Coping with Displacement: Adjustments to Rural Livelihoods Following Relocation from Celaque National Park, Honduras

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Abstract

Agricultural intensification is a common outcome of increased population densities in areas of land scarcity. Here, a comparative analysis of households relocated from Celaque National Park, Honduras, serves as a case study of intensification resulting from decreased access to land. However, in contrast to a single trajectory of intensifying agriculture, nearly half of the households used wage labor to acquire additional land in an attempt at post-relocation agricultural extensification. This paper contributes to the agricultural change literature through the application of household strategies of communal action and increased use of familial labor to promote more-extensive forms of agriculture in a situation of land scarcity.

Key words: cultural ecology, Honduras, land-use and land-cover change, agricultural intensification, agricultural extensification

Introduction

From Malthus' theory of population growth outgrowing agricultural production to Boserup's (1965) model of population growth driving agricultural intensification, the contributing forces and household strategies of agricultural change have been a key area of research in disciplines engaged in the study of cultural ecology. The importance of, and interest in, agricultural change is amplified by the recent global food crisis that threatens to be more systematic than cyclical this time around, particularly in the developing regions of the world where the vast majority of future population growth will occur (Timms 2009). Hence, the investigation of the causes of agricultural adjustments and the strategies employed by households to adapt in times of global change are as salient as ever.

Agricultural intensification is an increase in the relative amount of agricultural production on a given amount of land. Generally, the study of agricultural intensification in developing regions has been most applicable to lowland areas with fertile soils, particularly in the humid tropics (National

Research Council 1993). But with most of these locations already under intensified cultivation, attention has turned to more marginal environs, including arid regions, steep slopes, degraded pasturelands, and other locales with less-favorable geographic site factors. This is particularly acute in areas where access to land is curtailed, which, along with population growth, results in increased population densities and pressures on the natural resource base. In frontier regions with available land, it is argued that extensification, a decrease in the relative amount of production per unit of land, remains the desired choice due to savings in labor (Chayanoz 1923; Turner and Ali 1996). But there are mitigating circumstances that alter these choices beyond the Malthusian or Boserupian population and land forces, such as biophysical and institutional factors (Keys and McConnell 2005).

The purpose of this article is to evaluate altered livelihood strategies for small-holder farmers (in this case study, holding less than 10 ha of arable land) in terms of related land use and wage labor. The 1998 post-Hurricane Mitch relocation of households from Celaque National Park, Honduras, curtailed land access, induced agricultural intensification, and resulted in an increase in wage labor. However, in contrast to a one-way trajectory toward intensified agriculture and increased wage labor to meet subsistence needs, subsets of the households used coping strategies not only to meet household subsistence needs, but to acquire additional land and access multiple ecological zones in an attempt at post-relocation agricultural extensification. This paper contributes to the agricultural change literature by elaborating small-holder mechanisms of communal action and use of familial labor to extend agricultural production systems to mitigate the negative repercussions arising from relocation and intensification pressures.

The article begins with a brief literature review of agricultural intensification and extensification, with a focus on factors applicable to this case study. Following an introduction to the research site and research methods used, a comparative analysis of changes in access to land, intensity of agriculture, and income earning activities for households relocated from Celaque National Park is presented as an example of agricultural intensification. The quantitative survey data is expanded upon with qualitative interview data to explore in greater depth the driving forces and intent behind these livelihood changes, uncovering strategies that attempt to reverse, to some degree, the agricultural intensification that resulted from relocation.

Agricultural Intensification and Extensification Defined

Agricultural intensification is defined here as an increase in the relative amount of agricultural production on a given amount of land. This definition can include increased production on the same, or less, amount of land, or maintaining production levels on a declining land base. Commonly, definitions add the strategy of increasing use of agricultural inputs, be it increased labor or capital-intensive methods, to achieve this feat (Netting 1993; Keys and McConnell 2005). While intensification has been a general historical trend for the past ten-thousand years, the pace of intensification quickened substantially in the past century with the advent of the green revolution and its diffusion to developing regions of the world to address rapid population growth (Borlaug 1958; National Research Council 1993).

In contrast to Malthusian views about exponential growth in human populations outpacing arithmetic advancements in agricultural production, the diffusion of Green Revolution technologies in response to rapid population growth supports Boseup's (1965) proposal that population growth promotes agricultural intensification. More precisely, increases in population pressure stimulate an intensification of agricultural production to meet increased demand. The distinction between population growth and population pressure is important, as the latter is the true driving variable in Boserup's model that can occur from population growth, a decrease in access to land, or both acting in combination.

While the basic model is one between population pressure and intensification of agriculture, there are many confounding factors that impact the process (Lambin *et al.* 2001). These include biophysical site characteristics such as soil and climate (Turner *et al.* 1977), cultural elements such as local knowledge and skills (Netting 1993), and access to markets and adequate supplies of labor (Erenstein 2006). The addition of these driving forces adds important nuance to the understanding of agricultural change and intensification (Turner and Ali 1996). For example, in studying intensive smallholders who practiced diversified agriculture in areas of dense population, Netting (1993) found that intensive agriculture by small-holders can be sustainable and highly productive when dependent on labor-intensive and knowledge-based strategies such as crop diversity and rotation, animal husbandry and use of manure fertilizer, and appropriate irrigation with proper drainage. When these strategies are replaced with external energy sources, such as chemical fertilizers and biocides, the sustainability of the system is threatened, as evidenced by the socioeconomic and environmental critiques of the green revolution (Yapa 1979; Shiva 1991; Osmani 1993).

Further, agricultural intensification need not be a one-way trajectory; examples of agricultural extensification exist as well. Defined here as a decrease in the relative amount of production per unit of land, it often consists of increasing the area under cultivation (Erenstein 2006). In most cases, increasing an area of land under cultivation is a labor-saving strategy and is generally preferred in areas of abundant land availability (Chayanov 1923; Goldman and Smith 1995; Turner and Ali 1996). Under low population densities, extensive agricultural production can also be ecologically sustainable, but it becomes potentially damaging when fallow periods are shortened (Moran 2005).

Intensive agriculturalists can change to more-extensive forms of agriculture when faced with lower population densities, which can occur through population loss, acquisition of more land, or migration to frontier regions where new lands are opened for settlement (Boserup 1965; Netting 1993; Erenstein 2006). Extensification is less common and counterintuitive to the models of intensification, yet it has been argued that intensification can contribute to extensification by increasing production on a smaller land base and opening up additional areas for animal husbandry (Zweifler *et al.* 1994; Carr 2005).

An additional factor related to agricultural change is the use of wage labor to supplement livelihoods and/or address shortfalls in production due to increases in land scarcity (de Janvry 1981; Brockett 1991; Faber 1992; Stonich 1993), which is a coping strategy to negotiate the negative repercussions related to loss of land. This paper provides a case study of this process. Agricultural intensification created by relocation led to communal capital-pooling and use of familial wage labor to increase capital for the acquisition of additional lands. These additional lands were acquired in an effort to promote more-extensive forms of agriculture, which has been argued to be preferred by small-holder agriculturalists (Chayanov 1923; Yapa 1979; Shiva 1991).

Research Site and Methods

The Contextual Lencan Cultural Landscape

Located in the western highlands of Honduras, the Celaque Mountains are an extinct remnant of the Central American Volcanic Axis with deeply weathered, moderately acidic, and fertile clay loam soils which, in the highland wet climate at elevations above 1,800 meters, supports the largest cloudforest in the country (AFE-COHDEFOR and GTZ 2002; Wilson and McCranie 2004). At lower elevations, pine/oak savannah woodlands of the humid subtropical climate are characterized by relatively less-fertile, shallow soils with increased acidity and poor drainage (Portillo 1997).

Within the mountains, approximately three-thousand indigenous Lenca small-holders were, prior to relocation, located on the boundary between the lower elevation pine/oak forests and higher elevation cloud forest, accessible only by foot and pack animal along narrow and steep trails (AFE-COHDEFOR and GTZ 2002). Research over the past half-century in western Honduras has catalogued a pattern of Lenca settlements clustered in highland regions with *ladino* settlements and commercial coffee *fincas* encroaching from below (West 1958; Stonich 1993; Bass 2006; Schelhas and Pfeffer 2008; Timms 2008).

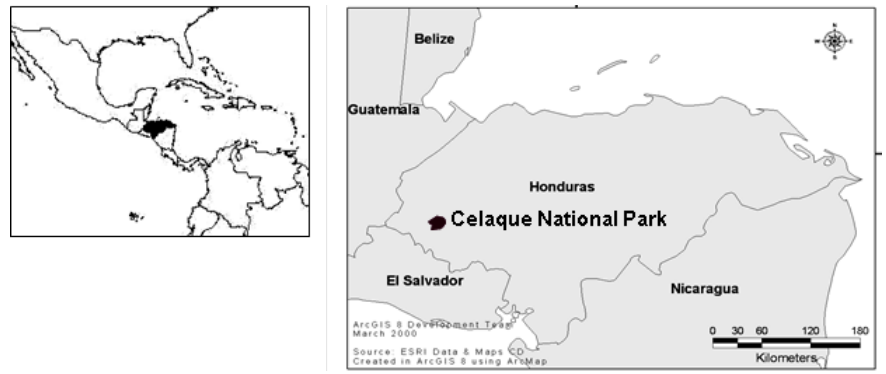

Figure 1.—Location of Celaque National Park, Honduras.

The highland Lenca are primarily subsistence agriculturalists using an extensive sedentary fallow system where vegetation is cut, burned with low-intensity fires, and planted in crops (Jansen 1998; Brady 2003). Cultivation occurs for three to six years before fallowing where grasses, bushes, and trees are established. The fallow system allows for the cycling of nutrients and maintenance of soil fertility, as well as control of weeds, pests, and plant diseases (National Research Council 1993; Netting 1993). Fallowed land also supports animal husbandry, providing dairy and meat products to the diet, fertilization with manure, and "hooved bank accounts" to mitigate times of economic pressures (Brady 2003: 66). And, with adequate amounts of land, secondary forests establish themselves on fallowed plots that have not been cultivated for extended periods of time (Aguilar 2003).

Lenca households grow a particular assortment of crops in accordance with the physical environment, including climatic conditions and soil types at different altitudes. Cultivation is based on the traditional *milpa*, dominated by the symbiotic production of maize and beans, along with a variety of secondary agricultural products to supplement nutritional needs, provide

ecological services such as nutrient cycling and pest suppression, and serve as sources of exchange or income. For example, the fertile soils, higher precipitation, and cooler temperatures of the highlands allow for the cultivation of crops such as cabbage, potatoes, and carrots, which can be exchanged or sold at Lenca market centers optimally located between higher- and lower-elevation Lenca settlements, where warmer temperature crops dominate (Brady 2003). Other income-generating activities used to supplement subsistence agricultural production include production of ceramic pottery and roofing tiles for sale at market, and seasonal labor on coffee *fincas* centered on the western side of the mountains (AFE-COHDEFOR and GTZ 2002).

While the Celaque Mountains have an historically documented cultural history stretching back *at least* to 1536 (Newson 1982), and likely much longer, in 1987 they were transformed into Celaque National Park, which threatened the residency of the Lenca within the park. Initially, resident populations were allowed to remain within the park's boundaries, but in 1997 a new park-management plan called for the "voluntary" relocation of resident populations (AFE-COHDEFOR and GTZ 2002). Hurricane Mitch struck Honduras in 1998 and provided an opportunity to implement relocation through conditional aid; only households that chose to relocate to one of two new settlements outside the park's boundaries would receive assistance (Oviedo 1999; Timms 2011).

Sixty-one households accepted this assistance, with forty-five relocated to a new road-accessible site, Otolaca, just outside the southeastern boundary of the park. Land for housing was provided by a local municipality, houses built by the NGO *Amigos de las Américas*, and arable land donated by the Catholic Church. A second settlement, Los Horcones, was located on a non-road-accessible site outside the southwestern boundary of the park and settled independently by sixteen households, with promises of relocation assistance in the form of house building and land acquisition. The main crux of the research was to investigate the changes in livelihoods, including land-use and income-earning activities, resulting from this relocation from Celaque National Park.

Research Methods

Initial pilot interviews and observations took place during a preliminary field research trip in the summer of 2002 to the relocated communities of Los Horcones and Otolaca. In addition, a 1998 data set of social and economic attributes of the relocated households prior to relocation was obtained from the nongovernmental organization *Proyecto Celaque* (Oviedo 1999).

Based on this data set and initial community visits, a structured interview questionnaire was developed for the collection of comparable quantitative data to analyze three main research objectives related to changes in land use and livelihood strategies created by relocation: (1) changes in access to land, (2) changes in land-use intensity, and (3) changes in income-earning activities. The data measures used to address these research objectives are listed in Table 1. The quantitative survey data is expanded upon with qualitative interview data to explore in greater depth the driving forces and intent behind these livelihood changes.

The main phase of field research was carried out by the author and two local assistants during the summer of 2004. In all, forty-nine of the sixty-one relocated households were surveyed, including all sixteen of the relocated households in Los Horcones and thirty-three of the forty-five relocated households in Otolaca. The information gathered from the questionnaire surveys, compared to the initial survey data collected in 1998 by the NGO *Proyecto Celaque*, allowed for a time-series analysis of the effect relocation had on households in terms of access to land, land-use intensity, and income-earning activities (Cernea 1991; Hough 1991; Machlis and Soukup 1997).

Table 1. Research Objectives and Data Measures

Access to Land	Land-Use Intensity	Income-Earning Activities
1. Amount of Land	1. Percent of Land Under Cultivation	1. Number of Income Activities
2. Number of Land Parcels	2. Percent Fertilizer Usage	2. Percent Selling Animals
3. Perception of Soil Quality	3. Percent Biocide Usage	3. Percent Selling Crops
	4. Number of Animals	4. Family Members in Coffee
	5. Agrodiversity	5. Weeks in Coffee

While eighty percent of relocated households were included, statistical normality was not assumed due to the relatively small dataset and tests of normality indicating non-normal distributions, particularly the post-relocation data where limited options of the relocation process created skewness and clustering of values. Hence, multivariate regression analysis to investigate relationships between variables was not applicable. Instead, comparison of dependent variables to determine significant changes before and after re-

location was performed with a Wilcoxen signed rank test, and correlations between variables were computed with a Spearman's rho test.

Results and Discussion

Access to Land

The average post-relocation amount of land of 1.24 ha is strikingly small, especially in relation to a previous estimate by Boyer in 1982 that claimed an average household in the mountains of southern Honduras required 7.2 hectares of land to fully supply their subsistence using a three-year fallow cycle (from Brockett 1998: 80). Further, there was a significant increase in the number of land parcels. Traditionally, households in Lenca settlements owned a single parcel of land surrounding their dwellings (West 1958). Increased numbers of parcels, while used by many small-holders throughout Central America to take advantage of multiple climatic and soil zones (National Research Council 1993), in this case represents a need to search more widely for available land in a settled region, creating an additional hardship in terms of time required to reach separate land areas.

Table 2. Access to Land Measures (asterisk represents a two-tailed Wilcoxon Signed Ranks Test)

	Land Access (ha)	# of Land Parcels
Pre-Relocation	4.16	1.02
Post-Relocation	1.24	1.63
Difference	-2.92	-0.61
Z Score	-5.503	-5.503
Significance Level*	0.000	0.000

In addition to the decrease in quantity of land was a decrease in its quality, as measured by perception of soil quality. Eight-nine-point-seven percent (89.7%) of households claimed the soils in the relocated communities were worse or much worse than the soils in their previous land holdings. While perception of soil quality is not a physical measurement of soil characteristics, it does reflect how the soils in a given location suit the needs of household crop production tied to local agricultural knowledge, technology, and methods (Jansen 1998). Further, the change in soil characteristics had repercussions for crop choice and soil inputs.

The changes in access to land were both a direct result of the relocation process and, afterwards, of the actions of households. For example, 0.70 ha of arable land was initially donated to each household in Otolaca by the Catholic Church. In response to this minimal donation, twenty of the forty-five sampled households in Otolaca cooperatively purchased an additional parcel of land, which was subdivided among them based on their respective contributions, resulting in the doubling and even tripling of household land-holding size. While household demographics showed no discernible difference between those acquiring more land and those that did not, sixteen of the twenty Otolaca households that participated were from the same original community within the park, El Cedro, while those that did not participate were exclusively from the original community of Poza Verde. This suggests that original community ties were important in collective action.

In Los Horcones, relocation assistance from the NGO *Proyecto Celaque* turned out to be less than promised and consisted of a single load of roofing timbers and tiles, delivered to a village two hours away on a path passable only by foot or mule. In lieu of outside assistance, the households in Los Horcones individually purchased land parcels and built houses. The households in Los Horcones were previously better endowed with land and animal resources in comparison to those relocated to Otolaca, and hence were able to negotiate their own relocation with the ability to purchase land through the sale of their animals, increased wage labor on coffee *fincas*, and personal loans within the relocated community to finance the purchases.

Interviews and informal discussions in Los Horcones uncovered an advantage for the independent resettlement process, which was closer in proximity to their former lands than in Otolaca. While it would take a household in Otolaca more than a full day of walking to reach their old communities, those in Los Horcones were located within a forty-five-minute to two-hour walk from their original lands within Celaque National Park, and three of the households in Los Horcones reported continuous cultivation of these previously utilized land holdings. While park regulations outlaw clearance of new lands, all lands previously and continuously cleared can be cultivated. If allowed to reforest, effective control of the lands returns to the Honduran forestry agency COHDEFOR (AFE-COHDEFOR and GTZ 2002).

These three households shared basic demographic characteristics. While the average age of the head of household for Los Horcones was forty-five years, the age of the head of households for these three were sixty-two, sixty, and fifty-five. They also had larger households of twelve, ten, and nine members, which exceeded the community average of 7.7. Further, these large house-

holds reported four adults, higher than the community average of 2.9. In comparison, three other households reported a desire to work their previous land holdings but were unable to do so, and in turn their previous lands had begun to reforest and reverted to state control. These three households had a younger age for the head of household (thirty-one, thirty-two, and thirty-two), smaller family size (five, six, and seven), and only two adults per household. These results indicate an advantageous adaptation whereby larger households were able to obtain additional lands in new ecological zones and expand both production and agrodiversity—continuing cool-weather crop production in the park while expanding warm-weather crops in the resettlement—based on availability of family labor.

Land-Use Intensity

The loss of access to land resulted in an intensification of land use as measured by percent and absolute amount of land under cultivation, a decrease in animal husbandry and agrodiversity, and an increase in the use of purchased fertilizers and biocides (pesticides and herbicides). The increase in the percentage of land under cultivation, coupled with an absolute decline in the amount of land under cultivation, is significant in that the traditional land fallow system was disrupted. A decrease in the amount of land with a perceived decrease in soil quality coincided with greater percentage of land cultivated, supporting the conclusion that the creation of land scarcity has led to intensified land use.

Table 3. Land-Use Intensity Measures

	% of Land Cultivated	% Purchasing Fertilizer	% Using Biocides
Pre-Relocation	61.7%	61.2%	0.0%
Post-Relocation	88.3%	98.0%	36.7%

In response to the change in soil conditions, purchased fertilizer use increased substantially from 61.2% of households to 98% and biocide usage increased from 0.0% to 36.7%. When the households were asked to explain the use of biocides, it was reported that the previous year's maize crop had been decimated by an insect invasion. The loss of land, coupled with the new ecological conditions, led to a decrease in agrodiversity and reliance on fewer crop varieties, which also increased the risk of pest invasions. The presence of pests was further exacerbated by the abandonment of the traditional fallow system, which relied on the use of cutting and low-intensity burning of fallow cover to cycle vegetative nutrients back into the soil and

clear the land of weeds, pests, and crop diseases. In the relocated communities, the loss of fallow periods obviated the use of fire, which has also been discouraged by authorities within other areas of the region (Jansen 1998). In response, the adoption of biocides was necessitated to replace the role of fire, which increases production costs and can lead to the pollution of land and water resources (Murray 1994). Together, these capital-intensive inputs increased the cost of production and signal the intensification of agricultural production as traditional processes are abandoned (Keys and McConnell 2005).

The decrease in land ownership also negatively affected animal husbandry. In addition to selling their livestock to raise money to purchase additional lands, the households that owned animals in the highland settlements prior to relocation reported the lack of land in the relocated settlements as a factor in the decrease in animal ownership. Besides a reflection of land scarcity, these results exhibit a breakdown in the fallow system, a decrease in diversity of farm activities, and the drawing down of their "hooved bank account" in order to expand land holdings (Brady 2003: 66).

Table 4. Change in Animal Husbandry and Agrodiversity (asterisk represents two-tailed Wilcoxon Signed Ranks Test)

	Number of Animals	Number of Crop Varieties
Pre-Relocation	2.53	6.45
Post-Relocation	0.35	4.04
Difference	-2.18	-2.41
Z Score	-4.344	-5.594
Significance Level*	0.000	0.000

Agrodiversity, measured here by the number of different crop varieties grown, declined in response to the decrease in land ownership and new ecological conditions. While the traditional *milpa* crops of maize and beans, along with sugarcane, remained the major staple crops, ten of the eighteen varieties of crops grown were abandoned after relocation. Most of these abandoned crops, such as cabbage, radishes, and potatoes, are more suited to the cooler temperatures and higher precipitation of the highlands as opposed to the drier and warmer climate of the lowlands.

The climatic characteristics of the lowlands did create better conditions for the cultivation of other crop varieties. For example, plantain, cassava, and

pataste were adopted by several relocated households and were grown for household consumption. The cultivation of coffee, which was non-existent in the highlands, by seven households occurred in Otolaca and represents a market-based crop that, in the future, once the trees begin to produce, would turn into an income-earning activity for the households. However, even with these crop substitutions, the overall trend was a decrease in agrodiversity and a greater reliance on basic foodstuffs.

Table 5. Change in Number of Households Growing Crop Varieties

Decreases			Increases		
	Pre-Relocation	Post-Relocation		Pre-Relocation	Post-Relocation
Peaches	35	2	Plantain	0	25
Sugarcane	32	30	Pataste	2	20
Wheat	31	0	Cassava	0	8
Linseed	29	0	Coffee	1	7
Cabbage	22	0	Mango	0	1
Chan	20	0	Pineapple	0	1
Avocado	17	1	Zucchini	0	1
Radish	10	0			
Potato	8	0			
Carrot	5	0			
Lemon	1	0			
Squash	1	0			
Mustard	1	0			

Income-Earning Activities

Income-earning activities had previously been a part of the livelihoods of the Lenca households, but land scarcity, increased land taxes, and the increased costs of land-use intensification necessitated by relocation increased reliance on wage-abor activities to provide subsistence in lieu of the sale of surplus agricultural produce and crafts. Prior to relocation, 71.4% of households sold surplus crops, particularly cabbage, at the traditional Lenca market town of Belen Gualcho. In addition, fifty percent of animal-owning households had marketed their animals. After relocation, only one household had sold crops at a market, and the sale of animals ceased entirely. The decline in market activity in the sale of agricultural products represents not only a decrease in production, with the bulk of production used solely for household needs, but also the geographical separation of the producers from their traditional market, Belen Gualcho, which was located on the opposite, western side of the Celaque Mountains.

Table 6. Percent of Households Engaged in Market Activities (asterisk represents only animal owning households)

	% of Households Selling Animals at Market*	% of Households Selling Produce at Market
Pre-Relocation	50.0%	71.4%
Post-Relocation	0.0%	2.0%

While there was a decrease in the number of income-earning activities, the change in the types of activities represents an important shift in livelihood strategies. Prior to relocation, household members engaged in the sale of agricultural produce, wage labor on coffee *fincas*, production and sale of roofing tiles, and the manufacture and sale of ceramic pottery. After relocation, most of the household members abandoned the sale of agricultural produce, roofing tiles, and ceramic pottery in favor of wage labor on neighboring *ladino* farms and a substantial increase in wage labor on coffee *fincas*. The income-earning strategies for the relocated household shifted from the production and sale of crops and crafts to almost sole dependence on wage labor for income.

Table 7. Number of Households Engaged in Income-Earning Activities

Income-Earning Activities	Before Relocation	After Relocation
Labor on Coffee Fincas	49	49
Sale of Crops at Market	35	1
Sale of Animals at Market	12	0
Pottery Production and Sales	7	0
Roofing Tiles Production and Sales	5	0
Labor on Ladino Farms	0	13

Not only did relocation shift income-earning activities toward wage labor, it altered the age and gender division of income activities. Prior to relocation, adult males produced roofing tiles while adult females were predominantly responsible for ceramic pottery production. Adult males also worked seasonally on the coffee *fincas*, which consisted primarily of picking coffee

beans during harvest. For example, 73.5% of the households reported only one male household member working on the coffee *fincas* annually prior to relocation. In a complete reversal, post-relocation households reporting only one member working on coffee *fincas* fell to 26.5%, and the time spent increased significantly. The work also changed from merely picking coffee to other activities, such as coffee processing and tree maintenance, that included male and female adults and children able to work.

Table 8: Income-Earning Activity Measures

	Income-Earning Activities	Household Members Working in Coffee	Weeks Working in Coffee
Pre-Relocation	2.25	1.88	2.33
Post-Relocation	1.43	4.71	7.12
Difference	-0.82	2.83	4.79
Z Score	-4.829	-4.879	-5.837
Significance Level*	0.000	0.000	0.000

The time devoted to working on coffee *fincas* increased to a greater degree in Los Horcones, where households averaged 7.88 weeks per year, as opposed to 6.76 weeks in Otolaca. As previously mentioned, the households in Los Horcones required additional income to purchase land and build houses, both of which had been provided for the households in Otolaca. Further, thirteen of the households in Otolaca participated in a new income-earning activity, laboring on the neighboring *ladino* farms. Throughout the year, male adults and children now perform wage labor in the fields for the *ladino* farmers, and female adults and children process the maize (husking, washing, grinding) during the harvest. While households in Los Horcones devoted their labor to working in coffee, those in Otolaca expanded their wage-earning activities and, hence, devoted slightly less time to working in coffee.

Relationships Between Variables

The results indicate a scenario of agricultural intensification and households increasingly reliant on wage-labor activities for income to pay for the rising costs of production and supplement their livelihoods. However, relationships between variables suggest competing explanations beyond agricultural intensification and increased wage labor. In a Spearman's rho correlation test, the amount of land owned in the relocated communities was positively

correlated with the number of land parcels, indicating the expansion of land ownership through acquisition of separate parcels. Since the households were relocated to more-populated areas, land availability was constrained and could only be acquired through the privatized land market (Carter and Salgado 2001). While there was no significant correlation between the amount of land owned and the number of income-earning activities, there was a significant correlation between the amount of land owned and the number of household members working on coffee *fincas*, along with the number of weeks spent working in coffee. Hence, the increased use of family labor working in the agro-export coffee industry was not just to supplement subsistence, it was a capital accumulation strategy by these households to be used in acquiring additional lands.

Only two other variables were significantly correlated with the amount of land owned: a negative correlation with the percentage of land under cultivation, and a positive correlation with the number of crop varieties grown. The households that were able to purchase additional parcels of land through increased work on the coffee *fincas* cultivated a smaller percentage of their land, allowing a small portion to remain in fallow. Further, they had higher agrodiversity in their fields in terms of number of crop varieties grown.

Table 9: Spearman's rho Correlation with the Amount of Land Owned

	Correlation Coefficient	Two-Tailed Significance Level
Number of Separate Land Parcels	0.650	0.000
Members Working on Coffee Fincas	0.404	0.004
Weeks Working on Coffee Fincas	0.393	0.005
% of Land Under Cultivation	-0.544	0.000
Number of Crop Varieties	0.415	0.003

The lower percentage of land under cultivation could have been a result of the greater number of family members working on coffee *fincas* for longer periods of time, leaving less labor to fully cultivate their land. However, the greater number of crop varieties grown and greater amount of absolute land under cultivation by the households with more land suggests otherwise. While the need for income is greater in the relocated communities due to a reported lack of agricultural production and increased costs, many claimed the main reason was to purchase land. Respondents stated they would de-

crease their wage-labor work when they had acquired a sufficient amount of additional land. What this suggests is a return to a more traditional and extensive form of agricultural production.

Whether through exploiting family labor in order to acquire more land in Otolaca, or as in Los Horcones where geographical proximity and exploitation of loopholes in national forest policies allowed access to different ecological zones, these are struggles through which households are attempting to return to a more-extensive form of agricultural production. In effect, it exposes another motive for household strategies to persist in the face of externally imposed pressures to adopt intensified agricultural production.

Conclusion

Quantitative and qualitative analysis demonstrated an absolute decrease in land owned, an increase in land parcels, and a decrease in soil quality as measured by household perception. As a result of the decrease in access to quality land, the traditional fallow system was substituted with intensified land use. The relative increase in the percentage, and absolute decrease in the amount, of land under cultivation contributed to the decrease in animal husbandry and agro-diversity as households focused on a smaller number of basic crop staples. In absence of the ecological services provided by the fallow system in maintaining soil fertility and controlling pests and weeds, households increased the use of purchased fertilizers and adopted biocides to compensate.

In turn, the costs attributable to the intensification of production increased reliance on income-earning activities to meet household subsistence needs. Land scarcity left households without adequate amounts of quality land to produce a surplus of crops or to support animal husbandry, as reflected in the abandonment of market activity in animal and crop sales. Further, all forms of craft production ceased as the households were geographically separated from the traditional markets and natural-resource base (i.e., clay soils) necessary for these crafts. In the place of a diversity of income-earning activities, wage labor became the main source of income as relocation placed the households in greater proximity to *ladino* farms. However, the most significant change was the exploitation of family labor for wage earnings on the coffee *fincas*, which became the dominant income-earning activity.

Elaborating upon the quantitative survey analysis through the addition of qualitative interview data allowed for a more in-depth analysis beyond merely chronicling a case of agricultural intensification. Instead, this research uncovered how Lenca households were able to mitigate the negative impacts of relocation to exploit niches left open to them in the process. In Otolaca, a select group of households found ways to acquire more land through communal action. For Los Horcones, several households expanded the ecological niches available to them by accessing their previous lands due to geographical proximity. The qualitative interview data identified these strategies as attempts to re-create more-extensive forms of agricultural production in which household demographics played a strong role, but not in terms of increasing intensity of production. Instead they are utilizing familial labor as an avenue toward acquiring additional land. The inclusion of a more-nuanced understanding of the intent of off-farm wage labor contributes to the agricultural change literature through the application of household strategies of communal action and exploitation of labor to promote more-extensive forms of agricultural production.

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