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UPLAND-LOWLAND PRODUCTION LINKAGES AND LAND DEGRADATION IN BOLIVIA*

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1. INTRODUCTION

As anthropologists have become more explicitly concerned with the "political ecology" of production (e.g., Hjort 1982; Schmink and Wood 1987; Wolf 1972), it has become apparent that the social and economic relations that define the conditions of production play a central role in how people use natural resources. Indeed, they define which critical natural resources to control in a particular time and place, as well as who will have access to those resources and under what conditions. When access to critical natural resources is restricted so that people become relatively or absolutely poorer, for example, people tend to become more extensive in their use of land, and to use land more destructively, deforesting larger areas in tropical lowlands and doing less to maintain soil fertility generally (Collins 1986, 1987). By the same token, when privileged interests are granted access to land on concessionary terms, they frequently are encouraged to be profligate resource users (Bakx 1987).

The same policies and practices that give land to the wealthy on concessionary terms are responsible for the continuing impoverishment of the poor, because they institutionalize inequitable access to natural resources. Thus, the crucial issue underlying environmental destruction in Latin America is the gross inequity in access to resources. Conservation and development efforts that do not address this issue will be at best palliatives, and may have the long-term impact of intensifying land degradation and impoverishment (Painter 1990).

Studying and understanding the social relations that drive processes of impoverishment and accumulation, and shape patterns of land use, raises a methodological issue. Researchers and planners frequently have difficulty identifying a unit of analysis or action that defines meaningful boundaries around their efforts, and that continues to encompass critical areas and relationships, because the social relations that must be comprehended cover wide and environmentally heterogeneous geographic areas, and do not necessarily involve face-to-face interaction.

An outstanding example of the difficulty, and the importance of overcoming it, may be found in the relationships that drive land degradation in the Andean nations of South America. Since pre-Hispanic times, sustaining production in the Andean region has depended on maintaining linkages between upland and lowland areas. The Inca state and its predecessors made control of vertically defined ecological zones a matter of state policy. In today's terms, it was a national security issue, for the legitimacy of the state depended on its ability to guarantee access to the diverse goods needed to sustain human populations. Conquest by Europeans marked the beginning of a continuing reorganization of production in response to the demands of international markets. The role of the state under the new order was to facilitate the extraction of commodities in demand at a particular time, and reconcile the conflicting claims that interests tied to different productive activities would make on labor and natural resources. Responsibility for maintaining the vertical production linkages necessary for the reproduction of peasantry on which the extractive structure depended fell to local kin and community groups.

At the same time, however, these were required to give up their best lands and provide the labor necessary for the functioning of the export economy.

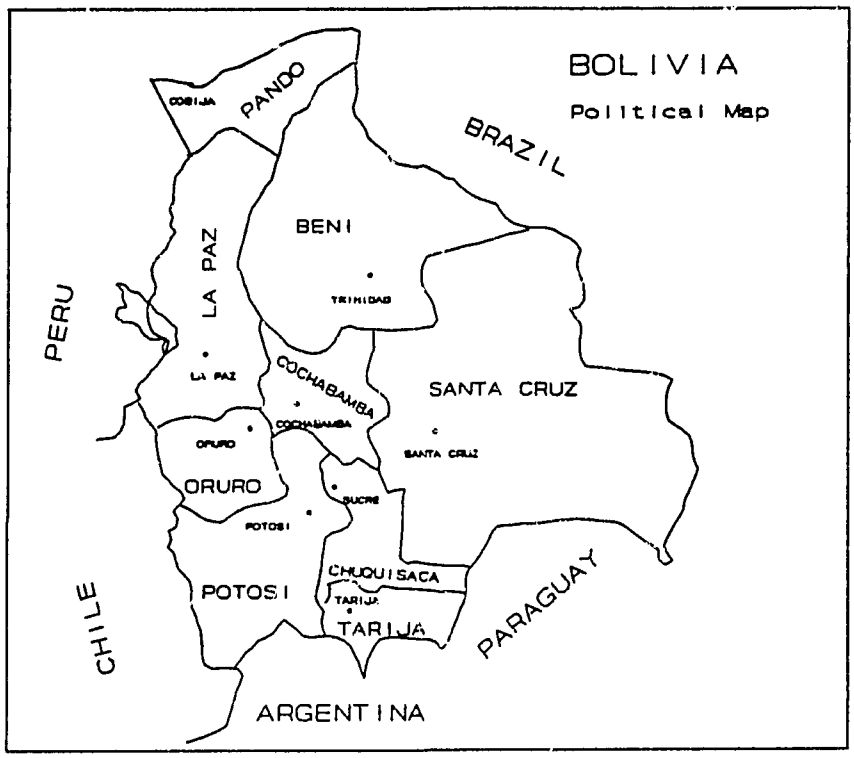
Over the years the contradictory pressures exerted by the export economy have undercut the basis of vertically integrated production, and established downwardly spiraling cycles of economic underdevelopment and environmental destruction. The responses to these cycles at all levels—rural households, commercial enterprises, state development policy, and development models promoted by international donor agencies—has been to seek out new lands to bring into production. The social and economic problems afflicting areas already being utilized have remained unaddressed. The result has been to perpetuate the cycles of economic underdevelopment and environmental destruction, and reproduce them in new areas.

The semiarid upland valleys of central Bolivia have suffered a long-term process of economic stagnation and underdevelopment, which has resulted in severe land degradation, because of the relationships of unequal exchange established with the export mining economy in the colonial period. A series of events in the twentieth century have accelerated the process and intensified its impacts on the land. As a result, most of the rural population depends on activities off the farm for a major and growing portion of its income, a situation that itself intensifies a mutually reinforcing relationship between impoverishment and land degradation. One aspect of this situation is widespread involvement in agricultural settlement of lowland areas, including northern Santa Cruz department and the Chapare region of Cochabamba department.

The sharpening of the problems of impoverishment and land degradation in upland areas coincided with a boom in the international demand for cocaine. In the case of the Chapare, poor farmers desperate to find a crop they could be reasonably sure of being able to sell came together with entrepreneurs interested in responding to the opportunities offered by expanding cocaine consumption in the U.S. and Europe. As a result, smallholder settlement based on the production of coca leaf destined for transformation into cocaine expanded rapidly in the Chapare, beginning in the late 1970s and running through much of the 1980s.

Settlement of the Chapare raises a number of issues related to the impact of settlement in humid tropical areas. The crucial problem over the long term, however, is that important elements of the social relations that resulted in the impoverishment of families in upland areas, and drove them to degrade farmland there, have been reproduced in the Chapare. Thus, it is probable that the cycles of impoverishment and land degradation will be repeated there as well.

Map 1



2. UNDERDEVELOPMENT AND LAND DEGRADATION IN UPLAND VALLEYS

Economic stagnation of the agricultural economy of Cochabamba's upland valleys was a development problem that dated from the colonial period of Bolivian history and periodically became a source of crisis. Agriculture has been closely tied to the mining industry, and the living conditions of rural dwellers have historically been affected by two major factors: (1) periodic droughts, which often caused crop failures in all areas not under irrigation, and eliminated the possibility of earning income through the sale of agricultural products for most families; and (2) fluctuations in international ore prices, which affected the amount of food and labor exported from Cochabamba to the mining centers. Over time the terms of trade between the Cochabamba's agricultural economy and the mining centers tended to decline, so that the export of workers to the mining centers became increasingly important. Of course, this intensified the region's vulnerability to the ebb and flow of the international mining economy, as Cochabamba supplied workers to the mines during periods of expansion, and reabsorbed them into the agricultural economy in periods of contraction (Dandler 1984, Harris and Albó 1984:36-54).

As the colonial economy evolved, the role of the agricultural areas was to supply mining and administrative centers with food and fiber. Smallholding farmers frequently undercut large estates in this enterprise, because they did not attach a value to their own labor, and could sell

their produce at prices the large estates could not match if they were to be profitable. In fact, large estates could only count on making money in drought years, when smallholders were obliged to consume most of what they grew and had little left to sell. Because their landholdings were small and located in the least favorable areas for agriculture, however, many smallholders could not support themselves from farming, despite the fact that they dominated the markets for agricultural products in most years. Smallholding farmers became heavily dependent on off-farm sources of income early in Bolivian history. In the eighteenth century craft industries grew in many areas of Cochabamba, including textiles, pottery, and gunpowder in the Valle Alto, located to the southeast of the city of Cochabamba, and *charango* production further south in Aiquile, capital of Cochabamba's Campero province. Similarly, by the end of the eighteenth century, smallholders dominated the production and sale of bread in the city of Cochabamba, undercutting and eventually eliminating the established baker's guild (Larson 1988:202-205).

In the late eighteenth century, Intendent Francisco Viedma proposed constructing a road linking the city of Cochabamba with the Chapare and promoting coca cultivation there as a way of infusing new life into the moribund regional economy. Although it was not built because of opposition from other regional interests, exploitation of the tropical lowlands as a way to stimulate upland economic growth was an idea that anticipated modern development strategies by 200 years (Larson 1988:253-258).

During the twentieth century two events accelerated the impoverishment of rural Cochabamba; the completion of the railroad link between Cochabamba and Oruro, in 1917, and the implementation of the agrarian reform, in 1953. The rail network, by connecting these cities with the Pacific Ocean ports (Mollendo and Arica), opened them as markets to such imported goods as textiles and housewares. The regional craft industries, which had previously provided these goods, were unable to compete effectively with imported manufactured goods, so large numbers of people could no longer supplement agricultural production through work at home, and entered the migratory wage labor force.

The implementation of the agrarian reform in the high valleys of Cochabamba and neighboring departments, in the first place, redistributing land more systematically in dryland areas than in irrigated bottom land, left the most productive land highly concentrated in the hands of few people. Second, with its focus on land redistribution, the agrarian reform did little to improve the productivity of agricultural labor in upland areas. Although institutions such as *sindicatos*, cooperatives, and producer associations have all attracted the interest of the national government and donor agencies, the real investments have supported export production—mining in the highlands and valleys and commercial agriculture in Santa Cruz, while investments in upland agriculture and associated improvements in market conditions, infrastructure, and the like have been relatively insignificant (e.g., Gill 1987; Frederick 1977; Heath 1969).[1] Thus, the

[1] For example, following short-term declines in food production resulting from the disruptions of the revolution and land expropriation under the agrarian reform, production of most basic foodstuffs rose steadily between 1955 and 1960. However, the value of agricultural

development investment that accompanied the reform actually exacerbated the unfavorable terms of trade that the agricultural valleys of Cochabamba and neighboring departments had been experiencing for some time with the export economy. Third, as the formal barriers to access to schools and health services declined following the 1952 revolution, the subsistence requirements of rural dwellers rose, for they were obliged to contribute a significant portion of the costs of these services. These factors compelled people to enter the growing flow of population seeking income off the farm. By the late 1970s, 90 percent of the families in many parts of rural central and southern Bolivia earned more than half their income through off-farm sources (e.g., USAID/MACA 1981; Deere and Wasserstrom 1980).

Climatic adversity and changes in international commodity markets during the 1980s accelerated the processes of impoverishment and environmental destruction driving migration from upland areas. A severe drought that began in 1983 and has not, in fact, abated in some areas, made life in their home areas impossible for many rural Bolivians. Northern Potosí was particularly hard-hit, as may be seen by the numerous families from that area in the streets of cities such as Cochabamba and La Paz, begging, selling lemons, and seeking some way to survive2. The drought pushed large numbers of smallholders throughout central and southern Bolivia "over the edge" in terms of their ability to earn a living through agriculture; thousands of families have left their homes permanently, and thousands more have either begun to migrate seasonally or increased the amount of time they spend away from home in search of employment.

Ironically, in some cases drought relief efforts have themselves increased the pressures on people to migrate. In Mizque, for example, many farmers received agricultural credit under the *Crédito Agropecuario de Emergencia* (CAE) program, sponsored by USAID/Bolivia, with participation of P.L. 480 and some *Instituciones Crediticias Intermediarias* (ICIs). The credit program was intended to speed the recovery of rural families affected by the drought by easing access to seeds, inputs, and improvements for their lands. Unfortunately, in many areas, such as Mizque, the drought lasted longer than the CAE program. Farmers had to repay their loans even though the drought had not ended harvests were still subnormal. In order to repay, many families sold livestock, farm implements, and even tried to sell or give their land to the financial institution, efforts that were generally inadequate. When USAID/Bolivia sought money for the

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production, calculated as part of Bolivia's Gross Domestic Product, declined from $113.1 million, in 1952, to $112.2 million, in 1958. Farmers worked harder and produced more, but received less. Furthermore, the economic crisis of the 1950s, and the stabilization program it triggered, led to heavy Bolivian dependence on foreign assistance. In 1959, for example, $10 million of the $32 million received by the Bolivian government in revenue collections was from counterpart funds. Only 12 percent of U.S. financial assistance to Bolivia went to agriculture, and only a small portion of this was targeted to benefit smallholding farmers in upland areas. In fact, the U.S. spent more between 1954 and 1957 ($56.6 million) to finance imports of surplus agricultural commodities to Bolivia than it did between 1952 and 1972 ($40 million) to support agricultural development (Frederick 1977:40, 46, 261-262).

credit component of its project to provide farmers growing coca leaf, it began to pressure the financial institutions involved in the CAE program to collect the outstanding loans and return the money to P.L. 480. Naturally, the financial institutions increased the pressure on farmers, who responded to the increased cash demand by migrating to the Chapare to earn money. Sometimes, the loan program was responsible for families who had not previously migrated beginning to seek employment in the Chapare (Cuba 1989).

In 1985, a second financial disaster struck the poorest sectors of Bolivian society, as international tin prices collapsed when the London Metal Exchange terminated trading. The result of an unfavorable shift in exchange rates and the accumulated debts of the International Tin Council, the event brought ruin to Bolivia's principal legal export industry. Between August 1985 and August 1986 some 27,000 mine workers lost their jobs. The *Banco Central de Bolivia* estimated the unemployment rate to be 20 percent by the end of 1985, largely because of the layoff of mineworkers, and, according to the *Central Obrera Boliviana* (COB), the figure approached 30 percent by the end of 1986 (Crabtree et al. 1987:20). The impact of the mining collapse on families not directly employed by the mining industry—but dependent on it—has never been measured. Many families migrated to urban areas, particularly Cochabamba and La Paz, and when they were unable to find work in the city, many went to the Chapare. Others went directly to tropical lowland settlement areas in Pando and Beni departments, as well as to the Chapare region.[2] For many, the Chapare was the destination of choice because coca leaf production offered an immediate source of wage labor.

These events took place in the context of general financial collapse, a collapse closely related to Bolivia's inability to continue payments on its substantial foreign debt, most of which was incurred during the 1970s under the Banzer regime. In addition, in 1983 the Siles government embarked on an ill-conceived attempt to unlink the exchange rate of the Bolivian peso from the U.S. dollar. The effect of this *desdolarización* on the already weakened Bolivian economy was a disastrous annual inflation rate that exceeded 14,000 percent at its peak in 1984. Even middle-class salaries evaporated, and only those with access to dollars enjoyed any protection. Lacking alternatives, many people turned to participation in producing or processing coca leaf.

In response to the hyperinflation, the Bolivian government of President Paz Estenssoro implemented an economic stabilization program that resembled in many respects the one implemented by the Siles government in 1957 (Dunkerly and Morales 1986; Urioste 1989). A major impact in rural areas was to accelerate economic decline. In Aiquile and Mizque provinces of Cochabamba department, a substantial portion of whose rural population depends on wage labor in the Chapare, overall potato prices declined by 9 percent, while the price of the chemical inputs required for commercial potato production increased by 100 percent during 1988-89. The price of seed potatoes, which is the major cash crop for smallholding families in

[2] Not all of the lowland settlement areas are agricultural. For example, most of the ex-miners who went to Pando are involved in gold mining cooperatives.

many upland areas of these and neighboring provinces, declined by 20 percent during the same period. In the *Valle Alto* of Cochabamba, which has long been a major source of Chapare settlers and laborers, the cost paid by farmers to transport agricultural produce increased by 33 percent, input costs went up by 15 percent, and the cost of dollars (needed to secure the inputs) increased by 160 percent, between 1987 and 1989. Farmer earnings associated with the production of a high-value potato variety declined from $1000 per hectare to $650 per hectare (Healy 1991).

Such economic hardship manifests itself in the ways rural families use land. Two of the most apparent results are deforestation, and the growth in importance of goat and other livestock production. Deforestation results from encroachment of individually held farm land onto forest and brushlands that previously had belonged to the community. Other factors drive it. For example, the decline in rural incomes has resulted in growth in the number of people involved in longstanding rural industries of the area, the brewing of corn beer, or *chicha*, and brickmaking, industries that consume large amounts of firewood (Perez 1991a).

Land scarcity also contributes to deforestation. A recent study contracted by the *Programa de Desarrollo Alternativo Regional* found that 63 percent of 360 "household heads" interviewed in the provinces of Campero and Mizque, in Cochabamba department, acknowledged having cleared forest in order to gain access to arable land (CEFOIN 1990). Land scarcity is commonly attributed to population growth, but the population in the area has remained relatively stable, with growth being offset by outmigration. Land scarcity seems to be more a product of declining productivity, resulting from the labor scarcity caused by reliance on off-farm employment and drought. Families require more land to grow the same amount of produce, and parents hold on to land longer before allowing offspring to inherit. This results in increasingly scarce farmland for newly formed households, and generates pressure on communities to allocate forest and grazing lands, which had been held in common, for use as cropland by individual families (Gisbert et al. 1991; Gisbert and Quitón 1991).

Finally, labor scarcity generated by high rates of outmigration contributes directly to deforestation. Rural women in dryland areas of Campero and Mizque provinces spend two or three hours a day gathering water, as much as four hours a day in food preparation, and two or three hours a day gathering firewood. Woman manage these domestic chores together with agricultural production and livestock management. With such demands on their time, women must relinquish past strategies to conserve fuelwood resources by spreading demand over a larger area, and instead forage for wood as near to home as possible. The result is an ever-widening deforested area around each house (Gisbert et al. 1991; Gisbert and Quitón 1991).

Environmental problems resulting from livestock management practices are interrelated with those of deforestation. The culturally defined norm for livestock ownership is that large livestock, primarily cattle, are owned by men, while small animals, among which the goat is most important, are owned by women. Goats are usually allowed to roam freely in the vicinity of where people live, and are the most numerous and visible livestock in the area. Considerable

environmental damage is attributed to them, resulting from the impact of their browsing on trees and shrubs in the semiarid environment and the paths they create on the steep hillsides.

In the face of widespread male out-migration, women also assume full responsibility for the care of cattle. In the context of the other chores that fall to them, care of the cattle is a burdensome addition, especially where cattle are kept in lands, called *monte*, that belong to the community or the local peasant union (*sindicato*), to which families have use rights, which are often located at some distance from where the families who use them live.[3]

The problems of impoverishment and land degradation come together around livestock in several ways. Because of the labor scarcity resulting from the high rates of male out-migration, livestock management practices deteriorate. In the case of cattle, labor scarcity makes it difficult for women to make long walks to *monte* areas as often as they should. Salt licks are not maintained; the condition of the cattle is not closely monitored; and they are not always moved as soon as they should be when grass and forage begin to deteriorate in a particular area. Similarly, goats are allowed to roam relatively freely in the vicinity of the home, with little control over their movements, which often depletes grass resources. The destruction associated with their browsing, compounded with that associated with women's wood gathering, severely degrade the immediate surroundings where people live. Also, the uncontrolled movement, combined with the labor scarcity, means that much of the manure produced by the goats goes unutilized, even though it is one of the resources for which goats are valued, and crops are denied a good fertilizer.

Two factors compound the deterioration of livestock management. One is the encroachment of agriculture onto land that had been reserved as community forest or pasture and forage areas. The conversion of land to a use that had been regarded as inappropriate, and the greater intensity of use of the remaining pastureland by animals are both sources of degradation. In addition, the number of livestock making demands on the land is growing as an outcome of impoverishment and growing dependence on off-farm income. The scanty statistical data available on the area show a steady increase in the number of livestock through the 1970s (e.g., CIDRE 1987:211). Farmer responses in interviews state that this trend continued and accelerated during the 1980s, in response to several factors.[4] In the absence of rural financial institutions, livestock is the only form of savings available to families when cash earnings are not totally consumed in meeting immediate needs. The animals and their products assume greater importance in the context of the frequent crop failures experienced as a result of the prolonged drought of the 1980s.

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[3] These are the same areas, discussed above, that are being converted to agricultural use as a result of land pressure.

[4] Recent research (e.g., CEFOIN 1990) has provided quantitative documentation of current herd sizes and composition in different areas of Campero and Mizque, but there is no reliable quantitative information on changes in the numbers and kinds of animals during the 1980s.

The combination of more animals being maintained on smaller pasture and forage areas has begun to generate new types of human pressure on the environment. For example, in communities where livestock are maintained in *monte* areas, farmers report a marked increase in the last two to three years of attacks on farm animals by the Andean puma. This predator had succeeded in living relatively invisibly in the *monte* areas for many years, but encroachment by people and animals has reduced its range and destroyed habitats on which its normal prey depends. Although relatively rare, pumas are now coming under a double pressure as the incidents of livestock killing has piqued farmer interest in hunting the cats down and killing them in order to protect their animals.

3. PATTERNS OF MIGRATION AND SETTLEMENT

3.1. Settlers in the Chapare

Migration is a response to the impoverishment and land degradation afflicting upland areas such as Campero and Mizque provinces, and the labor scarcity migration provokes perpetuates the mutually reinforcing relationship between the two processes. The most common rural destination for migrants from much of central Bolivia during the 1980s and early 1990s has been the Chapare (Blanes 1984; Flores and Blanes 1984; Painter and Bedoya 1991; Perez 1991b). The Chapare is a major source of coca leaf for cocaine production, but migration out of central Bolivia began well before the international boom in cocaine demand, and a number of migratory destinations have been and continue to be important. Bolivian cities, particularly La Paz, Cochabamba, and Santa Cruz, have been the largest overall recipients of people from rural areas (Perez 1991b). Similarly, migration to provide agricultural labor in Argentina (e.g., Whiteford 1981), unskilled or semiskilled labor in Buenos Aires (e.g., Balán and Dandler 1986), and agricultural labor or settlement in Santa Cruz (e.g., Hess 1980; Stearman 1976, 1985; Painter 1987; Painter and Partridge 1989; Perez 1987) has been prominent over time, in different parts of central Bolivia. The importance of one or another migratory destination rises and falls with the opportunities for securing land and/or work. Many families have maintained contacts in different areas, and respond rapidly to changes in the opportunities and costs associated with each (e.g., Balán and Dandler 1986; Carafa et al. 1987).

One begins to appreciate the resource scarcity that motivated families to settle in the Chapare by examining the situation regarding agricultural land they left behind. As part of the research being described, the *Centro de Estudios de la Realidad Económica y Social* (CERES), a private Bolivian social science research institution, interviewed 194 Chapare farmers regarding their settlement experiences and agricultural production systems.[5] Of the 194 farmers interviewed, 176 responded to questions about why they had moved to the Chapare. Of these, 143, or 83 percent, said they had migrated because of a lack of economic opportunity, in the form of inadequate land or income, at home. Of the 194 farmers interviewed, 187 provided information on their landholdings in their communities of origin. Of these 187, 111, or 59 percent, reported that they did not own land in their home communities, meaning that they had been landless before they migrated, or that they had given up their claims to land in their home communities after settling in the Chapare. Of the remaining 76 farmers who continued to own

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[5] This material will henceforth be referred to as the CERES interviews. The overall findings of the study are summarized in Rivera (1990). The figures cited here result from a retabulation of the interview material conducted by Eduardo Bedoya. CERES interviewed a nonrandom sample of 194 farmers who were selected as representing characteristics of the farmer population that the research team felt to be of interest, including location of land in one of seven ecological microregions, size of landholding, length of residence, and family size. The insights offered by the CERES dataset and its limitations are discussed in Painter and Bedoya (1991).

land in their home communities, 48, or 64 percent, of them owned one hectare or less, while 92 percent owned three hectares or less of land (Painter and Bedoya 1991:15, 24-25).

Settlement of the Chapare began in the 1930s and the population increased gradually into the mid-1970s. In 1967, 24,361 people resided in 54 settlements in the Chapare (Flores and Blanes 1984:82). Settlement accelerated rapidly in the mid-1970s, the time of an economic crisis in eastern Bolivia triggered by a precipitous drop in international cotton prices. Many farmers in Santa Cruz, responding to incentives provided by the Bolivian government and international donor agencies, had gone heavily into debt to expand cotton production, and the decline in cotton prices left them in dire financial circumstances. By some accounts (e.g., Bascopé 1982), this crisis precipitated large-scale investment in coca leaf processing by parts of the Santa Cruz agricultural elite, and stimulated demand for coca leaf. By the end of 1981, approximately 83,525 people lived in 247 settlements in the Chapare (Flores and Blanes 1984:88-89). This represented a 243 percent increase in the settler population and a 357 percent increase in the number of *colonias* in the Chapare (Jones 1990). By 1987, this population had more than doubled again, to between 196,000 and 234,000 (Durana et al. 1987). Figure 1, below, draws on information collected from coca farmers by the Bolivian government's *Dirección de Reconversión Agrícola* (DIRECO), to confirm this general migratory pattern.[6]

As may be seen in Figure 1, most Chapare farmers come from within Cochabamba department. In fact, of 10,703 farmers interviewed by DIRECO, 6,867 (65.2 percent) were from Cochabamba. Potosí ranks second as the department of origin, accounting for 1,292 (12.3 percent) of the farmers interviewed by DIRECO.[7] The predominance of Cochabamba contrasts sharply with the origins of farmers in the Yapacaní and San Julián settlement areas of northern Santa Cruz department. In Yapacaní, which borders the Chapare on the east (but which settlers reached by going first to the city of Santa Cruz and moving northward), the departments of Cochabamba and Potosí are of nearly equal importance, with each accounting for approximately one third of the settlers. The department of Chuquisaca is the next most important source of

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[6] This material, henceforth referred to as the DIRECO database, consists of information collected from 10,703 Chapare farmers who voluntarily discussed with DIRECO officials the question of reducing the amount of coca they were producing between November 1985 and the end of December 1989. The material remained in unanalyzed questionnaires until it was computerized and analyzed as part of the research being discussed here. The dataset represents a nonrandom sample of between 20 and 40 percent of the Chapare farmer population. The quality of the information and limitations on drawing conclusions from it are discussed in Painter and Bedoya (1991).

[7] The DIRECO database contains 10,703 records, rather than the 10,531 mentioned here. Because the material was collected over an extended time, with no analysis, and the collectors had unclear or contradictory notions about the purpose of the data collection, the format of the questionnaires varied and there were many inconsistencies in how responses was recorded, resulting in anomalous or missing information in the database.

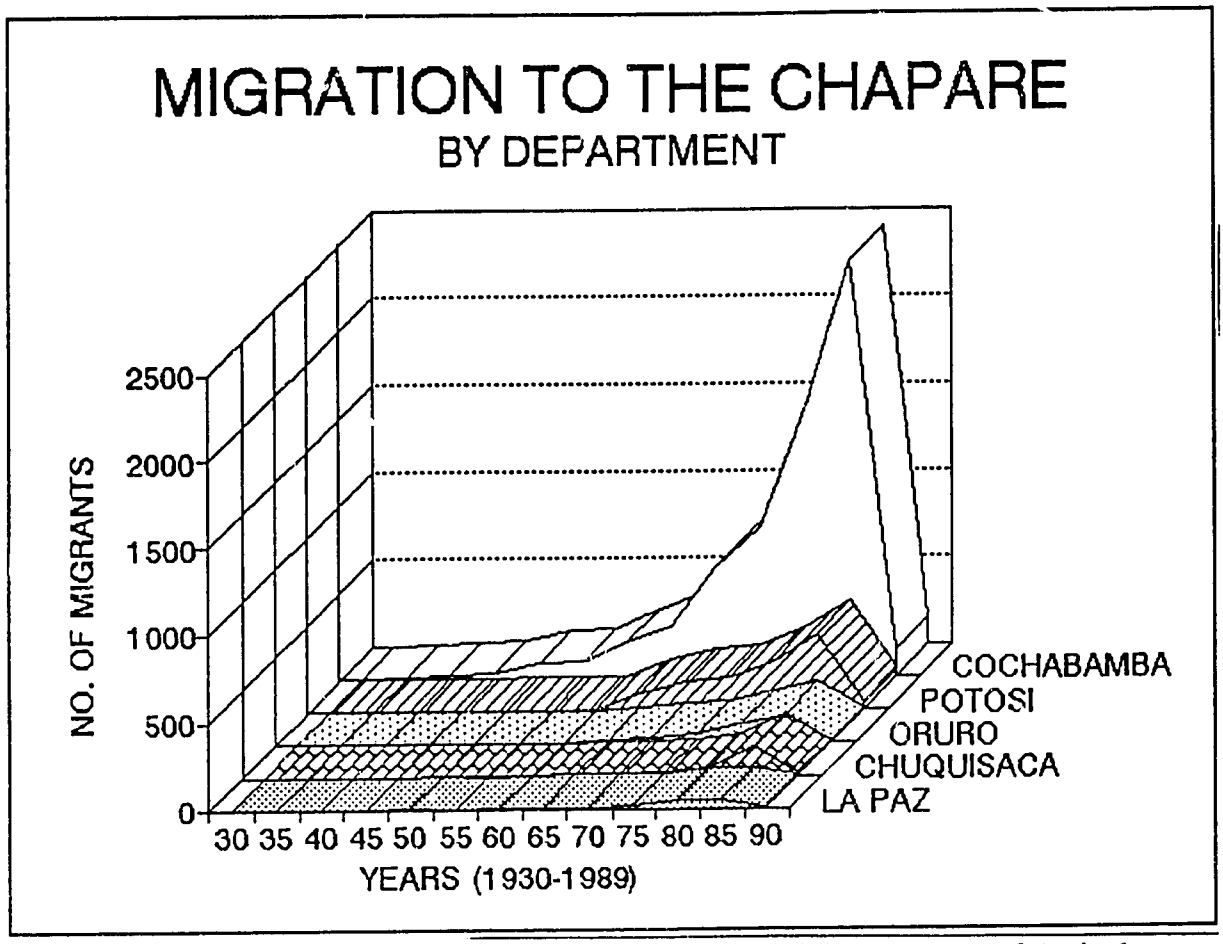


Figure 1. Migration to the Chapare, by Department of Origin and Year of Arrival
Source: DIRECO database.

migrants to Yapacaní, accounting for approximately 19 percent. In San Julián, Potosí is the largest source of settlers, accounting for 44 percent, with Chuquisaca and Cochabamba ranking second and third, accounting for 20 and 15 percent of the settlers, respectively (Painter and Bedoya 1991:23).

The dynamic resulting in the settlement of the Chapare differed from other areas, as is shown by the contrasting importance of departments of origin of settlers in different areas. Table 1, below, shows the province of origin of Chapare farmers from Cochabamba department interviewed by DIRECO. The largest number come from Chapare province itself, and 70 percent come from provinces bordering Chapare province (see Map 2, below). This shows that proximity to the Chapare has been particularly important in farmers' decision to settle there, especially when compared with the other settlement areas mentioned.

In addition to simple proximity, however, historical factors help explain the population movements in recent decades. The Chapare that has been the object of land settlement is an area composed of the tropical portions Chapare and Carrasco provinces, which is drained by the

Chapare and Chimoré-Ichilo Rivers. While only these two provinces contain tropical as well as upland areas, much of the population of the neighboring upland provinces maintained access to land in different ecological zones, including tropical land, along the slopes leading down into the Chapare. This was the basis of Intendent Viedma's plan, in the 1780s, to build a road into the Chapare to promote commercial coca leaf production there on a scale that would compete with production from the *yungas* area north of La Paz (Larson 1988:246-258).

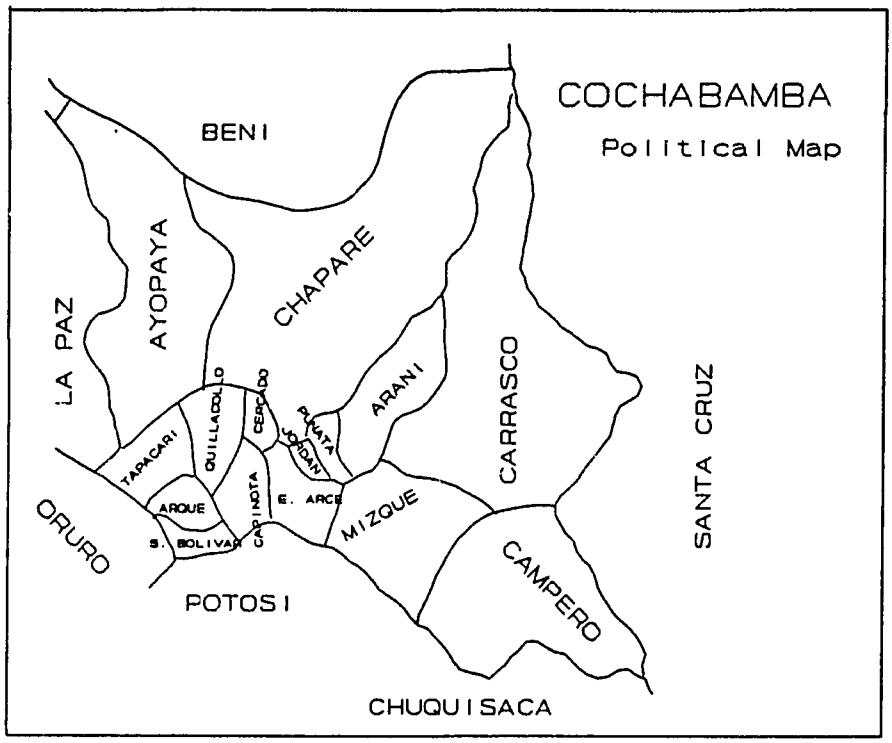
Table 1. Provinces of Origin for Farmers in the Chapare From Cochabamba Department

Province	Farmers	%
Chapare	1,981	28.8
Quillacollo	1,031	15.0
Arani	484	7.0
Ayopaya	483	7.0
Capinotr	406	5.9
Punata	355	5.2
Arque	290	4.2
Tapacari	274	4.0
Cercado	249	3.6
Carrasco	214	3.1
Esteban Arze	194	2.8
Mizque	131	1.9
Campero	53	0.8
Jordan	51	0.7
Bolívar	2	0.0
No response	669	9.7
TOTAL	6,867	99.7

Source: Direco database.

In fact, people cultivated coca leaf and other tropical products on the lower slopes and in the Chapare for several centuries. The area never supplied as much coca leaf to the mines and other traditional consumption markets as did the *yungas*, but this production was important for family consumption, trade, and sale. In interviews, many farmers tell that large numbers of people left their homes beginning in the late 1970s, and particularly during the 1980s. In some extreme cases, one finds isolated communities that have been totally abandoned, with empty houses falling into disrepair. The drought of the 1980s and a lack of water more generally are often cited as the specific reason prompting the move (e.g., Jones 1990:18-19). The drought and economic traumas of the 1980s were for many the finishing blows that occurred

Map 2



within a context of long-term economic decline and land degradation, forcing many to abandon land altogether and many others to become significantly more dependent on off-farm income sources.

A high percentage of settlers come from the upland areas immediately bordering the Chapare. Farmer interviews and direct observation indicating a pattern of upland fields and residences being abandoned or falling into disuse. The settlers abandoned the upland portion of what had been vertically organized production systems along the slopes leading from the uplands to the tropical Chapare. Table 2, below, shows the communities of origin of farmers from Chapare and Carrasco provinces, the two provinces containing the tropical area commonly referred to as the Chapare. As may be seen, 91 percent are from upland localities. These upland areas have long-standing vertical production linkages of different types extending downward toward the tropical Chapare. It is probable that many of the other upland provinces bordering the Chapare have similar histories of agricultural production. The family labor required to sustain agricultural production was too great in the face of the declining productivity and profitability of upland agriculture. Many families apparently hoped to improve the returns to their labor by concentrating their efforts in the tropical lowlands.

Chapare farms, with the mean farm size between 9 and 12 hectares, are small compared to those in lowland settlement areas elsewhere in Bolivia Farm sizes in the San Julián area averaged 40 hectares, with farmers who formalized their settlement through the INC receiving 50 hectare lots (Painter et al. 1984). In Yapacaní, the mean farm size is approximately 29

Table 2. Localities of Origin—Farmers from Chapare and Carrasco Provinces Cochabamba Department

Locality	Province	Farmers	%
Upland Localities			
Sacaba	Chapare	635	41.4
Colomí	Chapare	552	36.0
Totora	Carrasco	100	6.5
Ucuchi	Chapare	54	3.5
Palca	Chapare	18	1.2
Pojo	Carrasco	13	0.8
Pocona	Carrasco	10	0.7
Corani	Chapare	5	0.3
Candelaria	Chapare	4	0.3
Chillichi	Carrasco	4	0.3
Quehuiñapampa	Chapare	3	0.2
Subtotal		1,398	91.3
Lowland Localities			
Todos Santos	Chapare	44	2.9
Villa Tunari	Chapare	14	0.9
Espíritu Santo	Chapare	11	0.7
Chipiriri	Chapare	9	0.6
Paracti	Chapare	9	0.6
Chimore	Chapare	3	0.2
Ibirgarsama	Carrasco	1	0.1
Other	--	43	2.8
Subtotal		134	8.7
TOTAL		1,532	100.0

Source: DIRECO database.

hectares. The mean area of settlers' landholdings in the Chapare is about 10 hectares, with between 1.25 and 4 hectares under cultivation. Coca leaf accounts for between about .5 and 1.6 hectares of the area under cultivation.

Even more important than the mean figures, however, is the unequal land distribution. Table 3, below, shows the distribution of land among the farmers in the DIRECO database. It

Table 3. Frequency Distribution of Chapare Farms by Lot Size

Hectares	MICROREGIONS						
	Reg. 1	Reg. 2	Reg. 3	Reg. 4	Reg. 5	Reg. 6	Reg. 7
0	23	37	178	79	14	7	2
0<n≤5	208	65	847	660	128	21	2
5<n≤10	237	211	1,597	1,385	112	93	14
10>n≤15	71	178	291	179	19	57	24
15<n≤20	30	688	513	93	4	294	49
20<n≤25	7	27	27	7	2	20	1
25<n≤30	1	2	7	3	1	0	43
30<n≤35	1	6	0	0	0	0	20
35<n≤40	1	3	6	2	0	1	9
40<n≤45	0	0	1	1	3	0	2
45<n≤50	0	8	0	0	0		19
50<n≤55	0	0	0	1	0		1
55<n≤60	0	4	1	0	0		9
60<n≤65	0	0	0		0		0
65<n≤70	0	0	1		1		
70<n≤75	0	1	0		0		
75<n≤80	1	0	2				
80<n≤85	0	1	0				
No. of Farms	580	1,231	3,471	2,410	284	493	195
Max. Farm Size	78	82	80	54	70	36	60

Source: DIRECO database.

further divides the farmer population according to their residence in one of the Chapare's seven microregions, which are relatively homogeneous with respect to agricultural production conditions.[8] While the mean farm size is 10 hectares, 25 percent of the farmers who provided the information appearing in the table own less than five hectares. Table 4 looks at the same information another way, showing the distribution of land among different cohorts of farmers,

[8] The Chapare has been divided into seven microregions by the *Instituto Boliviano de Tecnología Agropecuaria* (IBTA), of the Bolivian government. Based largely on soil characteristics, the microregions vary considerably with respect to their potential for supporting agriculture, with Microregions I and III generally regarded as having the greatest agricultural potential.

ranging from the 10 percent who own the least land to the 10 percent who own the most. The 20 percent of the settlers with the largest farms own about five and a half times the amount of land as do the 20 percent of settlers with the smallest.

One result of the large number of small landholdings, coupled with the variation in agricultural potential of Chapare land, is that the upland pattern of families relying heavily on off-farm income is reproduced in the Chapare. Various accounts of how families organize migration between upland and lowland areas (e.g., Carafa et al. 1987; CEFOIN 1990; Jones 1990) report that it is common for husbands and older sons to work family lands in the Chapare, while wives and daughters remain in upland areas, caring for small children, farming if the family maintains land in the upland area, or attending to some commercial activity. Various data suggest that off-farm income, most of which is generated by women, is very important for Chapare settlers. While only 40 percent of the farmers interviewed by CERES had land in their areas of origin, 66 percent owned a house or other property outside the Chapare. Also, the DIRECO information on settler household composition shows a singularly low number of female offspring. The total number of male offspring reported by the 10,708 farmers interviewed was 25,388, which works out to a mean of 2.37 male children per household. At the same time, farmers reported that only 3,213 female offspring resided with them, for a mean of .3 female children per settler household. Thus, more than eight times as many sons as daughters live in the Chapare.

These figures contrast sharply with others from the Yapacaní settlement area, which borders the Chapare to the east but where farmers arrived as part of the settlement of northern Santa Cruz, rather than through the Chapare. DIRECO interviewed 1,143 farmers in this area, who reported totals of 2,094 sons and 1,894 daughters residing with them. This works out to means of 1.83 sons and 1.62 daughters, respectively, per household, or only 1.13 times as many sons present as daughters.

These figures appear to confirm observations that settler families in the Chapare need the income from women working outside of the Chapare.[9] The importance of this type of women's work is undoubtedly due in part to the proximity of the Chapare to the upland areas from which most settlers come. Families can divide their efforts and conduct economic activities in upland areas as well as in the Chapare. The combination of small, fragmented landholdings in the Chapare and extremely restricted economic activities in agriculture there oblige families to rely on off-farm income, much as they do in the impoverished upland areas already discussed.

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[9] An unfortunate failing of the DIRECO data is that they were gathered under the assumption that all farmers were male, and do not disaggregate farmers by sex. Also, the DIRECO data provide no information on farmers's spouses. These shortcomings necessitate the rather "roundabout" inference presented here. Jones (1990) found a significant minority of women farmers in the Chapare, although he was not able to make any quantitative assessment.

Table 4. Concentration of Landholdings in the Chapare

Strata	MICROREGIONS													
	Reg. 1		Reg. 2		Reg. 3		Reg. 4		Reg. 5		Reg. 6		Reg. 7	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Bottom 10%	41.5	0.90	352.0	1.80	289.3	0.88	341.5	1.68	9.0	0.47	202.7	2.55	123.50	2.35
9th 10%	159.1	3.46	1,092.1	5.59	1,275.1	3.87	1,065.2	5.26	57.0	2.95	491.4	6.18	245.00	4.66
8th 10%	249.0	5.41	1,361.2	6.97	1,741.0	5.29	1,205.0	5.94	96.1	4.97	565.4	7.11	338.00	6.43
7th 10%	290.0	6.30	1,780.0	9.11	2,357.6	7.16	1,616.6	7.98	120.8	6.24	755.0	9.49	384.00	7.31
6th 10%	372.3	8.09	2,077.3	10.64	3,177.5	9.65	2,284.4	11.27	145.0	7.49	938.4	11.80	429.00	8.16
5th 10%	486.3	10.57	2,300.5	11.78	3,470.0	10.54	2,410.0	11.89	178.0	9.20	1,000.0	12.57	550.70	10.48
4th 10%	574.0	12.48	2,460.0	12.60	3,470.0	10.54	2,410.0	11.89	215.4	11.13	1,000.0	12.57	599.00	11.40
3rd 10%	580.0	12.61	2,460.0	12.60	3,734.0	11.34	2,410.0	11.89	256.7	13.27	980.0	12.32	681.20	12.96
2nd 10%	686.8	14.93	2,460.0	12.60	6,999.2	18.22	2,473.6	12.20	290.5	15.01	980.0	12.32	888.00	16.90
Top 10%	1,161.1	25.24	3,185.4	16.31	7,417.9	22.53	4,053.8	20.00	574.4	29.69	1,039.7	13.07	1,017.30	19.36

Source: DIRECO database.

3.2. Wage Labor Migration from Upland Areas

The discussion has focused on migration and settlement of the Chapare by farmer families. The rural upland population is not homogeneous, however, and it has responded to the crisis of underdevelopment and land degradation in diverse ways. Primarily because it produces coca leaf for cocaine, the Chapare is also a source of wage labor for many people. Large numbers of poor rural people migrate to the Chapare for varying lengths of time to work in the care of coca plants and harvesting of coca leaf, and many more work carrying coca leaf from isolated farms to bulking and processing centers and in the initial stages of extracting the cocaine alkaloid from coca leaf.

As discussed, Chapare farmers tend to be from the area immediately surrounding the Chapare. But, the Chapare is a source of wage labor to people living in a much wider area of upland Bolivia. While only about 2 percent of Chapare farmers are from the provinces of Campero and Mizque, for example, the Chapare is the most important migratory destination for rural families in these two provinces when they seek off-farm income.

This is confirmed by two sets of interviews conducted by the *Centro de Formación Integral* (CEFOIN), of the University of San Simón, Cochabamba.[10] As part of its research on the rural economy of Campero and Mizque, CEFOIN interviewed 46 elected leaders (*dirigentes*) of communities in the two provinces, and asked them about the most important 22migratory destinations of people from their communities. Among them, the leaders listed 89 migratory destinations, of which the three most important were the Chapare (mentioned 38 times), Santa Cruz (mentioned 23 times), and the city of Cochabamba (mentioned nine times). Similarly, CEFOIN asked 60 returned migrants about their destinations and received 73 responses, of which 39 included the Chapare, 25 included Santa Cruz, and nine included the city of Cochabamba.

In his discussion of these materials, Perez (1991a) notes that generally wage laborers migrate several times a year for relatively short duration. Reported duration varies widely, however, and, as Perez points out, almost all of the remaining migratory destinations mentioned that are ranked lower than the three most important are upland towns and cities within a short distance of migrants' homes. Since most migrants report several destinations where they go regularly to seek work, we see that migration as we conventionally think of it represents the extreme cases in a range of practices in which families engage to earn off-farm income. This suggests that off-farm income is even more important to the survival of rural families than we

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[10] This study was conducted by CEFOIN in collaboration with the broader research effort being described here. The results are summarized in CEFOIN (1990). The survey information collected by CEFOIN was subsequently reanalyzed by Melissa Cable, on whose work the figures presented here are based. Perez (1991a) has analyzed the rural economy of Campero and Mizque, drawing heavily on the CEFOIN report and Cable's reanalysis of the survey materials.

might be led to believe by looking at migration data, and that, while migration data are dramatic, they may actually underrepresent the crisis facing upland agriculture.

4. THE ORGANIZATION OF LOWLAND AGRICULTURAL PRODUCTION

4.1. General Tendencies

As discussed in Section 3.1, above, the mean farm size in the Chapare is 10 hectares, with the area under cultivation ranging between 1.25 and four hectares and the area dedicated to coca ranging between .5 and 1.6 hectares. The modal farm size is something less than ten hectares, and the mean varies considerably from one Microregion to another. Tables 5 and 6, below, summarize the distribution of Chapare farms according to the area of land under cultivation, and the area of land dedicated to coca cultivation. As may be seen, the modal amount of land under cultivation is slightly less than two hectares, while the modal amount of land dedicated to coca leaf cultivation is slightly less than a hectare. Table 7, below, summarizes the mean area per farmer in each microregion dedicated to the major crops cultivated.[11]

In general, Chapare farmers are smallholders with a diversified cropping system and few animals. Coca is the single most important crop, as one would expect, since it is the crop for which there has been the most reliable market over the last decade, but it is by no means the only crop cultivated by Chapare farmers. Chapare production systems include significant quantities of annual and perennial crops. In fact, in almost all cases, the amount of land dedicated to annual crops and other perennial crops exceeds the amount of land under coca cultivation. Coca amounts to approximately 40 percent of the area under cultivation in the Chapare.[12]

Crop production in the Chapare depends heavily on unwaged family labor. Of the 194 farmers interviewed by CERES, 94 percent indicated that farming is their major occupation, and only 13 percent stated that they ever work off-farm. The 194 farmers interviewed by CERES were accompanied by 343 family members, 70 percent of whom stated that their major occupation was unremunerated work on the family farm. While 58 percent of the farmers interviewed by CERES do hire labor from time to time, 87 percent regularly use unremunerated family labor, and 72 percent regularly practice *ayni* labor exchanges on their farms. Farmers

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[11] Many will undoubtedly wonder about the distinction between the "Other 1" and "Other 2" categories in Table 7. It was clearly meaningful to the people who originally designed the DIRECO interviews. But, over the years, its significance was lost, and interviewers began to arbitrarily use one or the other to indicate crops not previously listed. After some discussion with colleagues on our research team, I have elected to maintain the labelling distinction.

[12] DIRECO figures place coca production at approximately 44 percent of a farmer's cultivated area, on average, while the data collected by CERES yield average figures that range between 37 and 39 percent of the area under cultivation. The difference in the results of the two studies are not significant.

Table 5. Frequency Distribution of Chapare Farms by Cultivated Area

Hectares	MICROREGIONS						
	Reg. 1	Reg. 2	Reg. 3	Reg. 4	Reg. 5	Reg. 6	Reg. 7
0	4	6	23	8	2	2	1
0<N≤3	300	610	2,602	1,749	238	343	75
3<N≤6	183	453	677	565	36	112	63
6<N≤9	58	120	111	67	7	28	23
9<N≤12	25	26	36	15	0	1	12
12<N≤15	5	7	9	4	0	2	8
15<N≤18	2	2	8	1	0	3	4
18<N≤21	2	1	3	1	0	1	3
21<N≤24	1	1	0	0	1	1	2
24<N≤27	0	1	0		0	0	2
27<N≤30		0	1				1
30<N≤33		0	0				0
33<N≤36		0					0
36<N≤39		0					0
39<N≤42		1					0
42<N≤45		0					0
45<N≤48		0					0
48<N≤51		1					1
51<N≤54		1					0
54<N≤57		0					
57<N≤60		0					
60<N≤63		0					
63<N≤66		0					
66<N≤69		0					
69<N≤72		0					
72<N≤75		1					
75<N≤78		0					
No. of Farms	580	1,231	3,470	2,410	284	493	195

Source: DIRECO database.

Table 6. Frequency Distribution of Chapare Farms by Area in Coca Cultivation

Hectares	MICROREGIONS						
	Reg. 1	Reg. 2	Reg. 3	Reg. 4	Reg. 5	Reg. 6	Reg. 7
0	48	59	71	46	9	5	5
0<N≤1	277	398	1,825	1,145	189	210	129
1<N≤2	184	414	1,118	838	65	190	35
2<N≤3	51	227	363	278	13	63	14
3<N≤4	13	74	67	68	6	15	10
4<N≤5	4	38	17	17	1	9	1
5<N≤6	3	16	4	12	0	0	1
6<N≤7	0	3	2	2	1	1	0
7<N≤8		1	0	2	0	0	
8<N≤9		0	3	1			
9<N≤10		1	0	1			
10<N≤11		0	0	0			
No. of Farms	580	1,231	3,470	2,410	284	493	195

Source: DIRECO database.

Table 7. Total Areas in Hectares Dedicated to Crop Production Chapare Farmers Included in DIRECO Database

Crop	MICROREGIONS						
	Reg. 1	Reg. 2	Reg. 3	Reg. 4	Reg. 5	Reg. 6	Reg. 7
Coca	605.87	1,937.44	3,758.44	2,936.97	249.68	632.61	176.62
Bananas	454.53	399.56	885.05	257.44	63.49	121.43	174.46
Cassava	107.11	308.47	609.06	527.91	36.61	97.90	55.95
Corn	52.42	202.76	171.68	75.43	11.02	34.88	32.08
Rice	140.90	724.73	1,121.81	1,063.72	37.22	159.93	345.52
Citrus	597.37	755.40	1,026.15	751.99	60.60	224.16	42.08
Taro	3.84	3.28	18.42	15.10	4.10	1.38	4.00
Avocado	59.96	6.63	54.24	21.53	2.49	1.78	2.13
Other 1	45.10	128.92	254.69	74.12	24.14	38.87	240.76
Other 2	6.60	21.85	26.26	12.78	6.01	4.98	2.94

Source: DIRECO database.

regularly stated that the availability of unpaid family labor and the costs of hired labor are major constraints on their ability to produce.

As may be seen in Table 8, below, hired labor is an essential part of farming in the Chapare. But, two thirds of the farmers interviewed with less than 2.99 hectares under cultivation, which, as we have seen, constitutes the majority of Chapare farmers, rely exclusively on family labor to perform agricultural tasks. At this level of production, hired labor is clearly a complement to the labor provided by family members. As we would expect, the importance of hired labor increases significantly among larger farmers, although family labor continues to be used.

The importance of hired labor in coca production is greater than it is for crops in general, which reflects the fact that coca leaf is the farmers' most reliable source of income. Table 9, below, shows that the smaller coca producers interviewed by CERES, those with a hectare or less, hire workers to supplement family labor resources more frequently than do farmers with larger areas of coca. Coca leaf is the most difficult crop to accommodate within a production system based on family labor, because the labor requirements are very high, especially for the heavy amount of weeding required to protect young coca plants until they are big enough to shade the ground. A hectare of coca requires about 120 person/days in weeding, compared to 36 person/days for coffee, 32 for citrus, and 24 for bananas (Henkel 1971:190, 210). In addition, when coca leaf is being grown for the purpose of extracting the cocaine alkaloid, harvesting and transport make particular demands on labor resources. If coca leaf is not harvested and processed within a few days, the alkaloid content of the leaf drops substantially (Henkel, personal communication).

The patterns of family and hired labor use in the cultivation of coca leaf and other crops reflect the precarious economic situation of Chapare farmers. Both from farmer comments in interviews and from the greater area dedicated to coca leaf than to other cultivars, we see that coca is the most marketable crop. It is also clear that coca leaf is relatively more important for smaller farmers than for larger ones, for small farmers make a relatively larger investment to establish a coca plantation.

At the same time we see, from the very weak relationship between the amount of land that a family owns and the area under coca cultivation, that farmers are not maximizing coca production. Using 10,581 cases in the DIRECO database that contained information on farm size and area under coca cultivation, we calculated two correlation coefficients to measure the strength of the relationship between the two variables. The first, using Pearson's R, yielded a correlation coefficient of .12842, showing a weak relationship between the size of each farmer's holding and the area under coca leaf cultivation. The second, using Spearman's r_s, sought simply to see if there is a relationship between the ranks of the farms according size of landholding and their ranks according to the amount of land under coca cultivation. This too yielded a coefficient of .16252, indicating a weak positive relationship between the ranks. The relationship between the amount of coca cultivated and the amount of family labor available is

Table 8. Type of Labor Force Utilized According to Land Area under Cultivation

Number of Cultivated Hectares	Only Family Labor Force		Family Labor Plus Hired Labor		Total	
	#	%	#	%	#	%
0.1 to 2.99	28	67.0	14	33.0	42	100.0
3 to 4.99	16	36.0	29	64.0	45	100.0
5 to 6.99	4	25.0	12	75.0	16	100.0
7 +	1	7.0	13	93.0	14	100.0
	49	42.0	68	58.0	117	100.0
					7	No Answer
					124	

Source: CERES interviews.

Table 9. Type of Labor Force Utilized According to Land Area in Coca Leaf Cultivation

Number of Coca Hectares	Only Family Labor Force		Family Labor Plus Hired Labor		Total	
	#	%	#	%	#	%
0.1 to 0.5	17	47.0	19	53.0	36	100.0
0.51 to 1.0	10	38.0	16	62.0	26	100.0
1.01 to 2.0	19	56.0	15	44.0	34	100.0
2.01 +	1	7.0	16	94.0	17	100.0
	47	42.0	66	58.0	113	100.0
					11	No Answer
					124	

Source: CERES interviews.

also very weak. The Pearson's R coefficient of the relationship between the number of offspring a farmer has and the area under coca cultivation is .17092, while the Spearman's r_s coefficient of the relationship between the ranks of the farms according to number of offspring and area under coca cultivation is .21311.

Farmers are limiting the area they dedicate to coca leaf production according to considerations that are not particularly related to land and labor availability. In many areas around the world there exists a system of quotas on production to exercise some control over price and ensure that coca revenues are broadly distributed among farmers. Peanut quotas are enforced by the federal government in the southeastern U.S., and quotas on such high value cash

crops as tea are enforced by contract farming schemes, for example. One can imagine that the coca leaf producers' unions (*sindicatos*) might be interested in quotas to distribute the revenues from coca production among their members, while drug traffickers might be interested in dispensing production quotas as means of exercising control over producers. In fact, however, it is unlikely that an explicit quota system—formal or informal—exists in the Chapare; certainly our research uncovered no evidence of one.

A more likely explanation, based on the information presented here, is that more coca is not being grown because it is not profitable in a formal sense. If coca leaf production were profitable, we would expect farmers to hire the labor necessary to expand it more rapidly. The Chapare would approach being an exclusively coca leaf producing area, and production would be significantly constrained by land availability. Instead, farmers continue to rely heavily on the family obligations and labor exchanges described by Weil (1989) and others based on fieldwork conducted in the early 1970s. In recent years, the price of coca has been very volatile, to a certain extent responding to cocaine and coca leaf repression, and to a greater extent responding to pressures exerted at different levels of the narcotics industry that we simply do not understand (Jones 1990:13-15, 23-25). Farmers do not grow coca leaf because it is particularly attractive; they grow it because, even though the price is volatile and often low, it is the only crop for which they know they will have a buyer (Jones 1990; Rivera 1990).

The fact that farmers' most important crop, coca leaf, is not sufficiently profitable to provide incentives to hire labor and expand coca production is symptomatic of the kinds of pressures farmers are experiencing to use land extensively and destructively. Accompanying the lack of incentive to hire labor is a lack of incentive to invest in most capital inputs for the production of other crops. CERES found that only 5 percent of 124 farmers who provided information on this topic used improved seeds, and only 15 percent used fertilizers (Painter and Bedoya 1991:63). These figures reflect the kinds of trends in the Bolivian rural economy that caused coca leaf production to assume the prominent place it has. In 1976, despite primitive production technology, Chapare farmers produced 39 percent of Bolivia's plantains, 32 percent of its citrus, and 20 percent of its rice, at a time when only 6 percent of the area was occupied (OAS 1984:191). Today, farmers report that they cannot usually find a buyer for these products at any price, and their primary destination is consumption by farmers, their families, and any hired laborers. Many farmers give food in addition to or in lieu of cash wages to laborers, another symptom of the economic bind in which they are caught.[13]

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[13] The wives of men who go to the Chapare as laborers report that, because of the declining production and productivity of upland farming systems, the food that men bring home from the Chapare occupies an increasingly central place in satisfying families' basic consumption needs (Gisbert and Quitón 1991). This is indicative both of the threat to the "subsistence production" regimen that we conventionally think of as subsidizing participation in the wage labor market, and of the growing inadequacy of the wages that workers are able to bring home.

At the same time, farmers are using large quantities of insecticides; 89 percent of those interviewed by CERES reported that they do use insecticides. Farmers also report that the need for insecticides is increasing and that insecticides appear to be less effective than they used to be, an indication of broader land-management problems. Based on the information that farmers interviewed by CERES provided, the mean area per farmer of land in fallow, 6.39 hectares, is approximately twice the mean area under cultivation of 3.2 hectares (Painter and Bedoya 1991:61-62). In addition, only 29 percent of the farmers interviewed by CERES indicated that they were managing fallow land by growing perennial crops on it; 71 percent had agricultural systems that consisted of annual crops being rotated within an extensive fallow area, with no management of succession of annual crops through the use of tree crops. Furthermore, the percentage of farmers who use permanent crops to manage succession in fallow lands declines as plot size increases (Table 10), suggesting that larger farmers are more extensive in their use of land than small farmers.[14]

The lack of economic opportunity associated with Chapare farming discourages the use of modern inputs and leads farmers to rely heavily on family labor. In most cases, family labor is supplemented by hired labor only for coca leaf production, because of the role this crop plays in providing a minimum level of cash income for farm families. Even here, however, the level of profitability is insufficient to encourage producers to maximize coca leaf production. This suggests that coca leaf would not be a profitable crop without the extensive use of unwaged family labor. It is grown not because it is profitable, but because it is the only crop that farmers have reasonable assurance of being able to sell. The cash received from coca leaf is an increasingly tattered safety net, whose importance is greatest for the smallest farmers.

Since they are unable to earn sufficient revenues from farming to invest in inputs or labor, farmers seek to meet minimal production requirements through an extensive use of land. Lack of fertilizer use means that large areas of fallow must be maintained in order to maintain what has become an annual crop regimen directed almost exclusively to home consumption. Poverty and labor scarcity combine to make difficult the management of fallow areas through the use of perennial crops, for the purpose of maintaining soil fertility and increasing and diversifying farm production. Denevan and Padoch (eds., 1988:23-26, *passim.*) point out that some form of management of fallow is a critical feature of the agricultural systems of Native People and peasants in the tropical lowlands of South America that have proven to be relatively stable for extended periods of time. The exact nature of this fallow management depends on

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[14] Although the DIRECO database contains information on areas of land in fallow and forest, this discussion relies on the material contained in the CERES interviews. The DIRECO materials appear to reflect accurately the areas dedicated to individual crops, but its figures for fallow and forest are inconsistent with the information on individual crops and appear unreliable. The intensive CERES interviews, on the other hand, do appear to be accurate. The preceding two paragraphs draw heavily on conclusions reached by Eduardo Bedoya as a result of his analysis of the CERES material and the preparation of the tables presenting that material.

Table 10. Principal Cropping System According to Plot Size

Plot Size (Hectares)	Agricultural System with Fallow (Annual Crops + Fallow Area)		Agricultural System without Fallow (Permanent Crops)		Total	
	#	%	#	%	#	%
0.1 to 5	20	53.0	18	47.0	38	100.0
5.1 to 10	46	68.0	22	32.0	68	100.0
10.1 to 20	32	94.0	2	6.0	34	100.0
20.1 +	7	100.0	--	--	7	100.0
	105	71.0	42	29.0	147	100.0
					47	No Data
					194	

Source: CERES interviews.

land availability, soil conditions, and links between production and regional, national, and international markets. More needs to be known about how systems of fallow management might improve land use practices in the Chapare, but practices cannot improve without major improvements in the incomes settlers receive from farming.[15]

[15] This is not intended to imply that better fallow land management in the Chapare is the key to reversing land degradation. It was the focus here because it is indicative of the land management problems arising from the poverty of Chapare farmers. Problems of land degradation in the Chapare are more complex, beginning with the fact that only a small part of the region is suitable for prolonged farming, because of heavy rainfall and steep slopes.

5. IMPLICATIONS AND CONCLUSIONS

The upland valleys of central Bolivia have long suffered from economic stagnation and underdevelopment associated with the country's dependence on supplying export markets with a small number of commodities. In recent decades, for example, the economy has rested on minerals, particularly tin, and cocaine. These long-term problems were exacerbated by a series of crises that occurred during the 1970s and 1980s. The net effect on the rural population has been the establishment and acceleration of mutually reinforcing cycles of impoverishment and land degradation.

The major response to this has been migration, characterized by a wide variety of destinations and migratory patterns of diverse organization and duration. In the absence of investment to improve market conditions and the productivity of family labor in upland agriculture, migration transforms labor scarcity from a seasonal problem of peasant farmers to a chronic, year-round condition that obliges people to become increasingly destructive in their use of land. Because migrants are predominantly men, the principal agents and victims of land degradation are women and small children, and patterns of gender-based discrimination and oppression further complicate efforts to assist them in breaking the cycle of impoverishment and land degradation. Furthermore, the cycle actually increases the hardships to which women are subjected. Responsible for an upland production system that yields less and less in quantity and value, women contribute less and less economically, which lessens their claim on political participation.

Chapare settlement was a result of the crisis of upland agriculture, and specifically of the collapse of vertical production systems linking upland and lowland areas along the slopes bounding the tropical lowlands, but the same conditions that limited the production of food crops in upland areas also choked the production of lowland food crops. The growing reliance on coca leaf production reflected the lack of opportunity in food crop production. But, coca leaf has not improved the overall situation of Chapare farmers because it is a commodity whose price is unaffected by the labor embodied in it. As a result Chapare farmers are encouraged to use land extensively and destructively, mining it as a substitute for capital to subsidize the costs of labor they are unable to pay.

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