Smallholder Agricultural Expansion in La Amistad Biosphere Reserve: Perceived vs. Real Impacts of Cacao and Cattle

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ABSTRACT. Agricultural expansion by smallholder producers has been identified by management agencies as one of the main threats to the ecological integrity of La Amistad Biosphere Reserve, in Panama and Costa Rica. Promotion of cacao agroforestry has been proposed as a way to reduce the need for farmers to clear new land within the reserve. In order to realize this goal, the larger cultural, economic, and political forces that motivate agricultural expansion need to be examined, looking beyond the smallholder practices that are the immediately apparent causes of ecological degradation. The four main assumptions behind the proposal to promote smallholder cacao production in the buffer zone are explored: (1) cacao agroforestry is an ecologically benign agricultural system; (2) if cacao production were more financially viable, ecologically degrading activities, such as cattle grazing, would decrease; (3) migrants from other areas are primarily responsible for clearing land on the eastern side of the park; and (4) direct intervention at the smallholder level is the most effective means of preventing agricultural expansion. Our anal-

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ysis demonstrates that while cacao agroforestry is an ecologically appropriate production system for the buffer zone of the park, price and production stabilization is important for assuring adoption by smallholders. We also suggest that both indigenous and migrant groups are responsible clearing forest for agriculture and that a more useful distinction for managers to make is between clearing enacted as part of sustainable vs. unsustainable management regimes. Finally, we recommend that the impact to the biosphere reserve caused by large-scale cattle and banana production not be overlooked.

KEYWORDS. *Theobroma cacao* L., intensification, cattle, grazing, agroforestry, conservation incentives, land-use decisions

INTRODUCTION

La Amistad Biosphere Reserve spans the border between Panama and Costa Rica. Though it was purposefully placed in some of the least densely populated and most "pristine" areas, the land within its boundaries is and has been used by humans for centuries (Gordon, 1982). The patchwork nature of the different types of protected areas, each with its own set of regulations governing conservation, reflects the multiplicity of human interactions in the reserve (Chaverri & Herrera, 2003).

In assessing the ecological integrity of La Amistad Biosphere Reserve, many outside observers have concluded that the greatest threat to conservation is agricultural expansion by smallholders. One report stated that small-scale producers are the single largest threat to marine diversity and what appears to be the largest threat to terrestrial diversity (Finisdore, 2002). Another report of smallholder agricultural practices in the buffer zone of the reserve states that hilly topography combined with forest clearance, overgrazing and imprudent cultivation practices has accelerated land degradation, soil erosion and nutrient losses (Mehta & Leushner, 1997).

Several of these reports promote the relatively benign agricultural production of cacao, arguing that farmers are less likely to penetrate core forests if economic conditions in the buffer zone improve (Finisdore, 2002; Mehta & Leuschner, 1997). At the national level, the Forestry Action Plan calls for increasing agricultural productivity through agroforestry to reduce pressure on protected areas (UNDP, 2002). Throughout these arguments, a simplistic dichotomy is created between "good" indigenous cacao agroforestry systems and the "bad" cattle ranching, supposedly practiced exclusively by migrants from the neighboring province. Inherent is also the assumption that if cacao systems can be made to be more profitable, farmers will discontinue more harmful agricultural practices.

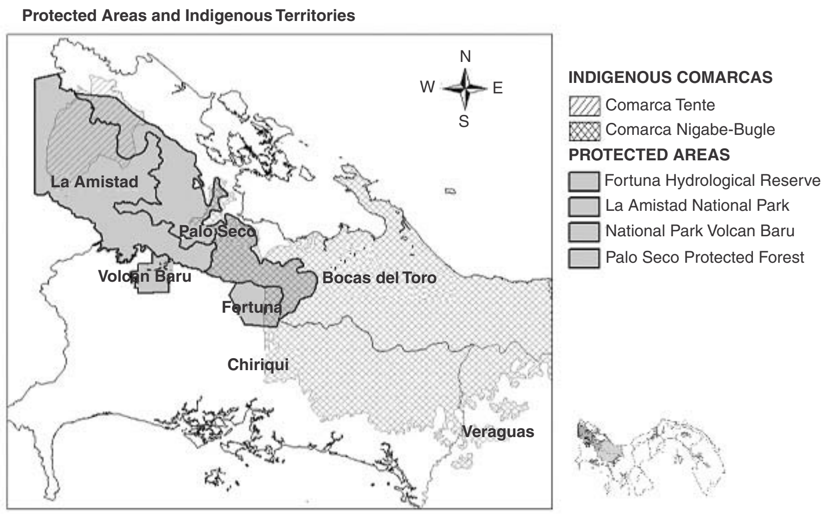
In these and other reports, the driving forces behind agricultural expansion are ignored in forming management strategies to mitigate its ecological impacts. Blame commonly falls upon smallholder farmers while larger political, economic, and cultural forces driving their choices are ignored. This narrow focus often leads to management or policy interventions that deal only with the immediate actors. Such policies are unsuccessful at halting agricultural expansion because they fail to address its underlying causes. Our paper analyzes the driving forces behind the development and expansion of cacao agroforestry systems and cattle production. These agricultural activities are described as now being practiced in the Bocas del Toro region, along with their potential ecological impact on the reserve. The forces that drive agricultural expansion are assessed. Finally, recommendations are put forth that address both the drivers behind these agricultural practices and their integration into the management plan for the reserve.

Site Description and Methods

La Amistad was designated by UNESCO as a Biosphere Reserve in 1982 (Chaverri & Herrera, 2003). The Panamanian side of La Amistad covers 207,000 hectares and lies in the provinces of Bocas del Toro and Chiriqui (ANAM, 2003). It is composed of indigenous reserves (*comarcas*), national parks, hydrological reserves, protected forests, and municipalities (Figure 1). This paper focuses on agricultural activities occurring in the Bocas del Toro portion of the reserve.

The province of Bocas del Toro covers (874,540 ha), encompassing 11.6% of Panama's national territory (MIDA, 2003; ANAM, 1999). Indigenous people comprise 38.8% of the population (MIDA, 2003). Bocas del Toro is one of the least developed provinces in Panama (Inter-American Development Bank, 2002). Historically, the primary economic activity in the region has been banana production by large corporations such as the Chiriqui Fruit Company and Chiquita Banana and has been restricted to the coastal lowlands (MIDA, 2003; Marquardt, 2001; Gordon, 1982). However, according to the 2001 Agricultural

FIGURE 1. Overlapping land tenure in the La Amistad Biosphere Reserve, Panama. Each class of protected area or indegenous territory (comarca) has its own policies to regulate environmental protection and management. These policies sometimes conflict when boundaries overlap.



Census, the number of productive farms in the province has increased 70.5% since 1991 (MIDA, 2003).

Field research for this paper was conducted over ten days, spent meeting with community groups, non-government organizations, and natural resource officers in Panama. Primary data was obtained through both formal and informal interviews with key stakeholders. Secondary data sources included project documents from various conservation and development organizations as well as an extensive literature review of shaded agroforestry systems and cattle in Latin America.

CACAO PRODUCTION IN THE BUFFER ZONES OF LA AMISTAD

In March of 1998, the First International Workshop on Sustainable Cocoa Growing was held in Panama. The following statement was agreed upon by the participants as a guiding principle for sustainable cacao production:

> Cocoa grown within a biologically diverse and environmentally sustainable agricultural system is capable of providing lasting economic, social, and environmental benefits. Grown in such a system, cocoa is a crop ideally suited to small-holder cultivation. (First International Workshop on Sustainable Cocoa Growing, 1998: website)

In this section, the system of cacao cultivation practiced in the buffer zone regions of the Atlantic side of the La Amistad Biosphere Reserve is described. In evaluating the above statement, the ecological, economic, and cultural sustainability of these systems is analyzed.

Description of Cultivation

Cacao, *Theobroma cacao* L., is native to the upper Amazon basin but has been cultivated in Central America since pre-European times (Johns, 1999). Cacao has been widely introduced and cultivated in tropical lowlands throughout the world. Being an understory species, cacao is traditionally farmed under the shade of other trees (Johns, 1999). In the 1950s and 1960s, however, new cultivation systems were promoted by government research centers in Latin America. Cacao production was increased by thinning or removing the shade trees while counteracting the loss of nutrients and the increase in pests, diseases, and weeds with chemical fertilizers and pesticides (Johns, 1999).

Rice and Greenberg (2000) have classified cacao production systems into three categories. The first is "Rustic Shade," in which cacao is planted beneath already existing primary or secondary forest cover. The existing understory is cleared, and the overstory trees are selectively thinned to leave those that offer the best shade or produce other products. "Planted Shade" is typified by a planted shade overstory. The species composition of these overstories varies in richness. The land is first cleared using "slash and burn." Either cacao seeds or annuals (corn, beans, rice, manioc, etc.) are then directly planted. Annuals are cultivated for 3-4 years until the soil is "tired." Then varieties of *Musa* spp. are planted and grown for 15-20 years. After, selected trees will be planted or allowed to naturally regenerate, and cacao will be cultivated below them (Gordon, 1982; Onil & Peterson, pers. comm.). Smallholder production on the Atlantic coast is almost exclusively either Rustic Shade or Planted Shade (Rice & Greenberg, 2000). "Technified Cacao" is delineated by the absence of an overstory, i.e., cacao is produced without shade.

The present day agricultural landscape in the Bocas del Toro region consists of a mosaic of highly managed forest gardens, shifting agriculture, and cattle pasture. Cacao is currently being cultivated in the area by both indigenous and *mestizo* small farmers. Indigenous groups in the region do not all use the same farming practices (Gordon, 1982) and there is also much transfer of technology between indigenous and *mestizo* groups (Salinas, pers. comm.). Therefore discrete classifications of farming practices can not be made. However, in general the indigenous *rastrojo* system of shifting cultivation selects and leaves more useful trees standing and burns less intensively than the similarly shifting *milpa* system of *mestizo* farmers (Gordon, 1982).

Currently, smallholder cacao production on the Atlantic coast of Panama falls almost exclusively into Rice and Greenberg's (2000) categories of Rustic Shade or Planted Shade. In the Bocas del Toro version of the Rustic Shade system, the understory of existing forest is cleared and the overstory trees selectively cut to leave those that are best for shade or that produce other desirable products. In the Planted Shade system, the land is first cleared using "slash and burn" techniques. The land is then managed by one of two systems. In the first, the cleared land is directly planted with cacao and the seedlings or stakes of desirable shade trees. In the second, the land is used for annuals (corn, beans, rice, manioc, etc.) for 3-4 years until the soil is "tired." Varieties of *Musa* spp. are then cultivated and/or selective natural regeneration is allowed to occur for 8-15 years. Finally, selected trees will be planted or allowed to naturally regenerate and cacao will be cultivated below (Gordon, 1982; Onil & Peterson, pers. comm.; Bribri comarca, pers. comm.). Regrowth patterns in forest vary according to localized edaphic conditions and management (Gordon, 1982).

Production of cacao in high densities or in monocultures increases its susceptibility to insect herbivory and fungal pathogens (Gordon, 1982; Arnold, 2001) though even cacao grown in diverse systems is highly susceptible. Witch's broom (*Crinipellis perniciosa*) and frosty pod (*Moniliophthora roreri*) are two of the most damaging pathogens in the Central American region (World Cacao Foundation, 2003). The World Cacao Foundation (2003) estimates that approximately a quarter of the world cacao production is lost annually to pest and disease.

Though primarily found in tropical lowlands, cacao can be cultivated to elevations of 900 m, mainly limited then by heat. The plants require 1300-5000 mm of rain per year and favor clay-loamy soils though tolerate a wide variety of types (Urquhart, 1955). Though cacao plants flower and produce year round, flowering peaks after the first rains of the wet season (Young, 1994). In the Bocas del Toro region, this cycle then leads to a large harvest in September-October and another smaller harvest in February-March (Gordon, 1982; Mendez & Ortiz, 1998).

Ecological Sustainability

Noble and Dirzo (1997: p. 522) articulate a common belief: "Agroforestry does reduce biodiversity, but it can also act as an effective buffer to forest clearance and conversion to other land uses, which present the greatest threat to forest ecosystems." Overall, biological diversity is enhanced in agricultural landscapes. Moreover, the integration of agroforestry systems increases landscape diversity (Parish et al., 1998; Power, 1998; Reitsma et al., 2001; Duguma et al., 2001; Huang et al., 2002; Schroth et al., 2003).

The potential for various agroforestry systems to serve as buffer zones to protected areas has been well explored (Ameeruggy & Sansonnens, 1994; Mehta & Leuschner, 1997; Noble & Dirzo, 1997; Murniati & Gintings, 2001; Young, 2003). Many agroforestry systems mimic the structure of natural forests. Researchers have analyzed their ability to perform some of the functions of forests, including the conservation of biological diversity (Perfecto et al., 1996; Greenberg, 1998; Reitsma et al., 2001; Huang et al., 2002), protection against soil erosion and watershed degradation (Robles & Nava, 1998), and sequestration of carbon and aquifer renewal (Newmark, 1998; Parrish et al., 1998). Agroforestry systems in buffer zones are appealing to conservation organizations, governments, and development agencies because of their ability to enhance conservation in buffer zones while providing economic returns for inhabitants (Murniati & Gintings, 2001; Smithsonian, 2003).

Studies of cacao agroforestry systems have mainly focused on biodiversity. In the nearby Talamancan region of Costa Rica, Reitsma et al. (2001) found higher levels of avian diversity in managed cacao systems than in the natural surrounding forest. However, woodland generalists were the predominant guild present in these managed systems. A number of authors have suggested cacao systems can be managed to enhance habitat value (Greenberg, 1998; Rice & Greenberg, 2000). At the landscape level, cacao agroforestry systems, occurring in large, contiguous blocks interconnected by corridors, allow for colonization by forest plants and animals (Alves, 1990; Rice & Greenberg, 2000; Reitsma et al., 2001). Cacao systems also serve as important refuges for these species, and, thus, they are valued where deforestation is a threat

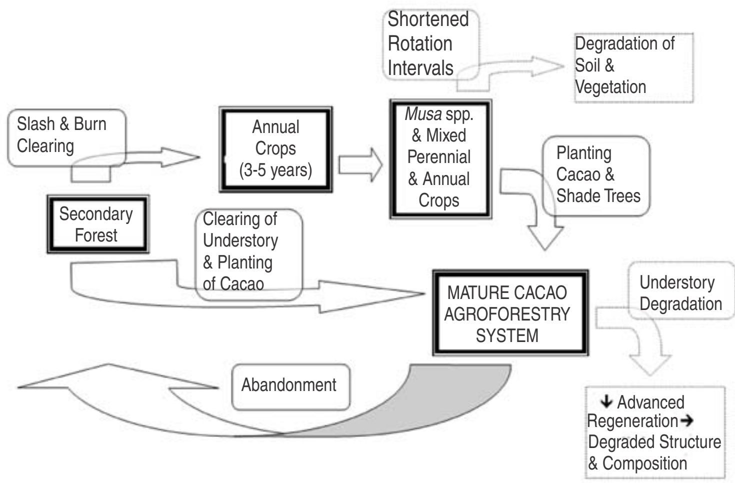
(Greenberg, 1998; Johns, 1999; Rice & Greenberg, 2000; Reitsma et al., 2001).

In pre-colonial times, before the introduction of the machete, farming in the Bocas del Toro region consisted mainly of the management of "forest gardens" with little intensive clearing characteristic of shifting "slash and burn" agriculture. Existing forest was highly managed to select for desirable food, fiber, wood or medicinal species. Land needed for cultivation of corn or other annuals would be cleared by low-intensity fires and some felling. In his study of the ethnobotanical culture of the indigenous groups of the Bocas del Toro region, B.L. Gordon (1982: p. 79) says that "a large part of the forest ecosystem has been subjected to cyclic changes of varying duration as a result of periodic human use; most forests in this area are themselves but advanced stages of secondary plant cover, though often not obviously so." Cacao, both wild varieties and the more highly selected varieties we use today, were grown as part of the understory of these shifting cultivation cycles' later stage.

Though cacao agroforestry systems do mimic the structure and functions of natural forests, certain management practices can lead to ecological degradation. Slash and burn clearing often mimics natural gap formation in forests. However, when clearing is extensive, or the interval between clearings is shortened, ecosystem degradation can result (Figure 2). Another possible source of degradation is bottom-up degradation. Chronic clearing of the understory, which occurs with cacao cultivation, debases forest structure and composition (Ashton et al., 2001). This disturbance does not allow regeneration to establish and eventually replace the overstory canopy (Figure 2) (Rice & Greenberg, 2000; Ashton et al., 2001). Reitsma et al. (2001) found cacao systems to have less canopy closure, less tree species diversity, and shorter canopy heights than surrounding forests. The extent of bottom-up degradation occurring in the cacao "forests" of the Bocas del Toro region is unclear as is the effect of farmer-assisted, canopy species regeneration in counteracting it.

Most smallholder cacao production in this region utilizes no agrochemicals and so the impacts of fertilizer run-off and pesticide contamination are negligible (Somaribba & Beer, 1998; Beitia, pers. comm.). One theory is that the increased income and benefits generated in these systems by diversity overshadow profits yielded from the application of chemical fertilizers and pesticides (Somaribba & Beer, 1998). Moreover, the higher and steadier prices associated with organic-certified cacao further deter the use of agrochemicals. The price received by members of CO.CA.BO, the only Panamanian cacao cooperative, was

FIGURE 2. Cycles of development and possible paths of degradation in cacao systems. Sustainable production systems rotate between the cacao agroforestry system and secondary forest. Degradation of this cyclical production system can be caused by the shortening of the rotation intervals or by understory degradation through intense pruning and clearing, which in turn leads to decreased advanced regeneration of shade canopy tree species.



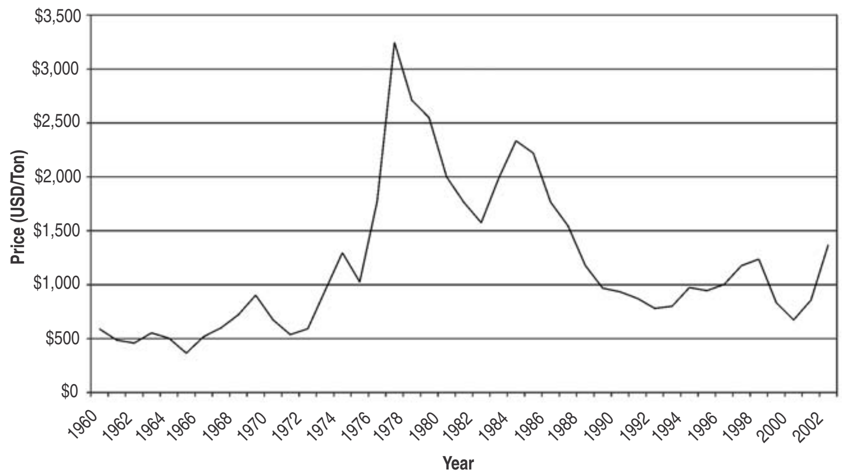
48% higher for organic cacao than conventional (CO.CA.BO., 2003). In 2002, 66% of the cacao from the 2,000 producers selling to CO. CA.BO. was organic-certified (CO.CA.BO., 2003).

Economic Sustainability

Cacao is a crop that is more susceptible to "the whims of fate" than most. There is little to no local market, so producers are dependent on a highly volatile global market. During the mid-1970s and early 1980s, prices rose and remained high (Figure 3). They crashed in the late 1980s and have remained low throughout the 1990s (Johns, 1999). Even though an increase from present prices is predicted for the coming years, a long term study of cacao prices has show an average decrease in real terms of $0.0128 pounds/year (Ramierez et al., 2001). Cacao is also very susceptible to pests and diseases, and outbreaks can radically alter levels of production from year to year (Evans, 1998).

During the 1980s, a frosty pod (*Moniliophthora roreri*) outbreak

FIGURE 3. Cacao bean average annual international market price 1960-2002. The price crash in the mid-1980s led many producers to abandon cacao in favor of banana and cattle production.



Based oon FAOSTAT Database

combined with the fall in world prices caused many medium to large-scale producers to convert entirely to banana or cattle production (Vinegas, pers. comm.). Indigenous farmers, however, allowed cacao to remain a component of a very diverse production system. Over a 35-year period, from 1965-2000, the area under cacao cultivation in Panama has remained relatively constant though levels of production have varied widely (FAOSTAT Database, 2003). A similar strategy has been observed in small-holder coffee farmers. In a diverse production system, maintaining perennial crop even when prices are low is sensible when considering both income generation and labor (Ponette, 2002). An on-farm study in Costa Rica by Ramierez et al. (2001) showed that diversified systems of cacao, plantains and timber production were in fact more economically profitable *and* stable than monocrops of any of the three. Even with lowered production rates, cacao has remained the primary cash crop for many of the smallholders in the region (Mendez & Ortiz, 1998). See Ramierez et al. (2001) for a more thorough analysis of the costs and benefits for various levels of diversification.

One of the strategies that can lessen the risk to smallholder cacao production is association of agrarian cooperatives. Cooperatives have increased bargaining power, can secure future prices for production and can provide credit or advanced payments to their members. The Co-operative de Servicios Múltiples Cacao Bocatoreña (CO.CA.BO.) in Panama and the Asociación de Pequeños Productores de Talamanca (APPTA) in Costa Rica are two well-established regional cacao cooperatives. Though already relatively strong, both show a desire to continue to expand services such as organic certification and marketing of diversified products (Beitia, pers. comm.; Vilchy, pers. comm.).

Currently, cacao production covers approximately 4,000 ha in Panama. The majority of production is located in Bocas del Toro province (FAOSTAT Database, 2003). The area of land under cacao cultivation has remained relatively small and fairly constant, unlike Costa Rica where cacao cultivation has decreased by 90% since 1960 (FAOSTAT Database, 2003). As a result, currently cacao is cultivated in this region almost solely in diverse, low-input systems.

Cultural Sustainability of Cacao

Cacao, though an anchor crop, is only one of many agricultural products produced in indigenous agroforestry systems. Subsistence farmers, by definition, maintain a diversity of crops, limiting their reliance on the cash economy by producing most of their basic needs. Diversity also provides an indemnity if one or two crops fail (Scott, 1976). While the cash yielded from cacao is therefore important, it is perhaps not the main consideration in management.

This concept was highlighted in a study carried out in the Atlantic region of Brazil (Johns, 1999). For twenty years, the Brazilian government attempted to modernize cacao cultivation by encouraging the removal of shade canopies and the utilization of agrochemicals. The majority of the small-holder cacao producers still maintain shade levels four to five times greater than the program's recommendations. Farmers indicated that the choice not to reduce shade was based on their understanding of the multiple benefits provided by shade trees and their unwillingness to change to a system in which they lacked experience (Johns, 1999). Johns concludes that this research suggests that cacao farmers employ an agroecological and risk-based decision logic.

Just as indemnity drives diversification in cacao agroforestry systems, it will likely also persuade farmers to seek an alternative source of income. Given their present level of integration into the market economy, if a cacao crop fails or the market collapses, farmers still require cash. The current alternative appears to be the other dominant, cash-based production system of cattle-ranching.

CATTLE

History of Cattle Production in Panama

Cattle have played an important role in Panama's rural economy since their introduction by the Spanish in the 1500s (Heckadon, 1997). Cattle grazing was originally confined to the Pacific side of the country where the Spanish population initially settled (Joly, 1986; Heckdon, 1997). The drier climate, presence of natural grasses and lower incidence of disease also made the Pacific coast more conducive to cattle production than the Atlantic (McCorkle, 1968; Heckadon, 1997; Jones, 1986). Cattle eventually expanded to the Atlantic coast in the 1960s. From the 1960s to the 1980s, a large-scale migration of *mestizo* peasants occurred from a region known as the "Interior." This region includes the Pacific provinces of Chiriquí, Los Santos, Herera, Cocle, and Veraguas. The migration of people from this Interior was spurred by high population densities, intergenerational fragmentation of family farms, and acquisition of small farms by larger landowners (Heckadon, 1984; Joly, 1986). Migration of cattle raising migrants to Atlantic provinces coincided with an outbreak of the fungal disease, frosty pod, that decreased cacao production (Joly, 1986). Many of the indigenous farmers responded by selling their farms to *mestizos* or abandoning cacao and incorporating cattle into their own farming systems (Jones, 1986; Joly, 1986). As a result between 1961 and 1981, heads of cattle in Bocas del Toro increased by 162% (Joly, 1986). In 1985, the completion of a road connecting the two sides of the country increased access to previously isolated lands in the province and facilitated further migration (Jones, 1990). This immigration surge mostly consisted of *mestizo* farmers and Ngöbe-Bugle Indians from the province of Chiriquí, both of whom practice cattle rearing (Jones, 1990; Heckadon, 1997).

Cattle are now an established and growing component of the land-use matrix in Bocas del Toro. A recent UNDP report estimates that cattle account for close to half of all of the agricultural land use in Bocas. The same report found cattle to be the largest and fastest growing agricultural activity in the region surrounding La Amistad Biosphere Reserve (UNDP, 2002). In addition, CO.CA.BO. has reported that with the downturn of world cacao prices in the late 1990s, an increasing number of its members are considering cattle as a way to diversify (Finisdore, 2002).

Current Production Systems

A variety of cattle production systems are practiced in Panama today. Most cattle grazing in Panama is done extensively (McCorkle, 1968). Average stocking rates are one head of cattle per hectare (IADB, 2002). The various production systems include specialized systems such as: (1) *ceba*, or fattening of beef cattle, which requires the largest amount of land and least amount of labor, (2) *cria*, or breeding to produce calves that are then sold for fattening, and (3) commercial dairy production. Labor requirements for dairy production are higher than either the *ceba* or *cria* systems as cattle require milking every day. Dairy production is restricted by access roads and established milk truck routes (Heckadon, 1984; McCorkle, 1968).

In addition to specialized production, a more generalized “dual-purpose” system exists, which produces both dairy and beef. The cattle used in dual-purpose systems are a cross of European breeds (*Bos taurus*), which produce high milk yields, and local *zebu* cattle (*Bos indicus*), which are more tolerant of the heat in tropical climates (McCorkle, 1968). Dual-purpose production is particularly popular with small and medium-scale farmers. This system allows farmers to generate income while contributing to household subsistence needs (Faminow, 1998). In addition, while specialized beef production requires more extensive landholdings, dual-purpose systems have been shown to be profitable on as little as 10 hectares (Schelhas, 1996).

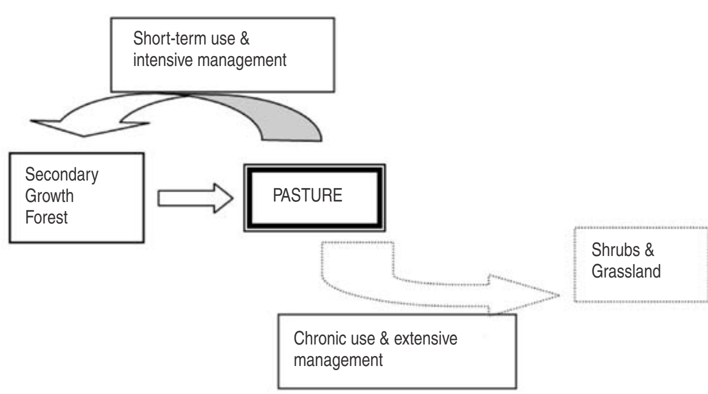
Ecological Impact of Extensive Cattle Systems

Numerous articles discuss the negative impact that extensive forms of cattle grazing can have on tropical ecosystems both as agents of deforestation and by degrading land once it is deforested (Nicholson et al., 1995). Of foremost concern is the loss of biological diversity associated with the destruction of tropical forests (Faminow, 1998; Mattos & Uhl, 1994; Southgate, 1998). Tropical forests provide habitat for a large percentage of all known plant and animal species. When land cover is converted from forest to pasture or agricultural crops, the ecosystem becomes less structurally diverse and supports fewer species (Jones, 1990; Mattos & Uhl, 1994; Southgate, 1998). In addition, the remaining tracts of forest may be reduced below a size threshold, making them unable to support viable populations of forest-dwelling species.

A second ecological concern is the alteration of the ecosystem services that forests can provide, particularly control of soil erosion and watershed protection. Trees have a deeper rooting system than pasture and, therefore, are better able to stabilize soils, particularly on steep slopes (Wishnie & Socha, 2003). Pasture grasses are capable of providing a certain amount of protection against soil erosion; however, this protection is negated if pasture grasses are overgrazed (Faminow, 1998). Deforestation in the upstream portion of watersheds is of particular concern because effects are disproportionately magnified downstream (Wishnie & Socha, 2003).

Finally, pasture degradation can lead to a cycle of deforestation (Figure 4). When tropical forest is converted to pasture, forage production gradually declines due to the loss of soil nutrients and soil compaction (Serrão & Toledo, 1990; Heckadon 1984). In the humid tropics, pasture productivity is further reduced by the high incidence of pests that attack forage grasses (Mattos & Uhl, 1994; Faminow, 1998). Weeds also compete with grasses further reducing productivity and increasing the cost of pasture maintenance (Mattos & Uhl, 1994; Serrão & Toledo, 1990).

FIGURE 4. Cycles of development and possible paths of degradation in pasture systems. Short-term use and intensive management can lead to a sustainable cycle that rotates between pasture and secondary forest growth. In contrast, chronic and extensive use of pasture will lead to a conversion to shrub and grassland, with little value as pasture and an inability to revert to secondary forest without rehabilitation.



When the weeds attain dominance, that pasture is thoroughly degraded and must be left fallow (Serrão & Toledo, 1990). Degradation can be accelerated by the frequent use of fire, overstocking, or insufficiently rotating animals in pastures (Serrão & Toledo, 1990).

Without intervention degradation will reduce a pasture's carrying capacity (Heckadon, 1984). When this happens, the farmer must decide among (1) reducing the herd, (2) investing to increase productivity, or (3) obtaining new pasture (Heckadon, 1984). When forested land is abundant and access is free, farmers usually choose to clear new land rather than invest in existing pastures (Jones, 1990). Limited market access also makes clearing new land attractive because restricted cash flow can make inputs prohibitively expensive. Conversely, when new land is scarce, investing in existing pastures may be more appealing, particularly when access to markets is strong (White et al., 2001).

Cattle Farmers

Cattle producers are often perceived to be a homogeneous group. In reality a wide array of actors engage in cattle rearing in Latin America ranging from wealthy landowners to subsistence peasants (Murgueitio, 1998; Kaimowitz, 1995). When drafting management policies, distinguishing amongst these various groups is important because their primary objectives differ and an intervention that is designed to influence one type of farmer will not necessarily affect the others.

At the broadest level cattle farmers can be divided into two groups: non production-oriented livestock owners and production-oriented livestock owners (Murgueitio, 1998). Nonproduction-oriented livestock owners do not seek value from cattle per se but from other benefits such as land speculation or capturing tax incentives (Murgueitio, 1998). In contrast, production-oriented livestock owners are motivated by deriving benefits directly from cattle or a cattle product. Examples of the production-oriented land user range from profit-maximizing corporations, to traditional ranching families for whom cattle is not only an income source but a lifestyle that provides a certain amount of social prestige, to subsistence farmers seeking to ensure the survival of their household (Kaimowitz, 1995; Nicholson et al., 1995).

A further distinction should be made within the production-oriented category of livestock owners between those whose primary objective is to maximize profits and subsistence producers. For profit-driven cattle farmers, the principal goals are to increase yields and generate higher profits. These land users can afford to invest in a greater amount of outside inputs to increase production and find a larger amount of risk acceptable. In contrast, subsistence-oriented cattle farmers cannot afford high levels of inputs and find very little risk acceptable. These farmers will attempt to minimize both inputs and risk even at the cost of lower yields.

An analysis of the rationale behind all the potential individuals involved with cattle in La Amistad Biosphere Reserve is beyond the scope of this paper. Our assessment is restricted to the behavior of small-scale cattle farmers who fall under the subsistence category mentioned above. However, other types of livestock owners may also be active in the region. Since the objectives of these other land users may differ from the smallholders, the recommendations in this paper should not be expected to influence their behavior. See Kaimowitz (1995) for a more thorough discussion of other types of livestock owners.

Appeal to Smallholders

Cattle are considered by many to be ecologically unsustainable in the tropics. In addition, some cost/benefit analyses conclude that it is often an unprofitable land use (Jones, 1990; Faminow et al., 1999). Nonetheless, smallholders throughout Latin America continue to include cattle in their land use strategies. In fact, except for farmers with prime agricultural land, the first thing that almost any small farmer in Central America does after he/she accrues a little land or money is to purchase cattle (Kaimowitz, 1995).

Cattle provide an entire suite of benefits to a smallholder household. Economic returns are only one component (Faminow, 1998). Extensive cattle systems require relatively low outlays of capital to establish and are easy to maintain. The low labor requirements allow family members to seek off-farm wage labor (Hecht, 1993; Faminow, 1998). At the same time, they produce a product that is highly marketable and transportable and contribute products for household consumption (Nicholson et al., 1995; Mattos & Uhl, 1994). Cattle production has a number of characteristics which, taken as a whole, even out risk and fulfill a number of requirements of smallholder household livelihood strategy.

Risk

Smallholder farming strategies are strongly influenced by the desire to avoid risk. Cattle ameliorate agricultural risk in several ways (Hecht, 1993). First, the risk of total crop loss is low. Panama is free of severe diseases, such as trypanosomosis (*Glossina* spp.), that decimate livestock populations in other regions of the world (FAO, 1998). Minor diseases, parasites and climatic anomalies can affect productivity but the risk of total herd loss is low (Mccorkle, 1968; Heckadon, 1984). Second, there is little variability in price and yields. Third, there are established and stable local markets for cattle products and, unlike the specialty markets of many perennial crops, no special market support is needed to access them. The variety of products that cattle can yield contributes to their marketability. In addition, cattle have the advantage that they can walk to market if necessary, which appeals particularly to farmers in remote locations. Finally, cattle are easy to liquidate due to flexibility of harvesting. As a result farmers often use cattle as an informal insurance policy. If an emergency arises, such as illness or the failure of other crops, or when there is need for a large cash outlay, such as a wedding or building a house, the sale of a cow can immediately provide a relatively large sum of money. Cattle are, therefore, a more secure store of wealth than cash crops.

Culture

Culture is another factor that motivates some smallholders. Cattle have historically been associated with the dominant Spanish social group in Central America (Heckadon, 1984; Jones, 1986; Joly, 1986). In regions where cattle has a strong tradition it is a land use that represents prosperity and carries a certain level of social prestige that extends the value of this land use beyond financial profit (Schelhas, 1996; Joly, 1986). Panamanian sociologist Stanley Heckadon-Moreno has labeled this *cultura de potrero,* or cattle culture. Many of the *mestizo* migrants in Bocas del Toro are originally from other provinces in Panama that have strong associations with the *cultura de potrero* (McKay, 1984).

The *cultura de potrero* undoubtedly has an influence on the land use choices of migrants in La Amistad Biosphere Reserve. However, this is only one of many factors that influence landholders' production choices and should not be focused on to the exclusion of other drivers. For example, in the Bocas del Toro province there are instances of both *mestizo* and indigenous farmers owning cattle. In a study of the Ngobe community in Valle de Risco, cattle were cited as one of the principal commercial agricultural activities of an indigenous community that has no tradition of 'cattle culture' (Mendez & Ortiz, 1998). Conversely, *mestizo* farmers have been know to convert from cattle when presented with feasible alternatives. An example can be found in the community of Las Delicias on the Costa Rican border. Founders of this community migrated from Chiriquí, a province renown for its cattle culture. Although their initial intention was to establish ranches, they instead adopted an indigenous swidden agricultural system after realizing it was more appropriate for the region. More recently, the community has solicited a grant from the Mesoamerican Biological Corridor to build facilities for ecotourism activities in a belief that this course has greater economic potential for the community than either agriculture or cattle (Salinas, pers. comm.).

Land Tenure

Land title regulations have been cited as a driver of pasture expansion throughout Latin America. In Panama, land title is contingent on usufruct rights. All unoccupied territory is considered property of the state and legal title is made available to anyone converting land to productive use (Jones, 1990). The Panamanian Agrarian Code, Law No. 37 states:

> Land meets its 'social use' when it is: (a) cultivated in pastures and/or occupied by bovine or equine cattle in proportion no less than one animal for every two hectares of land; (b) when at least two-thirds of the land is planted and maintained under cultivation; (c) when at least two-thirds of the land is planted with trees for the extraction of wood to be processed for industrial use; and (d) when land is converted into urban areas, according to current legal statues. (Joly, 1986)

Insecure title rights are considered to be an impediment to agricultural intensification. According to a United Nations Development Program (UNDP) project document (2002) approximately 2/3 of farmland in Bocas Del Toro is without title. PRONAT, a Global Environmental Facility (GEF)-World Bank funded land-titling project, is scheduled to begin in 2003 and is intended to register lands that have been occupied for the past 15 years. A potential benefit of this project is increased tenure security, which may encourage farmers to invest in intensification of their land use. However, there is also concern that the project could create a perverse incentive for cattle encroachment in the short term as speculators may rush to clear land in an attempt to obtain title (UNDP, 2002).

FARMER DECISION-MAKING STRATEGIES: CATTLE VS. CACAO

When deciding upon land use strategies, farmers do not consider options in isolation of one another, but rather weigh the available alternatives before investing their labor and land. Table 1 outlines the principal characteristics of each agricultural system that may influence adoption by smallholders. The data used to compile this table is based on characteristics for each crop as reported in the literature rather than primary data collected in Bocas del Toro.

Cattle provide relatively low returns per unit of land, which can be attributed to the fact that stocking rates throughout Panama are low. As pastures become degraded stocking rates may decline, further reducing returns to land. Returns to labor, however, are quite high. This is particularly true for beef cattle that require the least amount of labor. Cacao

TABLE 1. The relative economic and management characteristics of cacao and cattle that may influence adoption by agricultural smallholders.*

CHARACTERISTIC	***CACAO***	***CATTLE***
Returns to land ($/ha)	High	Low
Returns to labor	Low	High (highest for beef, lower for dairy/dual)
Capital needed to establish	Low	Low
Specialized knowledge needed to begin production	Medium (knowledge commonly known and shared)	Low
Input requirements	Low	Low
Labor requirements	Medium (fluctuates according to season)	Low (beef)/ Med (dairy/dual)
Market access	Difficult w/o support	Easy
Price Variability	High	Low
Yield Variability	High	Low
Stability of Market Demand	Low	High
Risk of crop failure	High	Low
Harvest Flexibility/liquidity	Medium (two annual harvests at fixed times)	High (unlike crops, cattle can be harvested at any time)

* Rankings are based on an ordinal scale

provides higher returns per unit of land but lower returns to labor, as it is a more labor-intensive system.

One of biggest obstacles to adoption of perennial crops is fluctuation in market prices over time (FAO, 1998). The supply to the market is highly affected by phenological cycles, weather and pests (Ramirez et al., 2001). The high fluctuation in annual production creates a feedback loop that affects world market prices (Ramirez et al., 2001). Smallholders often lack the financial stability or infrastructure to postpone their harvest until the seasonal glut passes and prices rise. Both of these risks can be ameliorated by smallholder cooperatives. In contrast, while cattle yields exhibit some seasonality, particularly in regions with a pronounced dry season, prices and supply fluctuate relatively little.

Market access also influences cropping strategies. Lack of market access and failure of markets to materialize at first harvest are widely cited reason for farmers to abandon introduced agroforestry schemes (Fujisaka & White, 1998). A case study in Brazil found that, market access is needed in order for farmers to adopt more intensive technologies, both for improving pasture and for investing in agroforestry crops such as cacao (FAO, 1998).

In the analysis of farmers' decision making, another risk-averse strategy common to smallholders is diversification of production. In the Bocas del Toro region, because a farmer chooses to plant cacao does not mean that he or she will desist entirely in cattle production. A recent UNDP report estimates that 40% of farms in the Palo Seco forest reserve contain cattle pasture but noted that many of these farms also have newly planted cacao on lands that are too steep for cattle (UNDP, 2002). If strategies can be found to make cacao more profitable, and to have more stable returns, this will likely decrease pressure to expand cattle production.

RECOMMENDATIONS

A lack of technical knowledge is often not what makes extensive agricultural practices prevail over more intensive forms of production. Therefore, intervention strategies limited to training often fail to change agricultural practices. Broader socioeconomic factors render extensive management a more competitive option for farmers than intensification (Jones, 1990; White et al., 2001). Conservation groups working in the region should focus on altering the conditions that currently make extensive systems, such as cattle, more attractive than perennial crops, such as cacao. To be competitive, not only must other land uses be able to yield the same benefits as cattle, but also the conditions that make extensive cattle systems attractive must be altered. We recommend first that reducing the risk associated with ecologically preferable production systems will be the most effective intervention. Cacao can be encouraged by stabilizing fluctuating prices and yield. Specialty markets (organic, fair trade) are more stable than traditional commodity markets and offer higher prices

Second, the obstacles smallholder farmers face in accessing these markets should be mitigated. Certification required to enter specialty markets is complex and expensive. The infrastructure needed to process, store and transport the product requires an economy of scale that the smallholder lacks. Increasing the capacity of local smallholder cooperatives that have the capacity to partner with others is an important step in gaining market share.

Third, technical assistance should be provided through established cooperatives and community groups. Communities would like assistance in (1) replanting decrepit cacao plots and (2) marketing crops produced in association with cacao (CO.CA.BO., 2003; Beitea, pers. comm.). Any technical assistance provided should maintain the cultural and biological diversity present in "agroecosystems."

Fourth, silvopastoral systems should be encouraged. A growing body of literature suggests that silvopastoral systems support a higher degree of biodiversity than previously believed. Trees in silvopastoral systems serve as "stepping stones," connecting forest fragments, and allow more forest-dwelling species to persist on the landscape (Guevara et al., 1986; Guevara et al., 1998; Harvey & Haber, 1999; Harvey et al., 2000).

Fifth, subsidies and/or credit would allow farmers to intensify production. The use of improved pasture and silvopastoral agroforestry systems extends productivity in pastures, reducing pressure to clear new land. Intensification requires a large investment, unattainable for most smallholder farmers, but returns on pasture improvement are considerable. Providing credit schemes or subsidies for intensification and silvopastoral systems makes them more feasible options for smallholders.

Finally, land tenure security for smallholders needs to be addressed. This security is necessary for land owners to invest in intensification or perennial, slow-to-produce systems, such as cacao. In addition, supporting indigenous claims to land may discourage migration from other provinces. Support the development of alternative, more ecologically-friendly income sources such as ecotourism (see Cusack & Dixon, this volume) or subsidized management for conservation, such as the Mesoamerican Biological Corridor (see Dettman, this volume), in order to provide alternatives other than cattle when cacao prices are low.

CONCLUSION

Agricultural expansion by smallholders has been targeted as the primary cause of ecological degradation by the organizations responsible for creating a management strategy for La Amistad Biosphere reserve. We have teased out assumptions of these organizations concerning the drivers and the solutions to ecological degradation and to analyze their validity. Below we list both assumptions and our conclusions.

Cacao agroforestry systems are entirely ecologically benign. Though empirical evidence is scarce, the cacao agroforesty systems, of the kind cultivated by smallholder producers in the region, do support many of the same ecological functions as natural forests. The ability of these systems to support high levels of biodiversity, though species composition may be slightly different from that of forests, make it an appropriate land use alternative for buffer zones of La Amistad Biosphere Reserve. However, certain management practices–shifts from intensive to extensive clearing in the slash and burn phase of the system, prolonged clearing of the understory and of lianas and vines, decreased tree diversity and density, and increased use of chemical fertilizers and pesticides–can lead to degradation of the ecological integrity of these systems. Understanding the economic and policy conditions, which might promote degrading management practices by cacao smallholders, is important and safeguards against them should be included in management plans for the reserve.

If cacao production is made to be more financially viable, incentives for expansion of cattle production and shifting agriculture will be decreased. The issue here may be not so much the ability to make cacao production more profitable, but in how to make it a more secure investment. From the smallholder perspective cacao is a more risky option than cattle due to its susceptibility to disease and highly volatile market prices. One option, which might reduce the risk of cacao production, is the support of the cooperative marketing of cacao as well as some of the diverse products grown in association with cacao. However, smallholders will not likely desist entirely in cattle production simply because they are receiving increased or even more stable income from cacao. The multiple benefits of secondary products, ease of production and marketing and social status received through cattle production will mean that it will always be an attractive option to some if not all. A more viable solution would be to reduce the ecological impact of the grazing that does occur and decrease the need to expand by providing technical and financial support for the intensification of pasturage.

As for clearing for shifting agriculture, this is in fact part of the cycle of the cacao agroforestry system. The 3-5 year slash and burn phase of this cycle in which basic grains such a corn, rice and beans are produced is a crucial component of the indigenous system of subsistence. While extensive and/or overly intensive slash and burn practices can be ecologically degrading, instead of condemning all slash and burn practices, employing a more subtle criteria for targeting only those who are practicing unsustainable management would be more useful.

Migrants from other areas are primarily responsible for clearing of land for cattle pasture on the eastern side of the park. Again, this appears to be too gross a generalization. While some of the largest and most recently arrived cattle ranchers in the area are migrants, other actors are at work. Many of the indigenous groups in the area also graze cattle, some of which, particularly the Ngobe group, are expanding to new areas of the reserve. With smallholders in particular, a level of cultural assimilation over time may lead migrants to adopt agricultural practices that are more appropriate to the conditions found on the eastern side of the park than extensive cattle grazing. In the meantime, however, strengthening indigenous land tenure may be an effective measure against intrusion, particularly by large-scale cattle ranchers.

The most effective means to prevent agricultural expansion is intervention at the level of smallholder production. While this is certainly true to some extent, being aware of the larger forces that are driving smallholders' decisions to expand is important. Issues of market risk, security of land tenure, subsidies, taxation practices, and presence or absence of technical support all influence a smallholders' ability to maintain or to convert to the intensive, sustainable practices that reduce the need to expand agricultural production. In the case of increased pressure for expansion caused by migration from other areas, to understand and try to counteract the factors that stimulate or force migration is important. Not overlooking the larger players who are, in many cases, responsible for far greater ecological degradation than are the smallholders is also crucial. In the region of La Amistad Biosphere Reserve, to include the banana companies and large cattle ranching operations in the analysis of ecologically destructive agricultural practices is essential.

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