares (World Bank, 1991).

below -10%. Almost one third of the money loaned for livestock during this period was not recuperated on time, as opposed to only 16% of loans for agriculture and 19% of loans for industry (Aguilar and Solis, 1988). Real interest rates in the PRODEGA livestock project in Guatemala averaged -3.4% (World Bank, 1978). Interest rates in Panama were also historically subsidized, although usually positive in real terms (Boyer et al, 1990). Public - sector cattle loans in that country were periodically forgiven, and borrowers who did not repay previous loans frequently received new ones (Ledec, 1992b). Central American governments also indirectly subsidized cattle loans by placing ceilings on the interests rates which could be charged by private banks.

Subsidized credit for cattle promoted deforestation in several ways (Ledec, 1992b). Credit helped ranchers to overcome capital constraints, which would have otherwise limited pasture expansion. Interviews by the author in 1994 in Peten, Guatemala, for example, show that often the major reason why large ranchers have deforested only a portion of their land holdings is that they do not have the $36,000 to $90,000 required to clear, fence, and plant pastures on their 450 hectare holdings. Large ranchers also used a significant amount of livestock credit directly to purchase lands which they might otherwise have been unable to afford.[16] Traditionally, a

[16] Aguilar and Solis (1988) studied some 109 large and medium sized ranches in Costa Rica in the mid-1980s and found that 75% of the large farms and 65% of the medium sized farms which had purchased land did so with money from public loans. They also found that 30 percent of 291 cases of investment credit for livestock given between 1973 and 1978 were used for land purchases, and an additional 29 percent had "mixed uses", which may have included land purchases. In Panama, the public livestock credit programs explicitly prohibit the purchase of land with credit

rancher's ability to expand his or her area or cattle herd had been largely limited by the herd's natural growth rate or his or her ability to accumulate money from some other source, but with the appearance of government credit programs this ceased to be the case (Merlet, 1992).

Credit subsidies made livestock a more attractive investment prospect compared to other alternatives, and even when the credit was not subsidized it still made livestock more attractive because it transferred risk from ranchers to the banks. If the venture failed there was a high probability that the bank, rather then the rancher, would eventually assume a large portion of the loss. Subsidized cattle credit also created incentives for landholders to establish pastures on previously forested land simply to qualify for the credit, which could then be diverted to non-cattle investments. Indirectly, subsidized credit raised land prices, which promoted land speculation since banks would often not accept forested land as collateral. This provided an incentive for ranchers to deforest the land to improve their access to credit (World Bank, 1993).[17]

Another way that credit promoted deforestation was by facilitating the transfer of cattle from ranchers with sufficient pasture resources to others who needed to clear new lands to maintain their newly acquired cattle. Thus, for example, in recent

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funds. Nevertheless, because of fungibility, many ranchers nonetheless have used long-term, low interest governmental bank credit to expand their land holdings (Ledec, 1992).

[17] Flores et al (1993) report that in the 1970s public credit agencies in Nueva Guinea, Nicaragua made more credit available to ranchers who deforested large areas because this was taken as evidence that they were hard workers.

years the concentration of livestock credit in the hands of a few large ranchers in Nicaragua has allowed these ranchers to purchase cattle from smaller ranchers who lack liquidity (Maldidier, 1993). Once the cattle are purchased, the ranchers must acquire additional land to maintain them on, often in previously forested areas, while much of the smaller farmers' pastures is subsequently abandoned.

Nevertheless, the role of subsidized public credit in the conversion of forest to pasture should not be exaggerated. Ledec's 1992 dissertation on the impact of livestock credit on deforestation concludes that only about seven to ten percent of all Panamanian deforestation could be attributed to public livestock credit. Moreover, most of this deforestation was of small forested areas outside the agricultural frontier. He notes that in general banks prefer to lend to large established ranchers in traditional cattle raising areas, rather than to the relatively small colonist ranchers who are active in frontier areas. Other evidence which supports Ledec's thesis that subsidized public credit has been important in accelerating the forest-to-pasture conversion process but is not essential to that process include multiple regression and linear programming models of livestock production in Costa Rica, which show that beef cattle production is rather inelastic to credit availability and variations in interest rates, and the experience of rapid pasture expansion in Peten and eastern Honduras, despite the fact that relatively little public livestock credit has been available in those areas (Solera-Ruíz, 1981).[18]

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[18] Multiple regression models using national data for Costa Rica from 1967 to 1976 estimated that a 20% increase in credit for beef cattle would only increase beef production by 7% (Solera - Ruíz, 1981).

In the last fifteen years public livestock credit has become less available and less subsidized. Real livestock lending reached its peak in Guatemala in 1973 and then declined through 1989 (Vargas et al, 1991). Since 1986 ranchers have received little public credit (RUTA, 1993). In Costa Rica, the decline began in 1981, and by 1989, livestock lending there had fallen to the same level as in 1970 (Holman et al, 1992). Lending in Honduras, Nicaragua, and Panama rose until the second half of the 1980s but then fell abruptly (Jarquín and Videa, 1990; Maldidier, 1993; Sarmiento, 1992; SRN, 1991; Ventura, 1992). In the latter part of the 1980s, real interests rates have risen substantially and Nicaragua now has loan provisions which automatically adjust loan repayment rates whenever the national currency loses value in relation to the dollar (Aguilar and Solís, 1988; CATIE, 1990; Siles and Hernández, 1994). These changes reflect the unfavorable market conditions in the sector itself, as well as declining international support for subsidized public agricultural credit in general, and for livestock credit in particular.

Faced with unfavorable market conditions and falling government support, the ranchers associations have pressured governments for greater assistance. In certain instances they have succeeded for short periods, but in general they have been unable to maintain government support for more than a few years.

One example of this is the Agricultural Development Program (FODEA) in Costa Rica. In that case, as a result of unfavorable market conditions by 1987 nearly two thirds of Costa Rican banks' cattle loans were in arrears and cattle ranchers began heavily pressuring the government for debt relief (Czel, 1990). This resulted

in passage of the 1987 "FODEA" law, which canceled certain debts, provided longer pay back periods for others, and in general lowered interest rates on past debts (Hijfte, 1989). The law provided ranchers with an annual subsidy of 16 million dollars in 1988 and 1989, the vast majority of which went to large ranchers (Lutz and Daly, 1991; World Bank, 1993). Under similar circumstances, in 1985 the Honduran government created a 2.5 million dollar "compensatory fund" to reactivate the livestock sector, which directly subsidized the cattle purchasing price paid by the packing houses and in 1993 the Nicaraguan government extended repayment periods on short term cattle loans when 78% of loan recipients fell behind in their payments (Siles and Hernandez, 1994; Ventura, 1992). In none of these cases, however, were the subsidy programs maintained for more than a few years.

Probably the only country where reduced access to subsidized credit has had a major impact on cattle production is Nicaragua, where most ranchers have major liquidity problems after years of political turmoil and economic crisis. Large areas of pasture in that country have been under utilized or abandoned because landowners lack money to purchase cattle (Matus et al, 1993, Maldidier, 1993, Mercado, 1993). Smaller ranchers and production cooperatives have been particularly affected.[19]

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[19] The Nicarguan government recently signed a 22 million dollar loan agreement with the Central American Bank for Economic Integration (BCIE) which could significantly increase deforestation in that country (Siles and Hernandez, 1994).

In the other countries, the decline in credit availability has had some effect, but it has probably been greater in traditional cattle grazing regions than along the agricultural frontier.

ROAD CONSTRUCTION

If there is one single government policy which has had a major and indisputable impact on promoting conversion of forest to pasture it is road construction in forested regions (AHT-APESA, 1992, Deacon, 1991, Jones, 1990, Ledec, 1992b, Van der Kamp, 1990). This is reflected in a 1987 statistical analysis of deforestation in northern Honduras, which found that "those areas nearest to roads are most susceptible to deforestation. The further a road class is from a road, the smaller the percentage of (area) affected by deforestation. Beyond five kilometers there was a rapid drop in the percentage cleared" (Ludeke, 1987:76). In Panama it has been shown that "colonization and eventual deforestation are likely to occur within 2-10 kilometers of either side of an all-weather rural road which has penetrated a frontier area. This implies a deforestation area of influence of 400 to 2000 hectares for each new kilometer of road built in forested zones" (Ledec, 1992:199). Similarly, in Costa Rica, Sader and Joyce (1988) found that in 1977 the mean distance from nearest road or railroad to non-forest locations was only 5.5 kms. compared to a mean distance from forest locations of 14.2 kms. The magnitude of forest destruction that road building has caused can easily be understood if one

considers that between 1953 and 1978 the length of all-weather roads in Central America rose from 8,350 kilometers to 26,700 kilometers (Williams, 1986).

Road construction promotes the conversion of forest to pasture both directly and indirectly. By providing access to new areas it makes it easier to enter and deforest and cheaper to transport cattle and dairy products from the area. The latter is of fundamental importance since often transportation costs are the major determinants of land use patterns in agricultural frontier areas (Schneider, 1994). Roads also stimulate land speculation, a topic discussed in greater detail below.

Some public road construction in forested areas has been associated with specific colonization projects such as the Rigoberto Cabezas (PRICA) project in Nueva Guinea in Nicaragua, the Northern Transversal Strip Land Resettlement Project in northern Guatemala, the Aguan Valley colonization program in Honduras, and the agrarian reform settlements in northern and eastern Costa Rica (Featherjohn and Thompson, 1982, Jones, 1990, Merlet, 1992, Walker et al, 1993). Most, however, has been limited to constructing the roads themselves.

Private feeder-road construction by lumber companies has been another major problem (Herlihy and Herlihy, 1992; Ledec, 1992b; Utting, 1992). After these companies extract the wood they are interested in, they leave behind feeder roads which greatly facilitate the subsequent arrival of agricultural colonists and ranchers. In some cases in Guatemala, lumber companies have even offered to build roads for communities in return for access to the wood on their farms. Often, these feeder - roads have a much greater negative impact on the environmental services provided

by the forests than does the extraction of wood by the lumber companies themselves. Similar problems have occurred with publicly constructed roads designed to provide access to mineral, petroleum, and hydroelectrical resources in northern Guatemala and western Panama (Utting, 1992).

Unlike favorable market conditions and credit subsidies which tended to disappear in the 1980s, public road construction in forested areas continued largely unabated. The annual growth in roads in Costa Rica, for example, increased from 6.5% between 1974 and 1980 to 10.4% between 1981 and 1990, with much of the new growth being financed by the USAID Northern Zone project in the heavily-forested northern portion of Alajuela (Girot, 1989, Holman et al, 1988). New roads such as the Chiriqui - Bocas del Toro highway in Panama, the route between Las Cruces and El Naranjo in Peten, Guatemala, and the roads connecting Rio Blanco and Siuna and Nueva Guinea and Bluefields have recently brought floods of colonists to previously forested areas (Flores et al, 1994; Jones, 1990). There are also currently plans to close the only remaining gap in the Panamerican Highway which is in the forested area of Darien, Panama and to greatly improve most of the existing main roads in Peten, Guatemala.

In some instances Central American governments have attempted to control settlement, land speculation, and deforestation along newly constructed roads, but invariably they have failed. In Panama, for example, in 1973 the government banned settlement within an eight kilometer radius of the, newly constructed, section of the Panamerican highway between Tirao and Canglon in Darien. The attempts failed,

however, and by 1984 there were already 9,729 people living in that area (Herlihy, 1989). Similarly, the Costa Rican government declared that most of the area to be crossed by a new road between San Jose and Guapiles to be a national park before the road was announced, and tried to strictly enforce prohibitions on land clearing. They were also unable, however, to stop major deforestation near the road in a number of areas (Joyce and Sader, 1988; Van der Kamp, 1990).

In many areas, the principal justification for government road building in the 1980s was to facilitate military access to areas of armed conflict or potential conflict. This was certainly the case in northern and eastern Nicaragua, northern Costa Rica, south-eastern Honduras, and northern Guatemala. Unfortunately, however, these areas were propitious for non-conventional warfare precisely because of the presence of large forested areas where it was easy for troops to hide and difficult for their opponents to reach. By opening up these areas to greater troop mobility, the Central American governments and their foreign sponsors greatly facilitated the process of deforestation.

As much as any other single factor, the continued growth in roads during the 1980s and 1990s helps to explain why, despite the loss of favorable markets and subsidized credit, land clearing on the agricultural frontier continued throughout Central America.

THE IMPLICATIONS FOR POLICY

Restricting livestock credit in agricultural frontier regions can contribute to reducing forest clearing for pasture. Credit for cattle fattening is likely to promote greater land clearing than credit for dairy farming and calf production, because it generates multiplier effects in the livestock production system and is associated with more extensive production systems. The implications of providing livestock credit outside of agricultural frontier areas must be examined on a case by case basis.

Road construction and improvement in agricultural frontier regions will almost invariably promote rapid deforestation. Governments almost always lack the capacity to enforce restrictions on settlement and land clearing around new roads.

6. THE ROLE OF GOVERNMENT LAND POLICIES AND LAND MARKETS

The characteristics of local land markets and government land policies have a major impact on how fast new lands are incorporated into farms and cleared. This section first discusses Central American land markets and then looks at land acquisition and titling policies, colonization schemes, agrarian reform efforts, protected areas indigenous land rights, extractive reserves, and land taxes.

LAND MARKETS AND LAND CONVERSION

Purchasing, claiming, or forcibly grabbing rural lands in Central America has traditionally been quite profitable. In northern Costa Rica, for example, real land

prices have been rising steadily since at least 1875. "Particularly after 1932, land prices in the region began a slow climb which assured long-term gains for the patient investor" (Edelman, 1985:167). This process accelerated rapidly during the 1970s, with land prices quadrupling during the decade in San Carlos, Liberia, Bagaces, Nicoya, and Tilaran (Aguilar and Solís, 1988).

In Guatemala, real land prices in the Peten and other northern departments have risen rapidly since at least the mid-1970s (Colchester and Lohman, 1993). "Between the 1970s and the mid to late 1980s, land values in Peten rose from less than 10 quetzales to 27 quetzales to about 45 quetzales or more" (Schwartz, 1990: 269). Real land prices in the Guatemala's south coast livestock departments rose about eight percent per year from 1974 to 1988 (Shearer et al, 1993). Rapid increases in real land prices in recent years have also been reported in agricultural frontier regions in Atlantida and Colon in northern Honduras (Hernández-Mora, 1994).

Probably the only country in Central America where real land prices have not risen in recent years is Nicaragua, where political instability, economic crisis, and land tenure insecurity have kept land prices low (Matus et al, 1993). Even there, however, newly incorporated lands on the agricultural frontier grow rapidly in value as they become more accessible.

One major reason land values have risen over time is that they have become more accessible as a result of the road construction discussed above (Edelman, 1985). "Heckadon reports that land prices in the Tonosi district of Los Santos province in

Panama increased from less than 50 dollars per hectare before road access was established, to more than 100 dollars immediately thereafter" (Ledec, 1992b: 96). Similarly, cattle lands along the road from Mulukuku to Siuna in Nicaragua sold for 112 to 140 dollars per hectare in 1992, while comparable lands one day's walk from the road went for 30 to 40 dollars per hectare, and land in the most isolated places was worth only 10 dollars (Maldidier, 1993). In some areas of Petén, Guatemala land prices have doubled or even tripled in the last few years in anticipation of new road construction. Public investments in utilities, agro-industrial processing plants, and subsidized credit has also tended to be capitalized into land prices (Edelman, 1985; Holman et al, 1992). Land is frequently purchased or claimed that it would be currently unprofitable to farm in anticipation of future road construction that will lower transportation costs and make cattle raising attractive (Schneider, 1994).

Other factors which have encouraged higher land prices have been high beef and milk prices during certain periods and rising demographic pressure (Escuela de Ciencias Agrarias, 1987; Holman et al, 1992). In Costa Rica, the expansion of tourism, subsidized reforestation, and banana and citrus production have also been important in the 1980s.

Several authors have also pointed to a purely speculative component to land prices which "involves people attributing to deforested land an asset value that is well in excess of its actual production value" (Ledec, 1992:96). Griffith and Zepeda (1994) have used linear programming techniques to show that the shadow price of land for small milk producers in Monteverde, Costa Rica is substantially lower then

the land's market value and in certain instances may not justify the cost of even clearing the land. According to Shearer et al (1993) "money laundering, labor remittances, and a hedge against inflation and devaluation help keep land prices above their value solely for production." There may also be what the literature calls "rational bubbles", in which ranchers expect land prices to rise so they become willing to pay higher land prices, which in turn bids up market prices and converts their expectations into self-fulfilling prophesies (Clark et al, 1993). An additional factor fueling land speculation in several countries has been the purchase of large ranches by governments and international agencies at higher than prevailing market prices for land redistribution, refugee resettlement, or conservation areas (Edelman, 1992; Kaimowitz, 1995). The incomplete nature of rural financial markets in many agricultural frontier areas also means that the local population has few alternative opportunities for savings and investment besides purchasing land.

Not only have land prices tended to rise, but deforested lands usually sell for much higher prices than forested lands (Ledec, 1992b; World Bank, 1993). In Peten, Guatemala, for example, deforested land typically sells for approximately $80 more per hectare on average than land with degraded forest (Kaimowitz, 1995). This is in part a reflection of the labor invested in land clearing (known throughout Central America as "mejoras" or "improvements") and in part due to the more secure land tenure status of deforested lands, discussed below. There are even people in some places who have made land clearing practically an occupation, moving into forest

land and clearing it in order to sell it for a price reflecting the implicit wage cost of land clearing (Cruz et al, 1992).

At the same time, land price increases caused by urbanization in peri-urban areas such as the Central Valley of Costa Rica and the area around Guatemala City, have made specialized dairy production in these areas less profitable than parcelling the land and building houses on it. This has promoted the search for new regions for milk production, such as the (previously forested) northern portion of Alajuela in Costa Rica (Camacho, 1989). Similarly, as land prices have risen rapidly on the South Coast in Guatemala, due in part to the expansion of sugar cane production, south coast ranchers have sought cheaper lands in frontier areas in Izabal and the Peten (World Bank, 1978).

The rise in land prices has been so significant in agricultural frontier areas, that a large percentage of pasture expansion may have as much or more to do with land speculation as with cattle raising per se.[20] For example, a 1981 Banco de Guatemala survey of large ranchers in Petén, Guatemala found that despite that fact that "financial calculations show that ranches take six to nine years before they have positive cash flows and the internal rate of return is substantially below other investment opportunities" ... "The ranchers interviewed...were optimistic thanks to: 1) the opportunity to obtain capital gains as land prices rise...2) falling transportation costs resulting from government road construction, and 3) the possibility to increase

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[20] Similar results have been found in the Brazilian Amazon (Browder, 1988; Hecht et al 1988), although they have been partially disputed by Mattos and Uhl (1994).

their productivity over time" (63). Similarly, Van der Weide, describing the large cattle ranches in the Atlantic Coast of Costa Rica says that a typical strategy was to "sell the best timber wood, prepare some land for maize or cattle grazing and wait for land prices to increase through speculation" (1986:36). "In some cases families just have cattle on land to show ownership while they speculate with land prices. Land ownership is a long term investment, which is more important than the income from livestock as such" (Hijfte, 1989:16). Hence, Jones is correct when he says that "Deforestation is often portrayed as an economic strategy, especially as a beef production strategy, a view which is only half correct. Deforestation is also a title establishment mechanism, in which cattle serve primarily to demonstrate active land use, and...only secondarily as a source of income" (1990:2).

LAND CLAIMS AND LAND TITLING

To better understand why land speculation in Central America has led to massive conversion of forest to pasture it is important to analyze the legal and practical aspects of claiming and protecting land in the region. Most land converted from forest to pasture over the last few decades originally belonged to the government. These lands could be legally claimed by farmers if they could show that they had been occupying them for more than a certain number of years. Often the laws required colonists to clear the forest in order to acquire possession rights, and in some cases, such as Costa Rica's Law 11 of 1941, permitted farmers to obtain title for larger amounts of land if it was for pasture than if it were for crops (Leon et al,

1982). That same law stated that people wishing to obtain title to areas where the majority of the land was covered in forest had to provide evidence of occupancy in the form of a public document issued more than ten years earlier. "As requiring a ten year old public document made lying about possession of forested area much more difficult, people simply cut 50 percent or more of the forest cover" (Utting, 1992:43).

Even when laws do not specifically require deforestation to demonstrate land possession, land clearing and the subsequent planting of pasture has still been one of the best ways to discourage squatters and avoid the threat of agrarian reform action designed to put "idle lands" into use (Edelman, 1992; Place, 1981; Salaverria, 1992; World Bank, 1993).[21] Thus, for example, many large landholders in northern Guatemala who have not deforested all their land, have had their forest areas invaded by squatters, while squatting is quite rare where pastures have been planted. Edelman (1992) analyzed all 13 squatter invasions involving over 500 hectares which occurred in Guanacaste, Costa Rica between 1963 and 1981 and found that in almost all the cases they involved heavily forested areas. Flores et al (1994) report that many farmers who are settling lands in eastern Nicaragua that were abandoned during the military conflict are deforesting as quickly as possible because they do not know if the land was previously owned and wish to improve their bargaining power

[21] The Honduran agrarian reform law exempted all pasture lands from potential expropriation. The 1962 Panamanian agrarian reform land specified that land served a socially useful function if it were in pasture, crops, tree plantations, or urban construction; otherwise it was considered "idle" (Graciela, 1989).

in case the original owners return by making "improvements". If one simply wants to show that his or her land is in use to guarantee tenure security while the land appreciates in value, grazing a few cattle on it is often the cheapest way to do so.

With the end of redistributive agrarian reform policies in Central America in the 1990s and recent modifications in the titling legislation in Costa Rica and Honduras designed to eliminate some of the incentives for deforestation, the incentive to convert forest to pasture to ensure tenure security may have weakened (Richards, 1994; Utting, 1992). Nevertheless, there is evidence that the changes in titling legislation have still had little effect on the behavior of government agencies at the local level and in many agricultural frontier areas land clearing remains the only effective mechanism for claiming possession (Hernández-Mora, 1994, Silviagro, 1992).

There is also evidence that recent land titling programs initiated by Central American governments to provide secure tenure rights for land occupants without legal title have fueled the speculative drive for land. In 1993, many families were attracted to the agricultural frontier regions of Rio San Juan in Nicaragua by rumors that the government was going to be giving land title in those areas, and that the titled land could then be resold at a handsome profit (personal communication, Jorgen Strange-Hansen, 1993). It has also been reported that passage of the 1972 Agricultural Modernization Law in Honduras which promotes land titling led many ranchers to claim new lands in the buffer zone of the Río Platano Biosphere reserve in the hopes of being able to title them (Richards, 1994). As a World Bank study

about Costa Rica, cited in Walker et al (1993) puts it "legalizing the purchase of illegally obtained lands encourages squatters"; and the best way for a squatter to show possession is by deforesting.

In the long run, land titling and government enforcement of individual property rights probably discourage land clearing aimed at improving tenure security and extracting natural resources before some one else can claim them.[22] One reason cattle ranchers in Costa Rica have been willing to abandon their pastures and let them return to secondary forest may be that as individual property rights have become more secure they no longer fear they will lose their land if they leave it "idle". To the (limited) extent that large landholders in agricultural frontier regions in other countries have tenure security and do not want to or cannot clear their land, this also provides some protection from deforestation by others. Legeay, for example, in his detailed study of the area between El Remate and Melchor de Mencos in Petén, Guatemala (1994) identified certain areas which had not been deforested by squatters because they were reluctant to invade private land owned by large landowners. It is not clear, however, how these long-term benefits of land titling can be achieved without fueling short-term land speculation.

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[22] Southgate et al (1991) also found that deforestation was lower in agricultural frontier municipalities in Ecuador that had higher percentages of titled land.

COLONIZATION SCHEMES

Some governments have gone beyond simply permitting the privatization of national lands for cattle raising to actively promoting it. By far the most important example of this has been in the Petén, Guatemala, where in 1971 the government passed a law authorizing the Institute for the Promotion and Economic Development of the Petén (FYDEP) to sell areas of up to 675 hectares at low prices to ranchers (Latinoconsult, 1974). Initially, the government sold land for prices ranging from two to nine dollars per hectare and even today land is sold for only between 22 and 42 dollars per hectare, which is a fraction of market prices. Moreover, the government only requires a down payment of 10%, with the remainder to be paid over twenty years at zero interest. Although there are no reliable figures on how much land has been sold in the Peten under this system, the Banco de Guatemala (1981) estimated that by 1980 FYDEP had given titles for 700 large parcels for ranching and another 700 similar cases were being processed. Most of these lands were sold to entrepreneurs and professionals from Guatemala City and Cobán, politicians and military officers from various regions, and medium sized ranchers from the eastern departments of Chiquimula, Jutiapa, and Jalapa. According to the law, purchasers were obliged to keep 20% of the land received in forest, but this requirement was never enforced (Schwartz, 1990). This colonization program was undoubtedly one of the major reasons why pasture area in the Peten rose from 32,000 hectares in 1964

to some 300,000 hectares in 1991 (AHT-APESA, 1992, ICAITI, 1974).[23] In order to maintain their lands, the Law required that land recipients begin "activities or investments" on the land within one year of receipt and not abandon it for more then six months.[24]

Government colonization schemes were also major forces behind the expansion of pasture area in Nueva Guinea, Nicaragua, northern Costa Rica, and the Northern Transversal Strip in Guatemala. When the Rigoberto Cabezas (PRICA) colonization scheme first began in Nueva Guinea in 1965 with support from the Inter-American Development Bank (IDB) over 75% was covered with forest and there were less than 32,000 head of cattle (Merlet, 1992). By the late 1970s, however, forest cover had shrunk to 27%, much of it heavily degraded, and the cattle herd had risen to 180,000 (Jarquin, 1990). A recent survey of ranchers in the area found that less than 5% of the land on their farms still had forest (Pijnenburg and Martínez, 1992).

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[23] Despite the favorable terms under which the Guatemalan government made land available in the Peten, many purchasers never fulfilled the conditions necessary to become owners. According to the law, to maintain their lands recipients had to begin "activities or investments" within one year of receipt and not abandon the land for more than six months (Valenzuela, 1994). Often, however, ranchers only went through the first few steps in the titling process, failed to make regular payments for their land, never invested on the land, or abandoned it for long periods of time.

[24] Most land recipients were never legally eligible to purchase land in the first place, since according to the law to buy land a rancher could not own more than 45 hectares of land outside the Peten. Thus, even today the legal means exist in Guatemala for the government to reclaim large amounts of land transferred to large ranchers.

Between 1974 and 1984, the Costa Rican government resettled 1,801 families on 36,815 hectares in Northern Alajuela, and in the following three years they resettled an additional 4,604 families on 45,460 hectares. The great majority of lands distributed were forest lands with poor soils that were subsequently converted to pasture (Cruz et al, 1992; Girot, 1989).

Most recently, following the end of the military conflict in Nicaragua, the government there turned over 286,000 hectares of land to 11,645 former military personnel, anti-government insurgents, and repatriated families (Ortega, 1993). Most of this land was in the forested areas of eastern Nicaragua, and has since been rapidly deforested. To-date, there are still few animals on these lands, since most land recipients have lacked funds to purchase cattle, but the majority plan to put cattle on their lands in the future (CIPRES, 1992).

None of these colonization schemes included a significant effort aimed at getting the families arriving in the areas to sustainably use forest products. For the most part, forests were viewed as a nuisance, that should be removed as quickly as possible.

AGRARIAN REFORM, PROTECTED AREAS, INDIGENOUS TERRITORIES, AND EXTRACTIVE RESERVES

Not all government land policies have promoted forest clearing. The agrarian reform process which began in 1979 in Nicaragua, for example, was an important deterrent to private investment in cattle ranching and offered tens of thousands of

families an alternative for gaining access to land different from moving to the agricultural frontier (Jarquin and Videa, 1990, Karliner, 1985). In the early 1980s, most of the 930 ranchers in that country with farms large enough to be subject to the agrarian reform law responded to the threat of expropriation by reducing their herds (Biondi-Morra, 1990). The lands expropriated were converted mostly to state farms, which at their peak in 1983 controlled 35% of the country's cattle and pastures, and for the most part these farms had little interest in converting forest to pasture. After 1983, the area in state farms in Nicaragua declined, as the Nicaraguan government began transferring lands to production cooperatives and individual farmers.[25] Large ranchers' fear of expropriation, however, continued until at least 1989 and this inhibited pasture expansion.

Another (and currently more relevant) land policy which has discouraged the conversion of forest to pasture has been the creation of national parks and other protected areas. Costa Rica first established its national park system in 1974 (Lehmann, 1991). The system expanded rapidly between 1974 and 1978 and has grown steadily ever since. Currently almost 25% of the national territory is in protected areas, of which more than two thirds is in forest (Peuker, 1992). Overall, the Costa Rican government has been quite successful in protecting forested area in national parks from land clearing, although it has had less success in protecting forest reserves (Jones, 1990). This, combined with the fact that there is no longer much

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[25] This process of privatization, which greatly accelerated after 1990 and culminated in the disappearance of the state farm sector, was in many instances accompanied by wide spread slaughter of cattle.

forest outside protected areas, is among the main reasons why deforestation rates have dropped precipitously in Costa Rica during the last five years.

The other Central American countries have also expanded the amount of land in protected areas over the last decade, with the total amount of land in protected areas in Central America going from 9 percent of the region's land in 1980 to 13 percent in 1990 (Herlihy, 1992). Most of this land is concentrated in six large protected areas of between 500,000 hectares and 1,500,000 hectares each: the Maya Biosphere in northern Petén in Guatemala, the Plátano River Biosphere in Honduras, the Bosawas and Indio-Maíz Reserves in Nicaragua, the Amistad National Park in Costa Rica, and the Darién National Park in Panama (Merlet et al, 1992).

Outside of Costa Rica, and to a lesser extent Panama, most national parks and other protected areas are subject to major encroachment problems (Boyer et al, 1980, Colchester and Lohman, 1993; Ortega, 1993; Valenzuela, 1994). In many cases the enabling legislation is incomplete and there are almost no resources available for enforcement. In addition, poverty levels in Guatemala, Honduras, and Nicaragua are much higher, implying that resource poor families have few better alternatives than squatting in protected areas. These areas' protected status may be a partial deterrent to pasture expansion there, but it is certainly not a complete deterrent.

The problems governments face in controlling access to protected areas have led some groups to propose using the military for this purpose; an idea generally supported by the armed forces themselves, who see it as an opportunity to obtain resources and public support at a time when they are under strong pressure to reduce

their budgets. The evidence regarding military intervention in protected areas, however, is mixed. On the one hand, military control over northern Peten prior to 1987, access to Darién Province in Panama prior to 1989, and access to parts of eastern Honduras in recent years succeeded in limiting land clearing in those areas and, in the case of Panama, the introduction of cattle. The Nicaraguan military also succeeded in removing most farmers from the agricultural frontier areas of Río San Juan during the military conflict in that country between 1983 and 1989. On the other hand, military control over forest areas in these countries has typically been associated with high levels of corruption, lumber extraction, and human rights abuses and may diminish public support for conservation policies, by associating them with the (generally unpopular) military forces.

In addition to protected areas, per se, there has also been growing interest in providing tenure rights for indigenous people or improving existing rights (Davis and Wali, 1993). It is argued that "Indian populations tend to be less destructive of natural resources than others groups in the region" (Herlihy, 1992); and while this may not always be true, it is the case that to date most indigenous groups in Central America have cleared little forest for pasture and are unlikely to do so in the near future (Godoy and Brokaw, 1994).

Panama is the country which has gone the farthest in formalizing indigenous land rights. Its Kuna Yala and Embera "comarcas" cover over 700,000 hectares, and have largely been able to avoid incursion by outside ranchers (Herlihy, 1992). In Costa Rica, indigenous reserves held some 278,000 hectares in the early 1980s. Small

areas in eastern Honduras have also been titled to indigenous communities. In Nicaragua, the regional autonomy and Indian land laws also recognize that indigenous people have certain territorial rights, although there have been problems with incursions by outsiders.

There have also been some initial attempts in Central America to create extractive reserves or forest reserves, in which specific communities or groups of individuals are given exclusive rights to extract wood or non-timber forest products from an area. This, it is hoped, will give these groups an incentive to protect the lands under their control from land clearing by outsiders.

During the 1970s, the Honduran government supported the creation of resin-tapping cooperatives in the pine forests by assigning them tracts of forest and given financial and technical support. Many of these cooperatives disappeared, however, when the price of resin plunged in the mid-1980s (Hernández-Mora, 1994).

Beginning in 1988, the Broadleaf Forest Project (PBL) in northern Honduras created ten "integrated management areas" (AMIs) of 1,000 to 5,000 hectares each in which groups of rural families were to develop forest management plans and be given exclusive rights to cut lumber, as well as receiving technical and social services. Because of disputes over rights to the forests, conflicts within the groups over various issues, and weak technical and financial assistance, however, these efforts were only partially successful and in the last few years have been largely discontinued (Hernández-Mora, 1994, Silviagro, 1994).

In the buffer zone of the Indio Maiz biological reserve in Rio San Juan, Nicaragua, since 1993 a group of retired military officers, former anti-government insurgents, and local farmers have received land, credit, and access to lumber markets in return for agreeing to abide by strict land use and forest management regulations (Didier, 1993). Over 5,500 square kilometers have also been set aside in the Uaxactun - Carmelita Multiple - use Reserve in Peten, Guatemala specifically for local harvesters of xate palm, chicle gum, and all spice (Heinzman and Rening, 1988; Nations, 1992b). In both the Nicaraguan and Guatemalan cases, however, it is still to early to evaluate the results of these efforts.[26]

Finally, the unique experience of Darien province in Panama is also worth mention. For years Darien has had restrictions on cattle, designed to avoid the spread of hoof and mouth disease from nearby Colombia. "Within 25 kilometers of the Colombian border no cattle raising is permitted. In the rest of Darien, cattle raising is permitted on a limited scale, but no cattle may be transported out of the province" (Ledec, 1992:177). Because of its interest in limiting the spread of hoof and mouth disease, the U.S. government has provided substantial resources to enforce these restrictions. Some forests have been cleared for pastures anyway, but overall the result has been a lower amount of forest cleared by each settler family in Darien than in most other agricultural frontier areas.[27]

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[26] For a well argued negative assessment of the prospects for extractive reserves in Central America see Edelman (1994).

[27] Due to lack of enforcement, however, a similar Nicaraguan government prohibition of extensive cattle ranching in the buffer zone of the Indio-Maiz buffer

LAND TAXATION

Theoretically, nationally - mandated municipal taxes with higher rates for pasture and crop lands than for forest could be a major incentive to limit forest clearing where cattle grazing is only marginally profitable. Similarly, land taxes could be used to discourage land speculation by raising the cost of using long-term land holding as a hedge against inflation or a source of capital gains, charging land owners for the costs of infrastructure improvement, and lowering the price of land (Strasma and Celis, 1992; Strasma et al, 1987).

Nevertheless, the experience to date has not been encouraging. Throughout Central America, not only have rural land tax rates been low (typically below 0.5 percent of assessed value), but governments have found it difficult to accurately access land values and no country indexes assessed values for inflation (Strasma and Celis, 1992). Land taxes require relatively complete and accurate catastral information, which does not exist in most Central American countries, particularly not in agricultural frontier areas. In fact, Skinner (1991, 1991b) argues persuasively that the administrative constraints on effective land tax administration are so severe in most developing countries that they should be largely discarded for this reason alone.

Costa Rica and Guatemala have traditionally had higher taxes for "idle" lands, which might have promoted deforestation were it not for the fact that tax rates and enforcement have been so low. On the other hand, Costa Rica has also exempted

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zone in Nueva Guinea and Rio San Juan has had little impact (Flores et al, 1994).

tree plantations and watershed protection areas from land taxation but this is equally unlikely to have affected ranchers' behavior for the same reason (Strasma and Celis, 1992). Costa Rican tax laws "contain provisions for automatically increasing assessments of properties whose value increases through public investment in roads and other infrastructure,..(but) the office charged with this responsibility was never established" (Edelman, 1992:251).

Perhaps with the recent strengthening of municipal governments in Central America resulting from national decentralization policies, these local governments may take greater interest in land taxes to improve their revenue base and may develop a greater capacity to accurately assess local land values.[28] Skinner himself acknowledges that local land taxes have been much more successful than national taxes. It will be difficult, however, to establish taxes high enough to significantly affect land use patterns without causing financial distress for cash poor farmers on the agricultural frontier.

THE IMPLICATIONS FOR POLICY

Improving land tenure security can reduce some incentives for deforestation. Nevertheless, policies which tolerate squatting on public lands and allow squatters

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[28] Nevertheless, a recent study by Hernández-Mora (1994) of the El Recreo community in Atlantida, Honduras found that municipal officials claimed to charge higher land taxes for land with perennial crops than for land with annual crops and no taxes for land with forests, but land owners were unaware of this distinction and complained that they were being forced to pay taxes on areas which they are not allowed to deforest and hence was "giving them nothing".

to obtain title for those lands are a major cause of deforestation. Government - induced settlement of agricultural frontier areas almost inevitably promotes forest clearing for pasture expansion. Protected areas, indigenous land rights, and restrictions on cattle in buffer zones of protected areas can be (and have been) effective in limiting deforestation, but only where there are sufficient resources and political resolve to enforce these policies and the local population is brought into the process. Agrarian reform programs can discourage investment in cattle raising and offer alternatives for obtaining land to poor rural families other than migrating to the agricultural frontier, but they can also favor deforestation if forest lands are subject to expropriation for being "under utilized". Land taxes which penalize deforestation could theoretically reduce land clearing, but are difficult to administer and are, for all practical purposes, still largely untested. Macro-economic policies which produce high and variable inflation rates, financial market policies which tolerate money laundering, and land purchases by governments and international agencies for above prevailing market prices favor rural land speculation, and thus, indirectly, forest clearing.

7. TECHNOLOGICAL CHANGE AND ENVIRONMENTAL DEGRADATION

Pasture researchers in Latin America have long argued that technological improvements in livestock production systems can reduce pressure on marginal lands on the agricultural frontier by making it possible to produce the same amount of

meat and milk on less land (Serrao and Toledo, 1993, 1992). This process is supposed to work through market mechanisms: As the efficiency of cattle production on existing pastures increases, the price of meat and milk will fall by more than the productivity gains and this will lower the incentive to put marginal lands into pasture.[29]

At the same time, many existing livestock systems in Central America are rapidly degrading the resource base on which they depend. This has major environmental consequences and could mean that more land is required to produce the same amount of meat and milk.

This section first examines the experience with technological change in Central American livestock and then the evidence regarding pasture degradation.

TECHNOLOGICAL CHANGE

The post-war cattle boom in Central America was accompanied by important advances in technology including wider use of improved stock and artificial insemination, introduction of new pastures such as African Star grass (Cyndodon plectostachyum), increased use of veterinary inputs, fertilizers and herbicides, and large investments in infrastructure such as fences, ponds, and wells. "The combined effects of better breeds, better pastures, and better animal care produced younger,

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[29] Improved livestock systems, if they were more labor intensive, could also theoretically diminish land clearing by limiting the amount of labor available for that activity; however, there is little empirical evidence available to assess whether this might really be likely to occur.

beefier, healthier animals for the packing plants" ... "From the moment of conception to the final fattening before slaughter, not a single stage of the cattle-raising process was left untouched as herd and pasture management adapted to the needs of the world market" (Williams, 1986:95).

Technological progress was especially notable in Costa Rica, where specialized meat and milk production with substantial input use became common. An average steer in Costa Rica's North Pacific gained 13 kilograms per month in the 1970s, compared to 9 in the 1940s, and the period required to bring a steer to slaughter fell from between 42 and 60 months in the 1940s to between 24 and 48 months in the 1970s (León, et al, 1982). Progress in milk production was sufficient for milk producers to improve their profitability during the 1970s despite falling real prices, thanks to better efficiency (Camacho, 1989).

In general, however, progress in improving weight gain, raising milk production, and reducing mortality was much greater than the advance in stocking rates, which was minimal (Alderman, 1973, Heckadon, 1984). With localized exceptions, most livestock systems continued to be extensive, with average stocking densities of only about one head of cattle per hectare (Ledec, 1992b).

More recently, there has been a certain amount of technological regression, particularly with regards to beef production. Between 1975 and 1990, the amount of meat produced annually per head of cattle fell in Guatemala, Honduras, and Nicaragua, and grew only moderately in Costa Rica and Panama. Average milk production per cow grew over 30 per cent in Costa Rica and Honduras, but fell

precipitously in Nicaragua and was constant in Guatemala and Panama (FAO, 1976, 1991). This stagnation is consistent with the general decline in profitability of livestock production during the period.

There is now sufficient technology available to double or perhaps even triple average stocking densities in Central America (Mercado, 1993). Even if this were to occur, however, it is unlikely that it would lead to a decline in deforestation. The experience of the last twenty years shows that pasture expansion in agricultural frontier areas can continue despite major declines in real beef and dairy prices. This is so because, as shown above, land speculation is often as important a factor in pasture expansion in these areas as the profitability of livestock itself, pastures are often the lowest cost land use which provides tenure security, and farmers in frontier areas typically have few viable production alternatives other than cattle.

Moreover, in the current context of increasing trade liberalization it is far from clear that changes in the efficiency of regional livestock production will affect prices, which are now determined mostly in the world market. von Amsberg (1994) has shown than when the demand for an agricultural product such as beef or milk is very elastic, as is now the case in Central America, technological changes which make livestock more profitable would unambiguously lead it to expand at the expense of forests.

A plausible argument can even be made that improved livestock technology applicable to areas with poor soils in the humid tropics is likely to increase deforestation, as it would make cattle raising in these areas more profitable. It is

often argued that by offering small farmers on the agricultural frontier a stable source of income, improved livestock (or agricultural) technologies could discourage them from selling their land and moving farther into the forest to clear new lands. Schneider (1994) has argued persuasively, however, that many of these farmers sell their land to ranchers not because the lands are degraded and are no longer productive but rather because large ranchers have a higher shadow price for the land than small farmers and thus are able to offer small farmers sums of money which seem quite attractive to them. Humphries came to similar conclusions based on field work around La Ceiba, Honduras (Sally Humphries, personal communication). If this argument is correct, improved livestock technology, rather than reducing land sales and migration by small farmers, is likely to increase it if large farmers have earlier access to that technology.

ENVIRONMENTAL DETERIORATION AND PASTURE DEGRADATION

At the same time as talk continues about the prospect of improving livestock technology in Central America, many cattle grazing areas in the region suffer from reduced pasture management and environmental degradation. Previous reference was made to the conversion of pasture to brush, wooded areas, and secondary forests. But even in many areas still in pasture, that pasture's quality has been greatly reduced, particularly in places with higher rainfall and steeper and less fertile soils.

A study in Boaco and Chontales in Nicaragua, the country's most important cattle region, found that although pasture area remained constant at 2.1 million

hectares between 1977 and 1987, due to the fall in pasture quality those 2.1 million hectares were equivalent to 1.2 million hectares of "good pasture" in 1977, but only 780,000 hectares of "good pasture" in 1987 (Hirvela et al, 1989). Another study of the Malacotoya watershed in Boaco in 1986 found that of the total area in pasture, 33.8% was in "degraded pasture with weeds" and 31.2% in "pasture and scrub forest". Less than 1% was in dense pasture with few weeds (Tremblay and Malenfont, 1992). Similarly, 32% of the pasture in nearby Nueva Guinea was said to be seriously degraded in 1992 (Carlor and de Kroes, 1994). At the national level, Holman estimates that due to the high presence of weeds, average real grass coverage in pasture areas in Nicaragua is currently less than 50% (1993).

Studies in Nicoya, Arenal-Tempisque, northern Alajuela, the central and south pacific, and the Atlantic Coast of Costa Rica all point to a deterioration in pasture quality during the 1980s (Escuela de Ciencias Agrarias, 1987, Fallas and Morera, 1993, Holman et al, 1992, Huising, 1993, Utting, 1992, Van der Weide, 1986). Severe pasture degradation has also been reported in Petén, Guatemala, Honduras, and Panama (AHT-APESA, 1992, Alderman, 1973, Boyer et al, 1980, Colchester and Lohman, 1993, Heckadon, 1984, Ledec, 1992b, Stonich, 1989).

Pasture degradation is the result of a combination of weed proliferation, soil compaction, constant burning of the land, erosion, lixiviation, nutrient depletion, and over-grazing (Ledec, 1992b, Place, 1981). These processes are caused by social and environmental factors, which are often difficult to distinguish and are mutually reenforcing. Among the social factors which have contributed to reduced pasture

management and over grazing are: the falling profitability of cattle raising, limited access to credit for cattle ranching, rising labor costs in Costa Rica, war-time labor scarcity in Nicaragua, physical insecurity due to military conflicts and banditry, and the concentration of cattle in areas near houses and towns to avoid cattle theft and kidnapping (Bastiaans and Clemens, 1986, Clerx et al, 1993, Holman et al, 1992, Jarquin and Videa, 1990, Matus et al, 1993, Namdar and Levard, 1984). Environmental degradation has made certain pastures more costly and less profitable to maintain, thereby reducing the attractiveness of doing so.

Purely environmental factors have also greatly reduced the carrying capacity of the pastures. Conversion from forest to pasture increases soil compaction, erosion, temperature variations and dry winds and decreases relative humidity, water infiltration, and organic matter in upper soil (Place, 1981). Four or five years after first burning the forest in the humid tropics, the levels of phosphorous drop significantly (Jarquin, 1990).

Much of the pasture land in Central America is "poorly adapted for cattle-grazing. Over grazing is common, and proper pasture management or field rotation is rarely practiced. Consequently pasture lands have problems of soil compaction and loss of capacity of infiltration and water storage, and obstruction of lateral drainage. During the rainy season, this causes floods in flatlands and promotes erosion in sloped areas...Whenever the pastures are extended on very steep slopes...furrows, ditches, sinkings and landslides are evident in the soil...With subsoils exposed and hardened, the soil develops a very low capacity to sustain nutrients for

pastures after a few years. But even when exhausted, the lands are continually burned and grazed...so that the soil is persistently impoverished until it often finally becomes worthless" (Thrupp, 1980:45-46).

Heckadon reports that in Panama, "a recurrent phenomenon of the expanding cattle frontier is the gradual decline of the carrying capacity of the pasture lands. Whereas in the initial years a producer can keep one head of cattle per hectare, after five or seven years he will need two or three hectares to keep the same animal" (1984:251). Likewise on the Atlantic Coast of Nicaragua, "the recuperation time of a new "India" pasture being grazed may be 45 to 55 days...Nevertheless, a pasture six to eight years old can take 70-90 days to reach the same height, without considering the decline in the total volume of forage due to the decrease over time in the number of plants per area and the lack of fronds" (Howard, 1988). In Petén and other northern departments in Guatemala, livestock productivity often plummets around seven to ten years after pasture establishment (Colchester and Lohman, 1993).

Soil erosion tends to be high in areas lacking vegetative coverage, and many pasture areas have large uncovered areas as a result of regular burning, overgrazing, soil compaction, and the characteristics of the grasses used. Jaragua and "india grass", two of the most common pastures in Central America, are particularly vulnerable to soil erosion since they grow in dispersed clusters (Carlor and deKroes, 1994). Even during the rainy season, a Jaragua pasture still leaves 40-50% of the land uncovered. Often, "the soil between the grass clusters is softened by the

trampling of animal hooves and then washed away by water runoff by the rains" (Boyer et al, 1980:21). In a survey of ranchers in Puriscal, Costa Rica in the late-1970s, over half of those sampled reported both erosion and landslides in their pastures, and only one fifth said that they had neither of these problems (Thrupp, 1980).

Weed encroachment, particularly by gramineas difficult to control with herbicides, is another problem (Colchester and Lohman, 1993, Jarquín, 1990). In the poor soils where many pastures are located, unless they are fertilized pasture production declines after a few years, less productive native gramineas replace the planted grasses, and weeds eventually dominate (Toledo and Navas, 1986; Paladines, 1978). Pasture compaction by animals and overgrazing accelerate this process.

In Costa Rica and Nicaragua, a particular problem has been the rapid expansion during the 1980s of "ratana" grass (Iscahemum ciliare), a grass with limited nutritional value, at the expense of more productive pastures (Morales, 1992; Pijnenburg and Martínez, 1992) Ratana was first introduced by ranchers, but later got out of control and began to aggressively invade new areas. This was said to have been the principal reason for an observed decline in per hectare milk production over a thirteen year period in 44 ranches studied in Rio Frio and Sonafluca in Northern Alajuela (Holman et al, 1992).

Reducing pasture degradation is important not only for increasing the productivity on existing pastures but also for reducing the incentive for "nutrient mining" (Schneider, 1994). There is evidence that ranchers often prefer to deforest

new areas to take advantage of their initially high fertility levels, rather than recovering recently abandoned pastures, which may have lower fertility and greater weed infestation (Federico Holman, personal communication). If cost effective techniques are found to avoid pasture degradation this could reduce the preference for clearing primary forest (although it would not eliminate other reasons for clearing that forest).

There is scattered evidence that some larger ranchers have begun to take measures to reduce pasture degradation, through the introduction of new pastures and better pasture management. In the Petén, for example, these ranchers have planted approximately 15,000 to 20,000 hectares of improved pastures in recent years (Kaimowitz, 1995). Such efforts, however, still seem to be relatively uncommon.

THE IMPLICATIONS FOR POLICY

Support for livestock research and extension is unlikely to significantly reduce deforestation in agricultural frontier areas, and could even increase it. There is a great need, however, to better understand the processes of pasture degradation in Central America, and technological change can reduce the environmental degradation associated with already existing pastures.

8. THE ROLE OF FORESTRY POLICY

Another view of why farmers have cleared forest land in Central America is that government policies have lowered the value of forest land and forest products, and hence the potential profitability of maintaining the land in forest (Kishor and Constantino, 1993, Stewart and Gibson, 1994, Stewart, 1992, World Bank, 1993). These authors argue that the use of log export bans, low public expenditure on forestry, restrictions on cutting timber, and cumbersome requirements for forestry management plans have discriminated against the forestry sector and made forestry less profitable compared to cattle raising and crop production.

Most forestry laws in the region traditionally gave the government total control over all trees, commercially planted or otherwise, and required a cutting permit, that might or might not be granted. This made plantation forestry risky and some times led farmers to rid themselves of their trees as soon as possible to avoid controls (Stewart, 1992). In Honduras the problem was even worse, since between 1973 and 1992 all trees were formally owned by the national government, which paid landowners only a small price for each tree harvested from their land (Walker et al, 1993).

All the governments have attempted to control deforestation by requiring permission from public forestry agencies to clear land. They have been universally unsuccessful, however, and in most countries more than half of all land clearing has occurred without government consent.

Stewart and Gibson estimate that if there were no policy distortions both management of native forests and forest plantations would currently yield higher returns per hectare of land than cattle in Costa Rica; and they imply that one simply has to remove these distortions and ranchers will stop deforesting and start planting trees (1994). Kishor and Constantino on the other hand, affirm that even without trade distortions cattle raising would still provide higher incomes than continuous management of natural forests, although they agree with Stewart and Gibson that forestry plantations would be more profitable than ranching (1993).

Several recent studies using net present value criteria have shown that secondary forest regeneration is probably already profitable in many of the more humid areas of Costa Rica if left for periods ranging from 15 to 40 years (Coseforma DGF-GTZ, 1993; Guillén, 1993; Herrera, 1990). The authors of these studies admit, however, that most existing secondary forests are the result of pasture or crop abandonment, rather than a conscious effort to produce forest products. This is consistent with a recent survey by Ortiz (1994) of 32 ranchers in Northern Costa Rica who own secondary forest areas. In this survey, none of the ranchers questioned stated that they had allowed their pastures to revert to secondary forest because of the value of the wood the land would produce.[30] Over half the ranchers, however, noted that despite the fact that the land had been "abandoned", it continued to grow in value because of increases in land prices and wood production. One third of the

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[30] About one third said they had abandoned the pasture because it was unprofitable, half mentioned that the land was not suited for pasture, and 15 percent said they planned to put the land to an alternative use.

ranchers interviewed by Ortiz expected to allow all of their secondary forest to regenerate indefinitely, 30% said they would leave part, and 25% expected to clear all of it.

The basic argument that policies which lower the value of timber discourage reforestation and secondary forest regeneration is undoubtedly valid. Nevertheless, in addition to comparing the net present value of cattle versus forestry, policy analysts must also consider the other reasons why landowners have preferred cattle over other investment options such as limited labor requirements, low supervision costs, ease of sale on short notice, and the advantages of cattle as a way to demonstrate land possession. Different types of forestry management have some of these attributes, but not necessarily all of them. Probably the only group of ranchers for which net present value per hectare is the overriding factor in defining land use are the investment ranchers. This implies that improvements in timber prices alone are unlikely to eliminate all conversion of forest to pasture, although they may reduce it.

There has also been a confusion in much of the literature referring to natural forest management between incentives which will promote sustainable management of natural forests, secondary forest regrowth, and new forest plantations and those that may encourage rapid extraction of valuable timber, thus leaving a forest of greatly diminished commercial valuable which would be subject to clearing. von Amsberg has shown unambiguously that a higher timber price, ceteris paribus, lead to a smaller area of biologically mature and previously unclogged forests. "This

results suggests that measures [such as export restrictions in the timber producing countries] to reduce the producer price for timber would be suitable as a second best policy to reduce the pressure on unmanaged forest frontiers" (von Amsberg, 1994: i). And while it is true that high forest product prices would be necessary to induce land owners to manage existing forests sustainably, there are still very few cases in the world of sustainably managed tropical broad leaf forests. Policies which favor reforestation and secondary forest regeneration by increasing timber prices and giving individual clear property rights over timber may at the same time encourage land clearing of primary forests.

In recent years, Costa Rica has spent large sums of money on fiscal incentives and subsidies for reforestation, at a rather high cost per hectare reforested, and other countries are considering greatly increasing their own incentives (Segura, 1992). Typically, these subsidies cover a large percentage of the costs of planting new trees. Even greater environmental services could be obtained, however, from promoting secondary forest regeneration through research, marketing support, credit facilities, and small cash payments. Secondary forests are more biologically diverse forests and often have lower levels of erosion than tree plantations. They are also earier to manage, respond well to silvicultural treatments, and many of the trees for timber have become attractive commercial (G. Budowski, personal communication). This alternative would probably be much cheaper, per hectare, than current reforestation incentives, since farmers would only need to be paid sums similar to or less than the small amounts of net income generated by livestock per hectare, particularly if these

payments were accompanied by guarantees of tenure security. These efforts would only accelerate pre-existing trends, and are compatible with farmers objectives and resource endowments. And, unless such measures are taken, much of the current brush and secondary forest may be cleared before reaching maturity.[31]

THE IMPLICATIONS FOR POLICY

Policies which increase the price of forest products and provide clear individual property rights for tree ownership simultaneously favor reforestation, secondary forest regeneration, and more rapid lumber extraction from existing forests. The relative importance of these effects will vary in each case, and little is known about the magnitude of likely policy responses. Past government efforts to regulate forest management have largely failed and the institutional capacity for such regulation in Central America is weak. One efficient way to increase forest - related environmental services may be to provide incentives to ensure that existing secondary forests are allowed to grow to maturity and to stimulate more ranchers to "abandon" marginal forest lands. This could be used along with other incentives such as technical and market information, access to long-term credit, and payments for carbon sequestration that could be made available to the forestry industry as a whole.

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[31] Admittedly, however, not all lands can quickly revert to commercial attractive secondary forests. This depends on the availability of seeds, soil and climate conditions, and other factors (G. Budowski, personal communication). Moreover, this argument in favor of incentives for secondary forests does not imply that incentives for reforestation or management of existing forests is never appropriate.

9. POLITICAL INSTABILITY AND VIOLENCE

Instability and violence have discouraged investment in cattle and limiting pasture expansion in Nicaragua and parts of northern Guatemala at different times, and expanded the cattle herds of Costa Rica and Honduras, as cattle was moved from Nicaragua to those countries. This section looks briefly at this issue.

THE ROLE OF VIOLENCE IN NICARAGUA

The Nicaraguan civil war during the late 1970s reduced the national cattle herd by between 25% and 35% as a result of direct war losses, indiscriminate slaughter, and live cattle exports to Costa Rica and Honduras (Cajina, 1986). The final 1979 insurrection itself led to the loss of an estimated 100,000 head of cattle (Biondi-Morra, 1990). Beef exports jumped 30% in 1978 and an additional 35% in 1979 as large ranchers sought to liquidate their assets, and this further reduced the cattle stock. Honduran statistics show an increase of 200,000 cattle slaughtered in 1979 over the previous year and a rise of 372,000 head compared to 1977 which can only be explained by wide scale contraband imports of cattle. Similarly, Solera-Ruiz estimated that unrecorded cattle exports from Nicaragua to Costa Rica were between 48,000 and 65,000 head in 1978 (1981).

After 1983, violence once again discouraged cattle production as a result of an upsurge in anti-government violence. Between 1983 and 1989, expansion of the agricultural frontier came to a virtual standstill, and tens of thousands of families fled

or were forcibly resettled from frontier areas (Maldidier, 1993, Prado et al, 1991). As a result, by 1988, the Nicaraguan government estimated that 300,000 hectares of farm land, five percent of all land in farms, had been abandoned due to the war (Gutierrez, 1988). Perhaps as much as 50% to 60% of the national cattle herd was located in areas affected by the war (Jarquín and Videa, 1990).[32]

The direct losses to the livestock sector provoked by the military conflict between 1980 and 1985 have been calculated at 5.7 million dollars (Biondi-Morra, 1990). There were also large indirect losses as a result of the heightened risk of investment, military - related labor shortages, over-grazing in areas close to the towns, and loss of access to pastures in humid areas used to feed livestock during the dry season. On the other hand, the abandonment of huge agricultural frontier areas also brought about an impressive regrowth of secondary forest on former crop and pasture lands.

The formal end of the military conflict in 1990 brought with it the return of thousands of displaced families to the agricultural frontier, but has not meant a complete end to rural violence. Armed bands took advantage of the chaotic situation after the 1990 elections to steal cattle on a large scale, particularly from state farms and cooperatives (Clerx et al, 1993). Land markets in the interior became more active in 1990 and 1991 after the war ended, but then became virtually paralyzed again, due to continued problems of insecurity. Frequent assaults and kidnappings

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[32] Almost all of the 25 ranchers interviewed recently by Rosario Ambrogio in Boaco, Chontales, and Nueva Guinea reported having lost cattle and having to abandon pastures during the 1980s due to the military conflicts.

and ranchers' inability to take effective possession of lands they purchase have continued to make it unappealing to buy land or locate cattle in inaccessible areas (Matus et al, 1993; Siles and Hernandez, 1994; Stanfield, 1992).

THE ROLE OF VIOLENCE IN GUATEMALA

Violence in Guatemala also had a major impact on the cattle sector, particularly in the Peten and Alta Verapaz. After 1980, growing violence in the Peten associated with Guatemala's internal military conflict substantially reduced the number of ranchers interested in purchasing land from the government and led many ranchers to abandon their lands or to sell them for low prices. Violence was particularly heavy between La Libertad and the Usumacinta river and near Poptun and Dolores. This situation continued until 1987 or 1988, after which the level of violence declined markedly. Since that time guerilla organizations have continued to extort contributions from ranchers in many areas, but these have rarely been high enough to affect their profit margins.

In Alta Verapaz, the northern cattle raising municipalities of Chisec and Cobán were practically abandoned after 1982 due to the military conflicts and only recently have ranchers returned and begun to invest again. In contrast, ranchers in municipalities further east such as Chahal and Fray Bartolomé de las Casas which were relatively peaceful during the 1980s currently face serious problems of theft, kidnapping, and extortion by anti-government insurgents.

Had it not been for the military conflict in the 1980s deforestation in the Peten and Alta Verapaz would have probably been much higher than it was. Since the levels of violence have subsided in the Petén investments in cattle and land prices have increased rapidly. Cattle grazing in Northern Alta Verapaz, on the other hand has been slow to recover, due to poor maintenance of the Northern Transversal Strip highway constructed in the late 1970s, especially poor soils and high rainfall, and persistent security problems.

THE IMPLICATIONS FOR POLICY

No one would suggest that military conflicts and banditry should be encouraged in order to reduce deforestation. These factors must be considered, however, when analyzing trends in deforestation rates, and policy makers must be aware that, unless no measures are taken to prevent it, less violence in agricultural frontier areas is likely to lead to rapid deforestation.

10. CONCLUSIONS AND POLICY RECOMMENDATIONS

While deforestation continues to be a very major problem in Central America, it declined significantly in the late 1980s. Unfavorable market conditions, reduced access to credit, higher interest rates, expansion of protected areas, and military conflicts were all important in this decline. And while there is little hard evidence on the subject, deforestation by entrepreneurs and large ranchers living outside

agricultural frontier areas probably decreased more as a result of the changes in market conditions and credit than did deforestation by ranchers living in agricultural frontier areas.

The forest clearing for pasture expansion which has occurred over the last fifteen years can largely be attributed to attempts to claim public lands and improve land tenure security, declining transportation costs resulting from public road construction, government colonization programs, and the specific characteristics of cattle raising which make it quite attractive to farmers with land but little capital, labor, management skills, and access to markets.

This pattern, in fact, is quite consistent with recent experience in the Brazilian Amazon (Hecht, 1992; Moran, 1993). There also, deforestation rates have come down since 1987 as a result of the termination of credit and fiscal subsidies, economic recession, and other policies. But after initially falling, deforestation rates in Brazil may have now reached a plateau, with most of the land clearing being carried out by small and medium sized farmers who are less affected by changes in government subsidies or the price of livestock products.

This implies that to bring deforestation rates down farther, whether it be in Central America or other areas of tropical Latin America, will require going beyond the elimination of subsidized public credit and fiscal incentives for cattle ranching, although such measures are appropriate. Given what has been shown about the limited responsive of forest clearing to changes in livestock product prices, trying to artificially lower the prices of livestock products through consumer boycotts or other

measures is also unlikely to do the job. Stimulating improved livestock technology and eliminating policies which depress timber prices have a number of virtues in their own right, but will probably not significantly reduce the clearing of natural forest, and could even increase it.

To further reduce deforestation in Central America below its current level will require directly addressing the issues of road construction, land tenure, land use regulation. Road construction and improvement in most forest areas should be discouraged. Governments must decide which public lands they do not want to pass into private hands and strictly enforce those decisions, and the incentives must be eliminated for clearing forests to claim land and improve tenure security. These governments cannot be realistically expected to maintain control over all current public lands, but they should attempt to keep control of prioritized areas. Protected areas must really be protected, while at the same time establishing the best possible relations with neighboring communities. Indigenous land rights should be expanded. Continued experimentation is also necessary to find common property regimes appropriate for forest management by non-indigenous people. Cattle ranching should be restricted in certain buffer zones around protected areas. Land taxes designed to discourage forest clearing could be tried through pilot projects.

Forestry policy in general merits more attention and resources than it has received in the past. If land holders are ever to seriously consider leaving more of their land in forest they will need more information on market and technical opportunities, less cumbersome forest management regulations, access to credit, and

in some instances transfer payments which reflect the environmental services provided by forests which are not received by individual owners.

Many of these policies involve a greater role for government or for non-governmental agencies which carry out public functions, and in some cases will demand the hiring of additional government personnel. In the current circumstances where the armed forces of several Central American countries are seeking new roles in post - war societies there may be some temptation to assign them to enforce property rights and guard protected areas. This may be appropriate in certain cases, but brings with it serious risks which must be considered, and should generally be viewed as an option of last resort.

Two final policy areas which merit greater attention are research and extension efforts designed to reduce pasture degradation and incentives for promoting secondary forest regeneration and sustainable utilization. Unlike the Amazon, there has been almost no research on the serious problems of pasture degradation in Central America, and efforts to reduce such degradation could greatly diminish environmental deterioration in large areas of the region already in pastures.

Much more needs to be understood about the economic, social, and biological aspects of secondary forest regeneration. But it would appear that, given the fact that ranchers have already begun to abandon large areas of marginal pastures, there may be great opportunities to turn these areas into permanent or semi-permanent "set-asides" at limited cost. This could offer significant benefits with respect to

carbon sequestration, soil and water protection, biodiversity, and the availability of forest products.

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