ECOLOGICALLY NOBLE AMERINDIANS?
Cattle Ranching and Cash Cropping among Shuar and Colonists in Ecuador*

Thomas K. Rudel, *Rutgers University*
Diane Bates, *Sam Houston State University*
Rafael Machinguiashi, *Federación de Centros Shuar*

Abstract: Observers have argued that as indigenous peoples become more acculturated and their reserves more populous, they begin to exploit tropical rain forests much as colonists and other outsiders do. The history of changes in land use between 1950 and 1980 among the Shuar, an indigenous group in the Ecuadorian Amazon, would appear to support this convergence thesis. The Shuar began to clear land, plant pastures, and acquire cattle, much like their mestizo competitors for land. Using survey and remote-sensing data for a later period, from 1987 to 1997, we demonstrate that convergence has given way to divergence in land-use trends among the two groups. While mestizo smallholders throughout the region continue to rely on cattle ranching, Shuar smallholders close to roads have begun to reforest their lands and cultivate former garden crops like coffee and cacao as cash crops. These recent trends in Shuar land use suggest that even when Amerindians become more acculturated, they still maintain more biologically diverse landscapes than their mestizo neighbors.

Market Expansion and Resource Use among Amerindians

In a recent article entitled "The Ecologically Noble Savage," Kent Redford argued that Amerindians are not "natural conservationists" (Redford 1991; Redford and Stearman 1993). According to Redford, indigenous peoples pursue more sustainable patterns of land use only under special conditions of low population densities and abundant land, conditions that increasingly

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do not pertain in rain forests. In its original form, this argument focused primarily on Amerindian hunting practices, but it applies to agricultural practices as well.[1] As Redford and Stearman have pointed out, indigenous peoples frequently use agricultural techniques that over time degrade and sometimes destroy tropical forests (1993).

Larger political and economic forces support these tendencies in land use. By encouraging the incorporation of indigenous peoples into markets, the global expansion of markets has encouraged the conversion of lands to economically productive uses that are environmentally unsustainable. Governments have contributed to this process through regional development programs that improved transportation, thereby encouraging peoples in remote regions to produce for national and international markets. Over time these transformations have created rural places with increasing numbers of acculturated, economically integrated indigenous peoples and have caused a convergence in land-use practices between Amerindian and mestizo smallholders.

Amerindians practice unsustainable agriculture and resource use under a wide variety of circumstances. As Machiguenga smallholders in the Peruvian Amazon have become regular participants in producing commodity crops during the past twenty years, they have increased the scale of their agricultural enterprises and destroyed larger amounts of rain forest (Henrich 1997). Yucatec Mayan farmers in southern Mexico have recently established permanent plots of land and begun to use chemical pesticides on a regular basis in cultivating corn (Humphries 1993). Large numbers of researchers have reported that Amerindian groups rapidly deplete local supplies of tropical forest flora and fauna when beginning to sell them in outside markets (Nietschman 1973; Behrens et al. 1994; Godoy et al. 1995; Sierra et al. 1999). Amerindian groups in Bolivia, Brazil, and Ecuador have permitted logging companies to extract commercially valuable timber from their reserves or village lands (Turner 1995; Roper 2000; Rudel 2000).

Perhaps the most dramatic illustration of the problematic association between indigenous peoples and low-impact use of resources involves Amerindians in the Ecuadorian Amazon. Until the 1950s, Shuar and Quichua peoples living at the eastern base of the Andes provided for themselves through a mix of hunting, gathering, and shifting cultivation that left the tropical rain forests of the region largely intact (Harner 1973; Whitten 1976). During the 1960s and the 1970s, however, Shuar and Quichua livelihoods changed in dramatic ways. Household heads cleared extensive tracts of rain forest and became small-scale cattle ranchers (Federación de Centros Shuar 1976; Rudel and Horowitz 1993; MacDonald 1981, 1984; Borgtoft et al. 1999). Although the Shuar and Quichua found the income from cattle useful in paying for medical care and consumer goods (Picard 1996), they became

1. Kevin Flesher, personal communication, fall 1999, New Brunswick, N.J.

cattle ranchers largely to secure title to their ancestral lands. Clearing land and raising cattle on it strengthened Amerindian claims to lands coveted by colonists newly arrived from the highlands.

These examples would certainly seem to justify the skepticism expressed by Redford and others about the potential for environmentally sustainable patterns of resource use among the more populous and acculturated Amerindian groups. Despite the supporting evidence, however, several empirical reasons exist for questioning the accuracy of this line of analysis. First, abstracted, ahistorical arguments about market expansion and its environmental effects do not capture the ways that historical events shape change in landscapes. Governments start and stop their efforts to incorporate remote rural areas into national economies. This intermittent pattern implies that processes of agricultural expansion and environmental destruction among Amerindian groups fluctuate in form and rate across different historical periods. Periods of convergence in land-use trends among smallholders may be followed by periods in which cultivators revert to earlier, ethnically distinct patterns of cultivation.

Second, the argument for convergence presumes that increased integration into market economies always brings high levels of environmental destruction. An extensive body of evidence on the ecology of smallholder cultivation challenges this presumption by showing that smallholders who market their harvests often work the land in environmentally sustainable ways (Netting 1993). Applied to Amerindian groups in the Amazon basin, this insight suggests that while increases in population density, market incorporation, and acculturation accelerate rates of deforestation on Amerindian reserves, these same trends may also encourage smallholders to adopt ecologically sustainable agricultural practices. We explore this possibility through a case study of changes in land use among Shuar smallholders in Ecuador and a comparison group of mestizo smallholders from 1987 to 1997.

Our data came from satellite images and two household surveys that we carried out among Shuar and mestizo smallholders in 1986 and 1997. The situation under study took the form of a quasi experiment (Cook and Campbell 1979). In the mid-1970s, Shuar and mestizo smallholders in the Chiguaza region of the province of Morona Santiago controlled similar amounts of natural resources, worked in similar institutional contexts, and had to cope with the same market forces. They differed in one important dimension: their ethnicity. The similarities in resource endowments, ecology, and economy made it possible to disentangle the effects of ethnic factors from others in studying land-use changes in the Chiguaza region. This possibility in turn enabled us to use these data to assess Redford's contention about the impact of globalization, population increase, and acculturation on indigenous land use.

The Historical Context: Shuar and Colonists in the Ecuadorian Amazon

Known as "Jivaros" to the early missionaries and ethnographers (Karsten 1935; Harner 1973), the Shuar have inhabited the upper reaches of the Amazon basin in what is now southeastern Ecuador since before the Inca arrived.[2] Along with the Huambisa, the Achuar, and the Aguaruna, the Shuar are members of the Jivaroan language group that stretches across the border between Ecuador and Peru in the western Amazon. These four tribes represent the largest population of Amazonian Amerindian groups (Descola 1996, 427). Of the four, the Shuar are the most populous, numbering more than forty thousand persons (INEC 1996). Until the mid-twentieth century, shifting cultivation and hunting provided most Shuar with a livelihood. But like so many other Amerindian groups, the Shuar endured an invasion of their ancestral homelands that changed the way they use land. Early in the twentieth century, Catholic priests from the Salesian order, with support from the Ecuadorian state, established missions at the base of the Andes in an attempt to contact and convert the Shuar to Christianity. Families of poor mestizos from the Andes followed the priests into the Amazon and established settlements around the missions.[3] The initial settlements attracted other colonists, and the new arrivals began appropriating or purchasing Shuar lands near the missions. Faced with this invasion by the much more numerous colonists, the few Shuar families in the immediate vicinity of the missions retreated to places further back in the rain forest. This pattern was repeated over and over between 1920 and 1960, as the Salesians and their colonist followers extended their network of missions further into the rain forest. Wherever the colonists claimed lands, they secured their claim by clearing the land, planting pasture, and establishing small herds of cattle (Rudel and Horowitz 1993).

2. The ethnographic literature on the Shuar is large but somewhat dated. Field research for the best-known of the general Shuar ethnographies was conducted almost forty years ago (Harner 1973), before the Shuar reorganized themselves into villages and took up cattle ranching. During the late 1970s, Philippe Descola and Anne Christine Taylor carried out an impressive ethnographic study of the Achuar, a closely related group living just to the east of the Shuar (Descola 1994, 1996). Like Harner's work, their research focused on households who earned their livelihoods in forested settings and had minimal contact with mestizos, and it therefore revealed little about the more numerous acculturated and market-oriented Shuar living closer to the Andes. Charlotte Seymour-Smith (1988) published an insightful study of the Shiwiar, who belong to the same linguistic group as the Shuar and live in a largely forested environment. Ediciones Abya-Yala in Quito has published a long series of illuminating works on Shuar culture by Shuar and Salesian authors, but these publications usually do not describe the life of the acculturated Shuar in much detail.

3. Almost all the colonists in the southern region of the Ecuadorian Amazon come from the poor Spanish-speaking peasants of Ecuador's southern highlands. Their culture represents a blend of indigenous and Spanish colonial cultures, and we therefore use the term *mestizo* to describe them. We use the terms *mestizo* and *colonist* interchangeably.

In the early 1960s, colonization efforts accelerated in Ecuador and throughout Latin America. Driven by fears that Cuban-style revolutions might occur elsewhere in Latin America, the U.S. government decided in 1961 to provide financial assistance through the Alliance for Progress to Latin American governments that initiated land reforms (Forster 1989, 96). A flurry of legislative activity followed as Latin American governments enacted agrarian reforms and created agencies to administer the land reforms (Thiesenhusen 1989). Ecuador enacted its first land-reform law in 1964 and augmented it in 1973 and 1977. The reforms set up administrative mechanisms to redistribute land but also established programs to expedite colonization of "unoccupied lands" in forested rural regions with small Amerindian populations. In Ecuador the new laws made legal the prevailing informal norm among colonists that whoever cleared a tract of land owned it and a portion of the surrounding forest (Rudel 1983). By promoting colonization, the laws gave legal expression to a patriotic political sentiment among colonists, politicians, and the military that colonization would contribute to defense of the country by establishing "a living frontier" along the disputed border with Peru (Zavallos 1989).

To counter the colonist invasion, the Shuar, at the urging of the Salesians, reorganized themselves. They moved from solitary houses in unbroken rain forests into clusters of houses in villages (*centros*) situated in tracts of rain forest, extending three to six thousand hectares, to which the villagers laid claim. Beginning in the mid-1960s, the Shuar lodged legal claims to these lands through the newly created Federación de Centros Shuar. To reinforce their claims, heads of household imitated colonists by planting pastures and acquiring small herds of cattle. Over the twenty-five years from 1960 to 1985, this strategy proved successful in securing a land base for the Shuar in Morona Santiago. Right-wing and centrist regimes in Quito did not validate Shuar claims to the land around their centros, but left-leaning regimes in the mid-1970s and again in the late 1980s processed all Shuar claims, and the villages thus obtained legally recognized titles to land. In the interim period before legalization, the high degree of organization among the Shuar coupled with their bellicose reputation persuaded most potential colonist invaders to look elsewhere for land. By the late 1980s, the Shuar had secured approximately 40 percent of the arable lands in Morona Santiago for themselves.

Between 1965 and 1985, Shuar and mestizo smallholders came to resemble each other in both their landholdings and land tenure. Landholdings ranging from thirty to seventy hectares predominated in both colonist communities and Shuar centros. While the colonists occupied a larger proportion of the lands at higher elevations in the western portions of the province, no one farmed inaccessible or steeply sloped land. Although the centros hold global titles to the land, household heads can sell their individual tracts of land to other Shuar or pass their land on to their children as

an inheritance. Most colonist smallholders in the region had some form of legally recognized individual title to land by the 1980s.[4] Disputes between colonists and Shuar over competing claims to land still occur in a few places in Morona Santiago, but their number has declined in the past twenty-five years as more claimants have acquired titles to land.

The Shuar have gained access to some credit in building herds of cattle. During the 1960s and early 1970s, the Salesians aided Shuar who wanted to establish herds, first by providing them with cattle from small mission herds and later by making credit for their purchase available to individual Shuar on a rotating basis.[5] Beginning in the 1970s the Federación de Centros Shuar obtained funds from European development assistance programs and later from Ecuadorian sources to establish subsidized lines of credit for Shuar households who wanted to acquire cattle (Federación de Centros Shuar 1976; Picard 1996; Rudel and Horowitz 1993). At first the credit went to *grupos ganaderos* (cattle development groups) run by the local political authority in each centro, and these groups maintained some pastures in common. But during the 1980s and 1990s, most of the cattle development groups fell apart, and households began to raise their own herds on their own lands in the centros. Because Shuar householders did not have individual title to their lands, they could not use them as collateral to obtain loans from the Banco de Fomento, and they therefore did not rely on credit as much as the colonists in building their cattle herds. The relative lack of credit may explain in part why the Shuar had smaller herds than the colonists during the 1980s.

The western Shuar showed clear signs of acculturation during the 1990s. With radio-assisted bilingual schools in every centro, levels of educational achievement rose rapidly. Heads of households averaged three years of education in the 1986 survey and five years of education in the 1997 survey. Shuar students graduate from centro schools with at least a rudimentary command of Spanish, and they have numerous opportunities to use it in their daily affairs. While a pattern of residential segregation persists with Shuar living in centros and colonists in nearby villages, the western Shuar shop regularly in the colonist communities and participate in regional cultural events like soccer tournaments, which pit teams from different settlements against one another. The Shuar, like the mestizos, are either nominally Catholic or Protestant. Young Shuar have gravitated to nearby urban

4. In most instances, colonists lacked full title to their lands because land surveys were required for titling, and most could not afford the cost. Most colonists had *pre-títulos*, which banks recognized as evidence of ownership in granting loans.

5. From the 1930s until the 1970s, the Salesians maintained the mission herds at least partly with the labor of Shuar children. Beginning in the third or fourth grade, Shuar children attended mission boarding schools. Typically, they would attend classes in the morning until lunchtime and afterward work in the gardens and cattle pastures that provided them, the priests, and the nuns with food. In return, the children received room, board, and education.

areas and entered urban occupations in recent years. One group of enterprising young men began a cooperative of Shuar taxicab drivers in the provincial capital of Morona Santiago in the 1990s. A Shuar writer recently suggested that a mineral company compensate the Shuar for access to their lands by constructing a network of gas stations in the centros (Chumpi 1999). These signs of cultural convergence, together with the similarity in land-use patterns during the 1980s, suggest (in line with Redford's argument) that Shuar and colonist patterns of land use will continue to converge during the 1990s. We put this expectation to a test with a mixture of remote-sensing and survey data collected from Shuar and colonist smallholders in the 1980s and 1990s.

Data and Methods

The data for this study came from three different sources. A 1986 survey of smallholders in two matched communities, one Shuar and the other colonist, yielded valuable baseline data on land-use patterns among 72 landowners in the two places (Rudel and Horowitz 1993). A second survey, carried out in 1997, included interviews with landowners in these two communities in addition to interviews with Shuar and mestizo landowners in other communities in the Chiguaza region. We conducted a total of 225 interviews with landowners in this second survey.[6] For both the Shuar and colonist subsamples, we stratified the samples by distance to the road so that interviews with both groups yielded data on land-use patterns close to roads and on land-use patterns far from roads (a two-hour walk or more). Key informant interviewing and participant observation during the past three decades provided additional insights that we have used in interpreting the interview data.

We supplemented the interview data with remote-sensing analyses of land-use changes in Shuar and mestizo communities between 1987 and 1997. The high degree of residential segregation between Shuar and mestizo smallholders in the Chiguaza region, outlined in maps produced by the Federación de Centros Shuar, made it possible to delineate ethnically homogenous areas where we could analyze changes in land use over the ten-year period. We used Thematic Mapper (TM) satellite images from September 1987 and September 1997 to carry out the remote-sensing analysis. The TM images classify land cover in units thirty meters square.

6. Historical antagonisms made it difficult for the same research team to work among both Shuar and colonist respondents. To avoid this problem, we used separate interviewers for each ethnic group. In 1997 and 1998, Diane Bates and Delores Quesada carried out all of the interviews among the mestizo smallholders. A team of Shuar interviewers, headed by Rafael Machinguiashi, conducted the interviews with the Shuar smallholders. In the 1980s, Tom Rudel interviewed the colonists, and Bruce Horowitz interviewed the Shuar.

We carried out a supervised classification of the images through the following steps. Based on our field knowledge of land-use patterns, we identified the locations of eight to ten plots with the same land cover and identified the range of spectral signatures for these plots. We were thus able to identify distinct ranges of spectral signatures for four types of land use: pasture, gardens, secondary forests, and primary forests.[7] We then used these signatures to classify the 1987 and 1997 images for eight colonist and five Shuar communities. Overlaying the 1987 and 1997 images made it possible to examine patterns of change over time in land use.[8] The remote-sensing analyses and interview data for the same communities provide valuable checks on the validity of our data. Because the remote-sensing analysis covers a wider set of communities than the interview data (thirteen as opposed to five), it also enlarges the scope of the analysis reported here.

Change in Land Cover among Shuar and Mestizo Smallholders, 1987–1997

Table 1 summarizes the results of the remote-sensing analysis of changes in land cover in eight mestizo and five Shuar communities in the Chiguaza region. Several changes occurred in both sets of communities. Smallholders from both groups continued to clear primary forests, but the Shuar cleared their lands at a more rapid rate. The differential rates of deforestation reflect an ongoing commitment to cattle ranching among Shuar located far from the main road. The colonists expanded their pastures at a more rapid rate, largely by converting cropland into pasture.

The large declines in cropland reflect decisions by both Shuar and mestizo cultivators to abandon large-scale cultivation (more than one contiguous hectare) of *naranjilla* (*Solanum quitoense*), a succulent citrus-like fruit, after pest problems worsened in the late 1980s. Unlike the colonists, the Shuar continued to cultivate naranjilla in combination with other crops in isolated plots that rarely exceeded one hectare. To some extent, the small size and isolated locations of these fields protected the naranjilla from pest infestations, and consequently, the Shuar did not use pesticides as often as the colonists. The Shuar also expanded their cultivation of other crops, mak-

7. Two measurement problems undermine the validity of our remote-sensing results to a small extent. First, more extensive cloud cover in the 1997 image than in the 1987 image forced us to throw out one area of interest (community) from the analysis. Second, the spectral signatures of primary and secondary forest were sensitive to elevation. In the westernmost areas of interest, the foothills of the Andes, it was difficult to distinguish between the two reliably. Because this problem affected only two of our twelve areas of interest, we believe that it does not invalidate the basic conclusions that we have drawn from the analysis.

8. The 1987 and 1997 satellite images were geo-referenced at the outset to ensure that the same coordinates in the two images referred to the same place on the ground. With this type of concordance between images, we were able to carry out the analyses of change over time in land uses.

TABLE 1 Remote-Sensing Analysis of Changes in Land Use in Shuar and Mestizo Communities between 1987 and 1997 in Percentages of Land Area

	% of Land Cover in 1987	*% of Land Cover in 1997*	*Change in % from 1987 to 1997*
Primary forest			
Shuar	57.5	37.8	-19.6
Mestizo	33.8	24.4	-9.4
Pasture			
Shuar	8.6	22.2	+13.6
Mestizo	15.0	44.9	+29.9
Crops and gardens			
Shuar	13.4	5.2	-8.2
Mestizo	22.4	3.5	-18.9
Secondary forest			
Shuar	5.2	19.3	+14.1
Mestizo	12.0	12.0	0.0

Sources: 1987 and 1997 remote-sensing images of the Upano-Palora region of the Ecuadorian Amazon.

NOTE: Mean areas devoted to different land uses in five Shuar and eight mestizo communities in the Upano-Palora region. The reported categories do not sum to 100% of the land area because bare ground, rock, water, and urban land uses are not included in the table. Places with undefinable land uses and cloud cover were not included in the calculations.

ing the decline in the extent of their cropland less severe than among the mestizos.

The disproportionate increases in the amounts of secondary forest in Shuar communities reflect the increased fallowing of lands that follows from their new commitment to raising tropical fruits and tubers as cash crops. Proximity to the road influences these patterns. The Shuar centro closest to the main north-south road experienced net reforestation between 1987 and 1997, while the centros farther from the main road continued to experience deforestation. Net change in forest cover, calculated by combining the changes in primary and secondary forests, differed between Shuar and colonist communities. During these ten years, forest cover declined by 5.5 percent in Shuar communities and by 9.4 percent in colonist communities.

The comparison in table 2 of social and ecological data from the 1986 and 1997 surveys conducted in the same roadside Shuar and mestizo communities points to several significant trends.[9] First, the survey data indicate

9. The communities in question are closer to the main north-south road through the region than some of the communities in the remote-sensing analysis, and therefore the results from the two surveys are not broadly representative in this respect.

TABLE 2 Changing Attributes of Shuar and Mestizo Households in Two Chiguaza Communities, Uunt Chiwias and Sinai

Variables	*Group*	*1987*	*1997*
Size of landholding	Shuar	63	53
(hectares)	Mestizo	61	46
Land in pasture	Shuar	20.8	16.6
(hectares)	Mestizo	39.8	29.4
Head of cattle	Shuar	5.0	2.0
	Mestizo	24.0	16.0
Cleared land	Shuar	38.0	55.0
(% of total)	Mestizo	76.0	79.0
Household size	Shuar	5.9	6.3
(persons)	Mestizo	6.8	4.8
Loans from banks	Shuar	25.0	22.0
(% of households)	Mestizo	90.0	40.0
Secondary forest	Shuar		7.1
(hectares)	Mestizo		2.8

Sources: 1986 and 1997–1998 surveys of household heads in the communities of Uunt Chiwias and Sinai, Chiguaza region of the Ecuadorian Amazon.

the same general pattern of change in land use as the remote-sensing data. The Shuar cleared more land during the decade and also allowed more land to revert to secondary forest. Second, the decline in the size of landholdings among both Shuar and mestizo respondents indicates a process of land subdivision in both populations. The accompanying increases in Shuar household size suggest that the shift into cash cropping represents a process of agricultural intensification driven in part by population growth. While some young Shuar have migrated to urban areas in the Ecuadorian Amazon, many more young colonists have migrated to more distant locales. With more Shuar youth at home, household heads have the labor force necessary for labor-intensive cultivation of cash crops. This option is not available in the labor-starved colonist households.

While the declines in the amount of pasture among both Shuar and mestizos reflect shrinkage in the overall size of farms, the disproportionate drop in herd size among the Shuar suggests a growing disaffection with cattle ranching, especially in communities along the road, where cash cropping offers an alternative livelihood. In the roadside centro of Uunt Chiwias, the percentage of landowners with cattle dropped from 88 percent in

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TABLE 3: *Transitions in Land Use among Shuar and Colonist Smallholders, 1987–1997*

	Changes in Land Use (% of all land)		
	Garden to Garden	*Garden to Forest*	*Pasture to Forest*
Shuar communities	5.7	9.2	8.4
Colonist communities	1.3	7.8	7.0

Source: 1987 and 1997 remote-sensing images of the Chiguaza region of the Ecuadorian Amazon.

1986 to 28 percent in 1997. Like the cattle-ranching Quijos Quichua (MacDonald 1981, 356), Shuar smallholders express little regard for cows. They consider them dirty animals and prefer eating game to beef (Rudel and Horowitz 1993, 126–28). Small herd sizes are not peculiar to the Chiguaza Shuar. Cattle herds averaged only seven head in a recent survey of three Shuar centros about a hundred kilometers south of the Chiguaza region (Picard 1996, 65). Remote-sensing analyses of transitions in land use support this overall picture. As the data in table 3 indicate, Shuar smallholders were more likely to allow both their pastures and gardens (of naranjilla) to revert to forest than were their mestizo neighbors. The Shuar were also more likely to maintain particular tracts of land in gardens over the ten-year period.[10]

The measures of crop diversity in table 4 clarify the diverging patterns of land use between Shuar and mestizo farmers.[11] While crop diversity has declined on mestizo farms, it has increased on Shuar farms. Pest problems led mestizo farmers to abandon the cultivation of naranjilla in droves. Ninety-seven percent of the colonist households now rely on cattle ranching for income, and a third earn additional income by cultivating sugarcane (*Saccarum officinarum*). In contrast, Shuar smallholders have begun to cultivate an array of cash crops for urban consumers, especially in communities located along heavily traveled roads between urban centers. More than half of the Shuar households surveyed in these places raise coffee (*Coffea arabica*), cacao (*Theobroma bicolor*), plantain (*Musa paradisiaca*), or

10. The figures for land remaining in gardens are somewhat misleading. The Shuar usually maintain a garden for only three years before allowing the land to revert to forest, and they often clear an adjacent tract of land for a new garden. Because TM images have a minimum resolution of thirty meters, they may in many instances count adjacent gardens, formed sequentially, as a single garden. For this reason, a change-over-time analysis of satellite imagery may not note any change in land use in places where small changes occur frequently as farmers practice shifting cultivation.

11. In our interviews with smallholders, we focused on crops grown for sale. Had we asked more questions about crops grown for household use, the diversity of crops grown on each landholding would no doubt have been much greater.

TABLE 4: Diversity of Commercial Crops on Shuar and Mestizo Farms: Mean Scores

	Shuar	*Mestizos*
Number of cultivars	3.17	1.56
Number of new crops in past ten years	2.09	0.35
Number of crops abandoned in past ten years	1.83	1.11
Number of different farm products sold	2.48	1.32

Source: 1997–1998 survey of Shuar and colonist smallholders.

NOTE: N = 75 farms for Shuar, 129 farms for colonists. All the differences of means reported here are significant at $p < .05$ or less.

manioc (*Manihot esculenta*) for sale to urban consumers or exporters. The shift into cash cropping seems remarkable given the sharp decline in coffee prices during the early 1990s caused by the disintegration of the international coffee cartel. In the same period, colonist smallholders in the northern reaches of the Ecuadorian Amazon reduced the amount of land that they devoted to coffee cultivation (Eberhart 1998). The apparent refusal of the Shuar to heed these price signals suggests that the need to intensify agriculture on a reduced land base, coupled with the availability of household labor and their long experience in cultivating gardens, may be driving their conversion to the cash cropping of former garden crops.

Shuar smallholders cultivate cash crops on sites that they have cleared of old-growth forests until yields begin to decline, when they move to another old-growth site. Secondary forests regenerate on the abandoned site. This pattern of cultivation explains why the Shuar have cleared so much primary forest as well as why their farms contain so much secondary forest. It also explains to some degree why cattle herds have recently declined among Shuar with the easiest access to markets. Between 1986 and 1997, the average size of herds in the roadside community of Uunt Chiwias declined from five to two head. Recent declines in the availability of credit from the Federación de Centros Shuar, resulting from difficulties in collecting on previous loans for cattle (Picard 1996, 71), may also have played a role in the decline of cattle ranching. Some Shuar without cattle rent their empty pastures to nearby colonists, while other Shuar allow the pastures to revert to forests.

Conclusion

The findings outlined in the four tables indicate, as expected in Redford's thesis, that the acculturated Shuar in western Morona Santiago have become active participants in markets for agricultural commodities. Yet despite greater participation of the Shuar in markets, Shuar and mestizo smallholders use the land in increasingly distinct ways. Data on the way the Shuar use land and the variety of crops that they cultivate for sale indicate that many of them are becoming horticulturalists, while mestizos remain firmly committed to raising cattle. Given the Shuar's long history as shifting cultivators before contact with Europeans in 1950, the return to horticulture is unsurprising, although it is not a simple reversion to past agricultural practices. The scale of the horticultural enterprise increased substantially when the Shuar began selling to urban consumer markets.

Our case study supports the contention associated with Redford's argument that acculturation leads to the incorporation of indigenous peoples into markets. But it also suggests that the paths of incorporation differ along ethnic lines: some groups specialize in one commodity, while other groups specialize in another. These differences in paths of incorporation have environmental consequences. The Shuar cleared land at more rapid rates than the colonists between 1987 and 1997, but the fields they created were more agriculturally diverse than the colonists' pastures. This pattern recalls recent arguments about the importance of considering variations in levels of biodiversity in different types of agricultural landscapes (Prefecto and Vandermeer 1995). With higher levels of crop diversity and smaller plot sizes, the emerging agricultural landscape of the Shuar displays higher levels of biodiversity than the more monocultural cattle-oriented mestizo landscape. In this sense, these findings argue against the idea that acculturation and economic integration eliminate environmentally benign Amerindian landscapes. As the Shuar have joined the market economy, they have created an agricultural landscape that has lower levels of biodiversity than a primary forest but more biodiversity than the nearby mestizo agricultural landscape. From a pragmatic point of view, these differences between landscapes have important implications for targeting agroforestry programs. They suggest that indigenous peoples like the Shuar should be among their primary targets.

Studies in other rural regions suggest that the recent return to horticulture among the Shuar is not an isolated event. First, the Shuar are not alone among indigenous groups in moving away from cattle ranching. Several Amerindian groups in the Peruvian Amazon have also abandoned cattle ranching recently (Staver, Simeone, and Stocks 1994; Putsche 2000). This pattern suggests that the original adoption of cattle ranching by some Amerindian groups represented a defensive reaction in a period of extraordinary state activity in rural development (Grindle 1986). In these years, governments promoted the colonization of the Amazon basin by outsiders,

thus threatening indigenous peoples' control over their ancestral homelands. The debt-induced decline in state activity during the 1980s and 1990s, coupled with the acquisition of titles to land, made cattle ranching an unnecessary strategy for securing a land base. In these circumstances, some indigenous peoples reverted to a more familiar, albeit modified, pattern of agriculture, cultivating garden crops that have now become agricultural commodities.

Second, recent patterns of agricultural change among the Shuar and more populous Amazonian Amerindian groups like the Quijos Quichua in Ecuador and the Machiguenga in Peru suggest that their agricultural practices increasingly resemble those of other smallholders in disparate locations around the globe. As Robert Netting pointed out, intensive smallholder systems "achieve high production, combine subsistence and market benefits, transform energy efficiently, and encourage practices of stewardship and conservation of resources" (Netting 1993, 320). Smallholders typically use abundant supplies of family labor to produce an array of agricultural products on relatively small family landholdings. The low chemical inputs and green-manure focus of Shuar smallholders, together with their appreciation for the value of forests in restoring soil fertility, makes it plausible to include them among smallholders who practice ecologically sustainable agriculture. While most Amazonian Amerindians, including some Shuar, continue to live in land-abundant agricultural settings, more and more of them reside on relatively small, individually held plots of land within reserves like the centros in the Chiguaza region. It is too soon to anoint the Shuar with ecological nobility because primary forests in their centros continue to disappear at rapid rates. Yet the recent shift of the Shuar from cattle ranching to cash cropping represents a step toward a well-known pattern of ecologically sustainable agriculture. For this reason, the indigenous promise of environmentally responsible stewardship remains real in a limited way.

REFERENCES

BEHRENS, CLIFFORD, M. BAKSH, AND M. MOTHES
1994 "A Regional Analysis of Bari Land-Use Intensification and Its Impact on Landscape Heterogeneity." *Landscape Ecology* 22, no. 3:279–315.

BORGTOFT, HENRIK, F. SKOV, J. FJELDSA, I. SCHELLERUP, AND B. OLLGAARD
1999 *La gente y la biodiversidad: Dos estudios en comunidades de las estribaciones de los Andes en Ecuador.* Quito: Abya-Yala.

CHUMPI, MARCELINO
1999 *Explotación petrolera y minera en los territorios Shuar: Problemas y posibles planteamientos.* Quito: Abya-Yala.

COOK, THOMAS D., AND D. T. CAMPBELL
1979 *Quasi-Experimentation: Design and Analysis Issues for Field Settings.* Boston, Mass.: Houghton-Mifflin.

DESCOLA, PHILIPPE
1994 *In the Society of Nature: A Native Ecology in Amazonia.* Cambridge: Cambridge University Press.
1996 *The Spears of Twilight: Life and Death in the Amazon Jungle.* New York: New Press.

EBERHART, NICHOLAS
1998 *Transformaciones agrarias en el frente de colonización de la región amazónica.* Quito: Abya-Yala.

FEDERACION DE CENTROS SHUAR
1976 *Solución original a un problema actual.* Sucua: Mundo Shuar.

FORSTER, NANCY
1989 "Minifundistas in Tungurahua, Ecuador: Survival on the Agricultural Ladder." In THIESENHUSEN 1989, 92–126.

GODOY, RICARDO, N. BROKAW, AND D. WILKIE
1995 "The Effect of Income on the Extraction of Non-Timber Forest Products: Model, Hypothesis, and Preliminary Findings from the Sumu Indians of Nicaragua." *Human Ecology* 23, no. 1:29–52.

GRINDLE, MERILEE
1986 *State and Countryside: Development Policy and Agrarian Politics in Latin America.* Baltimore, Md.: Johns Hopkins University Press.

HARNER, MICHAEL J.
1973 *The Jivaro: People of the Sacred Waterfall.* New York: Anchor.

HENRICH, JOSEPH
1997 "Market Incorporation, Agricultural Change, and Sustainability among the Machiguenga Indians of the Peruvian Amazon." *Human Ecology* 25, no. 2:319–51.

HUMPHRIES, SALLY
1993 "The Intensification of Traditional Agriculture among Yucatec Maya Farmers: Facing up to the Dilemma of Livelihood Sustainability." *Human Ecology* 21, no. 1: 87–102.

INEC (INSTITUTO NACIONAL DE ESTADISTICA Y CENSOS)
1996 *Cifrando y descifrando a Morona-Santiago.* Cuenca, Ecuador: INEC.

KARSTEN, RAFAEL
1935 *The Head Hunters of Western Amazonas: The Life and Culture of the Jibaro Indians of Eastern Ecuador and Peru.* Societas Scientarium Fennico Commentaciones Humanarium Litterarum, no. 6. Helsinki: Societas Scientarium Fennico.

MACDONALD, THEODORE
1981 "Indigenous Response to an Expanding Frontier: Jungle Quichua Economic Conversion to Cattle Ranching." In *Cultural Transformations and Ethnicity in Modern Ecuador,* edited by Norman E. Whitten, 356–83. Urbana-Champaign: University of Illinois Press.
1984 *De cazadores a ganaderos.* Quito: Abya-Yala.

NETTING, ROBERT M.
1993 *Smallholders, Householders: Farm Families and the Ecology of Intensive Sustainable Agriculture.* Stanford, Calif.: Stanford University Press.

NIETSCHMAN, BERNARD
1973 *Between Land and Water: The Subsistence Ecology of the Miskito Indians.* New York: Seminar.

PICARD, LOUISE
1996 "Les transformations de l'economie et de l'identité culturelle Shuar a la suite de l'expansion de l'elevage." M.A. thesis, Université Laval, Quebec.

PREFECTO, IVETTE, AND JOHN VANDERMEER
1995 *Breakfast of Biodiversity: The Truth about Rain Forest Destruction.* San Francisco: Food First.

PUTSCHE, LAURA
2000 "A Reassessment of Resource Depletion, Market Dependency, and Culture Change on a Shipibo Reserve in the Peruvian Amazon." *Human Ecology* 28, no. 1:131–40.

REDFORD, KENT H.
1991 "The Ecologically Noble Savage." *Cultural Survival Quarterly* 15, no. 1:46–48.

REDFORD, KENT H., AND ALLYN M. STEARMAN
1993 "Forest-Dwelling Native Amazonians and the Conservation of Biodiversity: Interests in Common or in Collision?" *Conservation Biology* 7, no. 2:248–55.

ROPER, J. MONTGOMERY
2000 "Whose Territory Is It? Resource Contestation and Organizational Chaos in Bolivia's Multiethnic Indigenous Territory." Paper presented to the Latin American Studies Association, 16–18 Mar., Miami, Florida.

RUDEL, THOMAS K.
1983 "Roads, Speculators, and Colonization in the Ecuadorian Amazon." *Human Ecology* 11, no. 4:385–403.
2000 "Organizing for Sustainable Development: Conservation Organizations and the Struggle to Protect Tropical Rain Forests in Esmeraldas, Ecuador." *Ambio* 25:78–82.

RUDEL, THOMAS K., WITH BRUCE HOROWITZ
1993 *Tropical Deforestation: Small Farmers and Land Clearing in the Ecuadorian Amazon.* New York: Columbia University Press.

SEYMOUR-SMITH, CHARLOTTE
1988 *Shiwiar: Identidad étnica y cambio en el Rio Corrientes.* Quito: Abya-Yala.

SIERRA, RODRIGO, F. RODRIGUEZ, AND E. LOSOS
1999 "Forest-Resource Use Change during Early Market Integration in Tropical Rain Forests: The Huaorani of Upper Amazonia." *Ecological Economics* 30:107–19.

STAVER, CHARLES, R. SIMEONE, AND A. STOCKS
1994 "Land-Resource Management and Forest Conservation in Central Amazonian Peru: Regional, Community, and Farm-Level Approaches among Native Peoples." *Mountain Research and Development* 14, no. 2:147–57.

THIESENHUSEN, WILLIAM
1989 "Introduction: Searching for Agrarian Reform in Latin America." In THIESENHUSEN, ED., 1989, 1–33.

THIESENHUSEN, WILLIAM, ED.
1989 *Searching for Agrarian Reform in Latin America.* Boston, Mass.: Unwin Hyman.

TURNER, TERENCE
1995 "An Indigenous People's Struggle for Socially Equitable and Ecologically Sustainable Production: The Kayapo Revolt against Extractivism." *Journal of Latin American Anthropology* 1, no. 1:98–121.

WHITTEN, NORMAN
1976 *Sacha Runa: Ethnicity and Adaption of Ecuadorian Jungle Quichua.* Urbana: University of Illinois Press.

ZAVALLOS, JOSE V.
1989 "Agrarian Reform and Structural Change: Ecuador since 1964." In THIESENHUSEN, ED., 1989, pp. 42–69.