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## Placing the plantation in smallholder agriculture: Evidence from Costa Rica<sup>☆</sup>

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### ABSTRACT

Where large-scale plantation agriculture spatially coexists with smallholding agriculturalists, they interact in multiple ways. A number of researchers have addressed the broader social, environmental, and economic consequences of smallholder/plantation relationships. Few studies, however, have examined the household-level conditions that drive smallholders to engage in plantation wage work. Research from off-farm and non-farm labor markets offer a number of clues to what types of households participate in plantation wage work. These studies, however, use aggregate economic categories and fail to consider the specific case of plantation wage work. Utilizing household survey data, this paper seeks to understand the relationship between smallholders and plantations by examining the household-level conditions that lead to engagement with plantation wage work within Costa Rica's Dos Novillos watershed. Our principle findings are: (1) agricultural assets are negatively predictive of engagement in plantation wage work; (2) a household's male labor availability is strongly predictive of a household's level of engagement in the plantation economy; (3) participation in plantation wage work appears to be an income strategy for asset-poor households more generally. Overall, this study finds little engagement in plantation wage work by smallholding agricultural households. Instead, this type of work appears to be the domain of asset-poor households that are marginally engaged in agriculture. This paper concludes by suggesting policy prescriptions and an agenda for future research in this watershed.

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## 1. Introduction

The future sustainability of tropical landscapes is largely dependent upon two very different types of land uses: large-scale commercial agriculture – including soybean, banana, and pineapple plantations – and small-scale, family-farm agriculture. While smallholding agriculture is often cast as a sustainable alternative to the often environmentally destructive land-use practices of plantation agriculture (Clay, 2004; Shiva, 1991), the impact of each of these farming systems on a human–environment landscape, however, is considerably more complex. Neither of these systems exists in a vacuum, and the sustainability of one system can be dependent upon its interactions with the other. For example, an ecologically sensitive smallholder may be able to survive economically only through part-time wage work on a nearby, high-input, environmentally problematic plantation (Bluffstone, 1993; Netting, 1993). In other words, the economic opportunities that agribusiness creates can, under some conditions, play a significant role in maintaining the economic and ecological sustainability of smallholding households (Grossman, 1998).

The social, environmental, and ecological consequences of plantation/smallholder interactions have been explored by a number of scholars (cf. Bassett, 1988; Grossman, 1993; Watts, 1983), however, the specific factors that drive a household to participate in plantation wage work have received comparatively less attention by researchers. While a great deal of research on ‘non-farm’ and ‘off-farm’ rural employment offers empirical clues as to what types of households engage in these forms of rural employment, this literature rarely considers the specific case of plantations in determining the impact of wage work on rural households. This is an unfortunate omission because plantations are often located in areas of smallholder agriculture, require a workforce with the skills that small-scale farmers possess, and represent one of the largest employers of small-scale agriculturalists in the tropics (Hardner and Rice, 2002; Mulley and Unruh, 2004; Williams and Karen, 1985)<sup>1</sup>. Thus, attention to the ways in which plantations might sustain small-scale agriculturalists is particularly important to those seeking to understand how sustainable human–environment landscapes in the tropics might be produced.

This article explores the extent to which plantation agriculture in Costa Rica’s Dos Novillos watershed sustains small-scale farmers by examining the household based assets and demographic features that translate into engagement with plantation wage work. The watershed supports large-scale banana and pineapple plantations, as well as smallholder land uses including cattle pasture and the production of multiple crops for consumption and sale (e.g., papaya, manioc, maize, and beans). This watershed is therefore an ideal setting for a broad inquiry into smallholder–plantation interaction. In addition, such research has important practical applications: the watershed has long

been a site of research outreach/extension by Costa Rica’s EARTH University (Escuela de Agricultura de la Región Tropical Húmeda), and the present study seeks to inform an ongoing project into achieving social and ecological sustainability at the landscape scale. The intention here is to contribute to this project by understanding the conditions under which smallholders are drawn into plantation employment. Understanding this interaction will also contribute to a broader understanding of the extent to which plantations affect other types of land use within the watershed.

This paper is divided into four sections. In section 2 of this paper, we briefly review past research on plantation/smallholder interactions. Then, we consider the often contradictory findings from both the off-farm and non-farm employment literature concerning the agribusiness/smallholder relationship. In section 3, we provide a detailed description of the study site and methods used to understand this relationship in the Dos Novillos watershed. In section 4, we present our results. In section 5, we consider the implications of our findings for the economic future of households that engage in plantation wage work, and conclude with policy recommendations and an agenda for future research.

## 2. Plantations/smallholders

### 2.1. Causes and consequence

A number of researchers have studied the consequences of plantation/smallholder interactions with respect to issues such as local food security (cf. Bassett, 1988; Grossman, 1993; Watts, 1983), environmental degradation (cf. Blaikie and Brookfield, 1987; Coxhead and Shively, 2005), and a country’s economic development more generally (cf. Beckford, 1983; Seligson, 1980; Hall et al., 2000). Collectively, these studies demonstrate that the consequences of this interaction are highly variable and context dependent. Bassett’s (1988) work in the Sahel, for example, has found that the allocation of land and labor to export agriculture prevents these inputs from contributing to local food production (see also Watts, 1983). Grossman (1993), however, found little evidence of a direct conflict between agribusiness and smallholders over land and labor allocation with regard to local food production on the Caribbean island of St. Vincent. Similar variability can be found with respect to the environmental consequences of smallholder involvement with agribusiness. The presence of off-farm employment, such as plantation wage work, has been associated with increased rural household incomes, which, in turn, decreases the need for additional land clearing, resulting in less deforestation (Beaumont and Walker, 1996; Godoy et al., 1997; Angelson and Kaimowitz, 1999). However, Zimmerer (1993) has shown that an increase in off-farm employment opportunities in highland Bolivia siphoned off household labor from on-farm conservation techniques, leading to an increase in soil erosion (see also Bebbington, 1993). Finally, a number of studies have questioned the ability of plantation-based economies to provide for socially and environmentally sustainable development (cf. Beckford, 1983; Hall et al., 2000). Seligson’s (1980) work in Costa Rica, for

<sup>1</sup> While these conditions do not hold everywhere, they can be found in many places, including the study site under consideration.

example, shows how the rise of coffee and banana production ultimately produced a class of landless, seasonal laborers as well as economically marginalized smallholders, whose claims to land tenure and livelihood security are often tenuous.

A number of writers have argued that smallholder engagement with plantation wage work is symptomatic of the eventual demise of smallholding agriculture, which will be replaced by fully proletarianized rural households (Bartra, 1993; de Janvry et al., 1989; Kay, 1995). This trend has attracted increasing attention from scholars as Latin American countries have moved into non-traditional agricultural exports, often attracting significant numbers of smallholding families (Gwynne, 2003; Korovkin and Sanmiguel-Valderrama, 2007) into what are essentially low-wage jobs marked by poor working conditions. Participation in these jobs has been shown to lower household labor time available for own-farm agriculture (Korovkin, 1997). Others, however, have argued that wage work participation by smallholders is not necessarily evidence of their decline, but rather, evidence of their resilience in the face of an ever changing social and economic landscape of agricultural production (cf. Bebbington, 2000; Love, 1989; Smith, 1984).

Such a view has been taken up by proponents of the ‘rural livelihoods’ approach, which recognizes that households commonly diversify into different income earning sectors (Ellis, 1998). Under this view, a smallholder’s engagement with plantation wage work is not necessarily the first step in its long march toward proletarianization, but rather, it reflects a strategy of income diversification as a response to different social, environmental, and economic signals (Chambers and Conway, 1991). The nature and extent of this diversification is highly variable, but is often conditioned by a number of external factors (e.g., price shocks, political instability, drought) as well as a household’s various human, social, environmental, and financial assets (Bebbington, 1999; Ellis, 2000). Much of the research on household diversification does not consider the case of plantations specifically, but rather, utilizes the aggregated economic categories of ‘non-farm’ and ‘off-farm’ labor (Ellis, 1998). In order to help us understand why households engage in plantation wage work, we now turn to this body of evidence, with attention to studies conducted in Latin America.

## 2.2. Rural off-farm and non-farm employment

Why do smallholders engage in plantation wage work? A large body of research on ‘non-farm’ (i.e., non-agricultural) and ‘off-farm’ (i.e., agricultural) wage work in rural economies provides clues to answer this question<sup>2</sup>. Some research on smallholders and rural labor markets suggests that rural employment

is an important component toward sustaining smallholder livelihoods. The major conclusions from this line of research are:

- (1) Wage work is one of a suite of activities in which small-scale agricultural households engage. This provides income diversity and livelihood resilience in the face of exogenous shocks such as price collapses or floods (Block and Webb, 2001; Lanjouw and Lanjouw, 2001; Rose, 2001; Webb and Reardon, 1992).
- (2) The seasonality of agriculture means that the continuous consumption needs of the small-farm household are mismatched with the uneven income flows of the household’s agricultural activities. Thus, wage work is a consumption smoothing strategy for small-farm households (Alderman and Paxson, 1992; Alderman and Sahn, 1989; Ellis, 2000).
- (3) Income from wage work provides households with a level of income that can lead to increased on-farm investments in productivity, usually through land intensification and investments in mechanization, improved seed, irrigation, etc. (Collier and Lal, 1986; de Janvry and Sadoulet, 2001; Rola and Coxhead, 2002).
- (4) Smallholder engagement with off-farm wage work can – when it diverts labor away from the frontier or allows families to invest in agricultural intensification – prevent the extensification of land use and so avert deforestation by smallholding households, particularly in land-abundant frontier contexts (Angelson and Kaimowitz, 1999; Godoy et al., 1997).

Other research shows that there is little interaction between smallholders and agricultural employment opportunities, and that it is primarily non-agricultural households (i.e., urban migrants, rural landless) that fill wage-earning jobs in the countryside on a seasonal or regular basis. For example, this research shows that:

- (1) Farm assets can discourage entry into non-farm labor markets (Berdegue et al., 2001; Corral and Reardon, 2001).
- (2) A lack of significant farm-based assets, such as land and livestock, can drive households into non-farm labor markets (Murphy, 2001; Reardon et al., 2001).
- (3) The opportunity to earn higher income encourages some households to specialize in wage labor and to abandon agriculture altogether (Deininger and Olinto, 2001; Rigg, 2006).
- (4) Under some conditions, off-farm wages are too low, the work too unhealthy, and the jobs too insecure to attract smallholders (Angelson and Kaimowitz, 1999; Chomitz and Griffiths, 1996; Mulley and Unruh, 2004).

This broad range of findings indicates that the relationship between smallholders and rural employment is highly variable and context dependent, with important contextual factors including land/labor ratios, rural governance issues, proximity to cities and roads, and regional histories of agricultural integration. This body of research, however, rarely addresses the specific household conditions that drive rural employment patterns. As Mulley and Unruh (2004) argue in their study on agribusiness and smallholders in

<sup>2</sup> While technically plantation employment is considered ‘off-farm’, we believe that the high level of manufactured inputs (e.g. pesticides) that plantations require, the existence of on-site processing facilities, and the importance of creating a “finished” product, all give plantation agriculture qualities of both manufacturing and agriculture. (Clay, 2004; Hernández et al., 2000). Thus, we believe that drawing on insights from both the “off-farm” and “non-farm” literatures is justified.

Uganda, the off-farm employment literature rarely offers an in-depth look at the relationship between the local context of wage workers and the specific forms of off-farm employment that are available. A similar critique can be made about research on non-farm employment. These studies often lump disparate employment sources, such as small home-based businesses (e.g., food preparation, shoe repair) with large-scale manufacturing plants (e.g., flower exporters, *maquiladoras*) without analyzing the relationships between specific types of businesses and households. In sum, the literature on rural employment offers a very diverse range of clues as to how smallholders might interact with plantations. This wide range of findings from the rural employment literature and the paucity of specific, recent studies on the specific issue of smallholder motivations for engaging plantation wage work makes it difficult to predict what the degree of interaction between smallholders and plantations might be.

Mulley and Unruh's (2004) work on smallholders and tea plantations in Uganda is one of the few studies that explicitly examines plantations as an income source for smallholders, and offers clues as to how they might interact. Their research suggests that plantation labor in this region does not come from smallholders, but rather, is supplied by outside migrants. This is because smallholders in this area are sufficiently prosperous to have little incentive to seek plantation-based jobs.

In contrast to that work's primary focus at the landscape level (i.e., it studied rural households in the aggregate), the

current study seeks to understand what motivates individual households to seek plantation wage work. To do so, we seek to determine:

- (1) the conditions under which households choose to devote labor to plantation wage work given multiple regional income-generating opportunities;
- (2) the circumstances under which households come to specialize in plantation-based employment, given that off-farm labor specialization by smallholders is generally understood to be a more risky path to household well-being than the pursuit of multiple income-generating activities (e.g., Ellis, 1998).

### 3. Study site and methods

#### 3.1. Land use and livelihoods

This research focuses on households living within the watershed of the Río Dos Novillos, which lies within Costa Rica's larger Reventazon-Parismina watershed. This area, roughly 4800 ha, is located in Guacimo cantón in Costa Rica's Limón province (Fig. 1). Costa Rica is the world's second-largest banana exporter (Clay, 2004), and the Dos Novillos' location within the country's broad Atlantic plain places it within one of Costa Rica's prime banana-producing regions (Hall et al., 2000). In addition, the region is also becoming increasingly

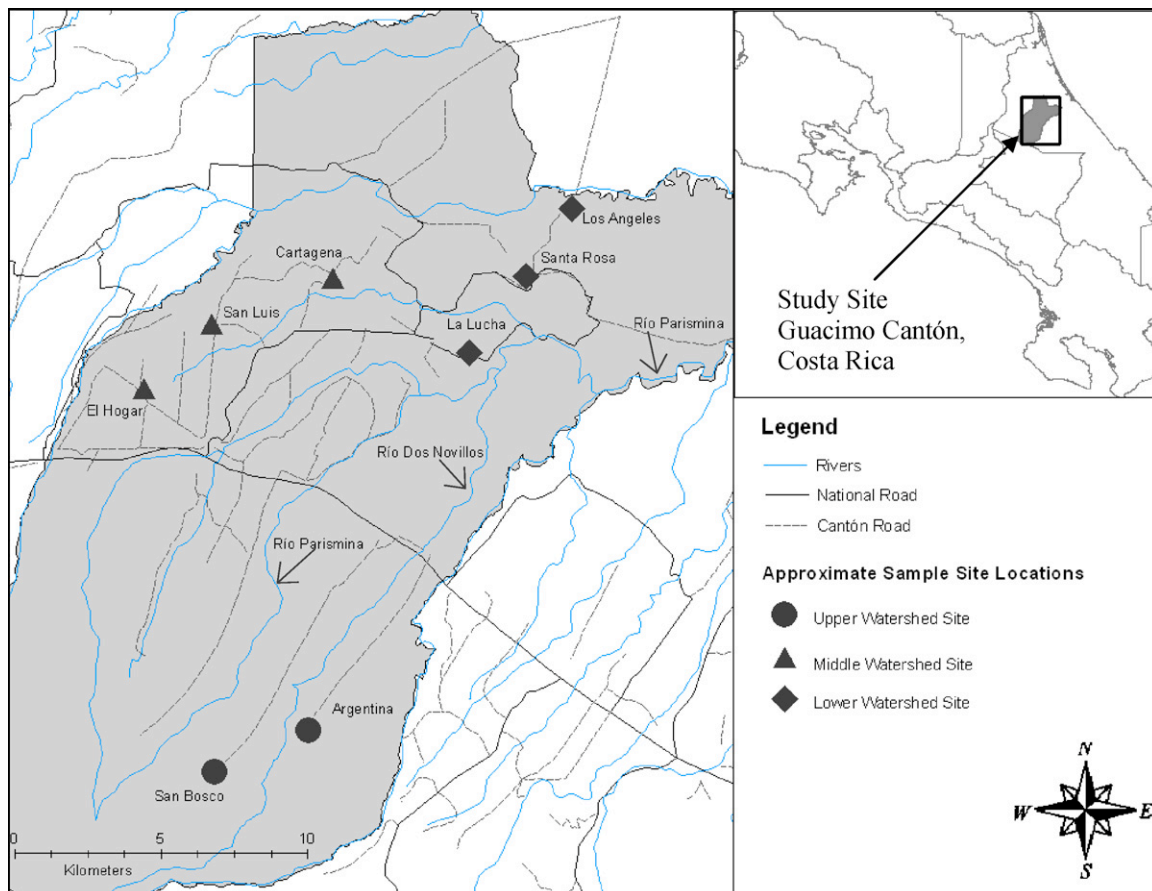


Fig. 1 – Study site location: Guacimo Cantón, Costa Rica, CA.



important for its contribution to pineapple export, in which Costa Rica is an emerging international player (Clay, 2004; SEPSA, 2005).

This area has been home to banana plantations since the late 19th century when Minor C. Keith obtained land concessions from the Costa Rican government in exchange for building a railroad from Limón to San José. The original labor force for both the railroad construction and the banana plantations consisted of West Indian and Chinese immigrants (Echeverri-Gent, 2002; Harpelle, 2001). The area remained thinly populated until the 1960s when the area was targeted by successive waves of colonization – both government-sponsored and spontaneous – by land-poor migrants from the Costa Rican interior, who raised cattle and planted subsistence crops. The towns of Guacimo and Cariari were among the first settled in the 1960s, followed by colonization efforts by the government in the late 1970s and early 1980s in response to sometimes militant land squatting events (Jones, 1990; Seligson, 1980). The result was a rapid increase in smallholders in an area that was formerly dominated by plantations and forest. Currently, the landscape is characterized by a diverse mix of plantations and smallholders coexisting side-by-side (see Fig. 2), which means, among other things, that smallholders have generally easy access to plantation wage work.

Smallholders in this area are currently engaged in a mix of raising cattle, manioc, papaya, maize, and beans. Specialization in cattle-rearing is common in some parts of the watershed. A new road connecting the capital of San José with the Atlantic coast was built through the area in 1987. Since this time, there has been increased urbanization. According to the 2000 census the percentage of urban dwellers in Guacimo cantón (where this study takes place) has increased from 9.5% in 1984 to 30.5% in the year 2000 (INEC, 2000). The 1990s also saw an influx of migrants from Nicaragua. By the year 2000, 8.1% of residents of Guacimo Cantón were foreign born, compared to 1.4% in 1990 (INEC, 2000). Not all Nicaraguans settle permanently; many enter the country in pursuit of seasonal work—especially on plantations, where they rent company housing. Only Nicaraguans who have formally settled in the region were included in the survey.

These development patterns have produced a land-use landscape that is characterized by a highly heterogeneous mix of plantation agriculture, small-scale farming and ranching, and small urban areas. Despite this patchy fabric of land use, field interviews and observations indicate that the land-use trend in this watershed is one toward more and larger plantations at the expense of smallholding agriculturalists. Ownership of plantations in this watershed ranges from multinationals (most notably Dole and Chiquita) to Costa Rican enterprises that sell their product to multinationals on a contract basis. In addition, there has recently been an emergence of smallholding contract farmers, who grow pineapples and bananas for larger multinationals, although such farmers remain relatively rare.

While household livelihood strategies and patterns of wealth accumulation are variable within the watershed, field observations, interviews, and the household survey have revealed some general trends. A typically ‘poor’ household in this region is characterized by a wooden house, ownership of a small amount of land (less than 1 ha) or none at all, no vehi-

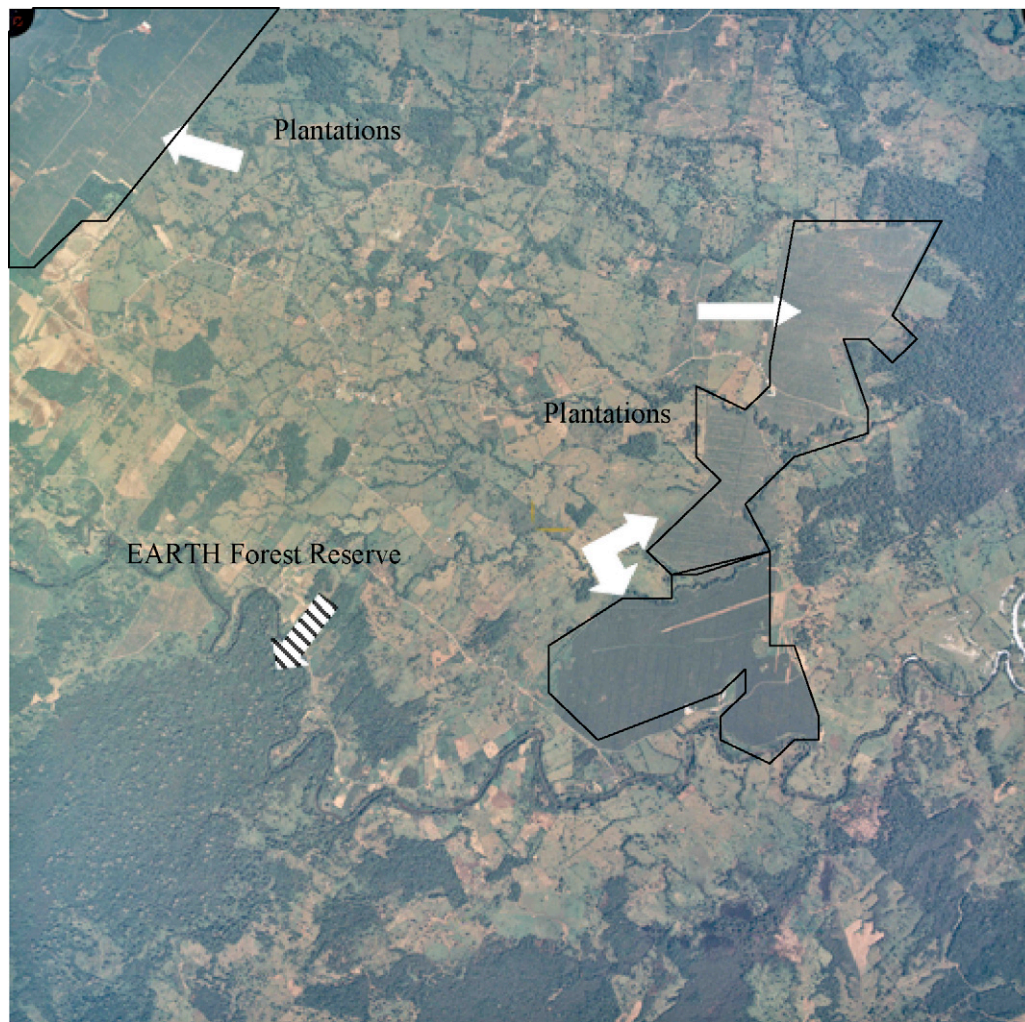
cles, and no cattle; most family members have completed only basic schooling. Households with ‘medium’ wealth endowments generally have higher quality housing (i.e., of cinder block with cement floors), ownership of multiple hectares of land, ownership of a motorcycle, and a few cows; their children may have all completed secondary school. A typically ‘rich’ household generally has more land, often owns a number of geographically separate parcels of land, high quality housing, ownership of a car, and a number of cattle; most children pursue secondary education and beyond. There are, of course, exceptions to these generalizations. There are ‘rich’ households with few land and cattle assets, and ‘poor’ households with modest land assets. Our observations and interviews indicate that households with less than 1 ha of land engage in few agricultural activities. They may have a home garden and some small livestock (e.g., chickens or pigs), but in general, these households rarely devote significant time to agricultural activities.

Most jobs on plantations involve maintaining and harvesting the fruit (e.g., applying pesticides, picking fruit) or post-harvest processing (e.g., applying additional fungicides, packing the product). Pay for both types of jobs is comparable; both are also generally tedious, difficult, and often dangerous (Clay, 2004; Lansing, 2005; Hall et al., 2000), involving near-constant exposure to agro-industrial chemicals. Visits to plantations and interviews with managers reveal that a fairly strict gendered division of labor occurs, with men working jobs in the ‘field’ and women more likely to work post-harvest processing jobs. Among both banana and pineapple plantations there is very little seasonality to the work, with employment numbers fairly steady throughout the year. Nevertheless, long-term job security is virtually non-existent: workers are generally hired on a monthly basis, and it is not uncommon for employees to work some months out of the year and not others. Further, wages and job security for all jobs varies little by crop type (banana or pineapple). Indeed, employees appear to frequently make ‘lateral’ moves between jobs on different type of plantation, depending on who is hiring at the time. For this reason, we have aggregated pineapple and banana plantations in our analysis.

There also exist a smaller number of higher skilled plantation employment positions. These include security guards, managers, machinery technicians, and engineers. In general, these jobs are more secure, pay better, are less dangerous, and have wider variation in the level of pay based on experience, skill, and type of job. These jobs also tend to be more secure than lower skilled employment.

### 3.2. Data collection

In August 2005, a detailed survey was conducted, in Spanish, with 182 households within the Dos Novillos sub-watershed. The study area was stratified into three zones: the upper zone, including the communities of San Bosco and La Argentina; the middle zone, including the communities of El Hogar, San Luis, and Cartagena; and the lower zone, which includes the communities of La Lucha, Santa Rosa and Los Angeles (Fig. 1). Households were chosen at random from each of the three zones and the sample size captures approximately 15–20% of all households in the watershed (INEC, 2000). This



**Fig. 2 – Areal photo of lower watershed study site. Smallholder properties are bounded on three sides by plantations (outlined in black and indicated by the white arrows) and EARTH University's forest reserve (indicated by the striped arrow).**

stratification was based on EARTH expertise conducting agricultural extension work within this watershed, as well as semi-structured interviews with a wide variety of residents, and was conducted to ensure that the survey captures the topographical variation in land use and livelihood patterns within the watershed. For example, the relatively steep upper watershed comprises intact forest within a land-use matrix dominated by plantations and cattle pasture. In contrast, the middle watershed has a higher concentration of smallholders surrounding the watershed's largest town, Guacimo (population: 13,950). Finally, the flatter, alluvial soils of the lower watershed are largely monopolized by plantations interspersed with significant numbers of smallholders.

Household heads were asked about all income-earning activities over the previous month (August 2005). These data were used to determine our dependent variables: that is, whether or not household members worked on a plantation in that month, and to what degree they did so. August is a relatively representative month for a number of reasons. First, plantation work is relatively abundant at this time. In contrast, this is a relatively quiet time in the subsistence cal-

endar, with the two busiest subsistence times of the year being October–December and March. We therefore expect that households who would ever work on plantations are likely to do so in August, and will therefore be picked up in our analysis. We do not suggest that August is a representative month for household cash income generation overall, nor that income portfolios are not seasonally dynamic. Instead, we posit that income activity data from this month will capture households that diversify into plantation labor.

The 1-month sample frame for income was also important for other reasons. Beyond 1 month, detailed reconstructions of income generation are susceptible to problems of recall (Ellis, 2000). More importantly, however, we did so for basic conceptual reasons as well as to avoid potential endogeneity in our models. That is, we envision involvement in plantation labor (as with any type of productive activity) as a function of a household's pre-existing capabilities and assets. Indeed, it is a basic concept of livelihoods research that activity choice is constantly re-assessed by the changing asset endowments of the household (Ellis, 1998; Scoones, 1998). We assume that the acquisition of key assets (education, productive assets,

land, etc.) lags the sample income month. By limiting our sample frame to the previous month, we are able to reasonably assume that household assets existed before the income activity, therefore minimizing potential endogeneity issues in our analysis.

Ethnographic techniques, such as interviews and participant observation (DeWalt and DeWalt, 2002), were initially employed to gain a better understanding of the livelihood issues faced by households in this watershed. This information was then used to design the survey instrument. The questionnaire was pre-tested on 10 households. Based on the results of this pre-test, the questionnaire was further refined for clarity and relevance. Once the survey design was complete, households were chosen following a stratified random sampling procedure (Chaudhuri and Stenger, 1992). Interviews were held *in situ*, either inside or just outside the house, with the household head. Whenever possible, they were conducted with both male and female members of the household present in order to capture the broadest possible range of household information. Interviews were conducted by a team of six surveyors, including Spanish-speaking students from EARTH university trained specifically to administer the questionnaire.

The survey asked a variety of questions about household demographics, history, production, and asset wealth. To maximize the accuracy of results, income queries were limited to activities performed within the previous month. Households were asked detailed questions concerning all cash income sources within the previous month. Income sources were varied, including specific forms of wage work as well as remittance income, pension income, small business earnings, handicraft sales, etc. Gathering information on waged employment usually involved eliciting a detailed work history for each household member, including the number of hours worked, job title and job location. These data were used to calculate total cash earned based on standard wage rates in the area, determined through interviews with plantation managers and government agencies. Farm-based income was queried by asking households to enumerate all animal and crop sales within the previous month; the value of these goods was then calculated using prevailing market prices for each good (e.g., eggs, meat, whole animals, etc.).

In addition to questions about income, questions were also asked about the basic demographic (e.g., household size, gender and age composition) and wealth status of the household. ‘Wealth’ here is understood, following the sustainable livelihood literature (Chambers and Conway, 1991; Ellis, 2000; Scoones, 1998), to include forms of human capital (e.g., education levels), social capital (nearby family; membership in organizations), productive assets (livestock, tools, vehicles), financial capital (access to credit, savings) cultivated land, fallow land, and forest holdings.

### 3.3. Data analysis

All data on income were then aggregated by type. These include earnings from wage work within the agricultural sector (disaggregated here into wages earned on plantations vs. other rural agricultural employment, such as clearing brush or for planting or pasture), earnings from employment outside

of agriculture (disaggregated into “non-farm” wage employment and salaried work as a teacher, security guard, etc.), farm income (from the sale of own-account production such as crops or animal products), land rent, self-employment income, and remittance/pension income.

Combined, the questions about income yielded four dependent variables measuring the degree of engagement with plantation-based employment: a dichotomous variable indicating whether the household had earned any income from plantation labor (yes/no); the percentage of total cash income earned from plantation work; the total income earned from plantation work; and, finally a measure of household “specialization” in plantation employment. The latter metric, adapted from the Herfindahl–Hirschman index of market concentration, approaches 1 if a household earns all of its cash income from plantation work alone; and 0 if income generation is equally distributed across all earning categories. “Specialization” is value-neutral: we expect that very poor households might “specialize” in plantation wage work due to the lack of assets, labor, or capabilities that would allow them to take advantage of multiple forms of employment, which is generally considered an important part of subsistence security. Conversely, the relatively well-off might have the assets to buffer the riskiness of specialization and benefit from potentially higher returns. Finally, we utilized survey data to identify and measure yielded 20 independent household asset and demographic variables. Information about the independent variables is summarized in Table 1. Income data was divided into 10 income categories as shown in Table 2.

Initial data exploration in STATA 7.0 yielded two outliers (one case with an extremely high *z* score for a household’s number of hectares, and one case which was identified through Mahalanobis distance as a multivariate outlier with  $p < .001$  (Tabachnick and Fidell, 2001)). These outliers were deleted for regression analyses, but retained for ANOVA and income diversity analysis.

To determine how land and wealth endowments influence households’ income sources, we used analyses of variance (ANOVA). Two regression models were then constructed in order to predict various levels of household engagement with the plantation economy: (1) a logit regression with the dichotomous dependent variable of “participation in plantation wage work”, (2) an ordinary least squares (OLS) regression using the dependent variable of “monthly plantation income” (limited to households that participate in plantation wage labor).

## 4. Results

### 4.1. Summary of dependent variables

Income summaries in Table 2 show that participation in plantation wage work is substantial. Roughly one third (35.10%) of households in the study area participate in plantation wage work. This is the highest level of participation for all income categories in this study. It is more than twice the level of participation in other forms of agricultural wage work (14.30% of households received income from non-plantation off-farm labor) and more than three times the level of par-



**Table 1 – Independent variable summaries and descriptions**

Variable name	Description	N	Mean	Median	Min	Max
5-Year migration	Migrated to watershed within previous 5 years	182	13%	0		
20-Year migration	Migrated to watershed more than 20 years ago	182	20%	0		
Male workers <sup>a</sup>	Number of males in household between the ages of 15 and 65	170	1.32	1	0	5
Female workers	number of female workers in household between the ages of 15 and 65	170	1.17	1	0	3
Head education	Years of education of household head	170	7.09	8	0	18
Head age	Age of household head	170	46.95	44.5	22	80
Head gender	Gender of household head (male = 1)	182	0.68	1		
Family close agriculture	Family in same town that engages in agriculture	182	27%	0		
Family close plantation	Family in same town that engages in plantation work	182	36%	0		
Number of vehicles	Number of cars, trucks, or motorcycles	170	0.71	0	0	5
Number of cattle	Number of cattle	182	6.48	0	0	300
Store distance	Kilometers from nearest store	182	0.939	0.65	0	4
Formal credit	Accessed formal credit in last year	182	18%	0		
House quality	Quality of house (1–4 ranking)	182	2.49	3	1	4
Land ownership	Ownership of land or house	182	76%	1		
Number of hectares	Number of hectares the household owns	182	6.4	0.5	0	175
Number of parcels	Number of geographically separate land parcels the household owns	173	0.87	1	0	3
Hectares in cultivation	Number of hectares in cultivation	182	1.01	0	0	22
Hectares in pasture	Number of hectares in pasture	182	3.55	0	0	164
Hectares in forest	Number of hectares in forest	182	0.87	0	0	37
Upper watershed	Location dummy variable	182	0.19			
Middle watershed	Location dummy variable	182	0.36			
Lower watershed	Location dummy variable	182	0.45			

<sup>a</sup> Sample size deviations from 182 are due to household non-response to question.

**Table 2 – Income category summaries**

Household income sources	N	Mean	Min	Max	S.D.	% HH participate
Plantation income <sup>a</sup>	182	47,091	0	550,000	82,431	35.10
% of total income <sup>b</sup>	161	32.6%				
Total farm income <sup>c</sup>	182	81,981	0	3,012,000	302,091	30.80
% of total income	161	24.6%				
Animal income	182	46,031	0	3,012,000	273,549	14.80
% of total income	161	10.2%				
Crop income	182	35,939	0	1,150,000	126,897	20.30
% of total income	161	14.5%				
Land rent income	182	1874	0	86,250	12,078	3.30
% of total income	161	2.1%				
Non-plantation off-farm income	182	12,880	0	300,000	40,808	14.30
% of total income	161	11%				
Salaried non-farm income	182	21,345	0	920,000	21,345	10.40
% of total income	161	8.7%				
Wage non-farm income	182	13,321	0	280,000	45,089	9.90
% of total income	161	8.8%				
Self-employment income	182	9380	0	500,000	48,172	10.40
% of total income	161	5.8%				
Remittance/pension income	182	3961	0	90,000	13,992	12.10
% of total income	161	6.3%				
Total income	182	191,837	0	3,012,000	310,007	88.50

<sup>a</sup> Mean and median income figures are in colones; at the time survey was taken, the exchange rate was 483 colones to one dollar.

<sup>b</sup> Income percentage averages exclude households that reported no income from the previous month.

<sup>c</sup> Total farm income is the sum of animal income and crop income.



**Table 3 – Household income specialization indices**

	N	Income specialization index <sup>a</sup>
Plantation households	64	0.874***
Non-plantation households	118	0.616***
All households	182	0.705

<sup>a</sup> Adopted from Coomes (1992, p. 360), who adapted the Herfindahl–Hirschmann Index of Market Share Concentration to estimate a coefficient of specialization (SC) as  $SC = (\sum_{i=1}^n X_i^2) / 1$  where  $X_i$  is the percentage of total household market income contributed by product (or in this case, sector)  $i$ , and  $n$  is the number of products sold (here, the number of sectors in which the household is engaged).

\*\*\*t-Test  $p$ -value < .01.

ticipation for non-agricultural (non-farm) wage work (9.9%). The mean average monthly income from plantation wage work is 47,091 colones (US\$ 97.49)<sup>3</sup>. This is the highest average for non-agricultural sources of income, but less than the average for own-farm income (81,981 colones). The average contribution of plantation wage work to household income is 32.6%. This is the highest average of all income sources, with own-farm agriculture the second highest average at 24.6%.

A closer analysis of all income sources for households show that households that engage in plantation income are significantly more specialized than households that do not. Table 3 shows the Herfindahl–Hirschman index for market specialization for plantation and non-plantation households. This table indicates that households that participate in plantation wage labor are among the most specialized in the study area. The average for the Herfindahl–Hirschman index of market specialization for all households was 0.70 (1 = complete specialization). Households that participate in plantation wage work had a specialization index of 0.87, which is significantly higher than households that do not participate in plantation wage work ( $p = .000$ ). This finding is further supported by Fig. 3, which shows average income portfolios for different types of households. When all households are included, average income sources in the survey sample appear to be fairly diversified, however, when only households that work on plantations are considered, we can see that these households are quite specialized in their sources of income, with 80.1% of their income coming from plantation wage work.

#### 4.2. Variance in income sources by land and wealth endowments

As shown in Table 1, 76% of the households in the survey own land. However, 44% of landowning households own less than 1 ha (Table 4). Overall, the landless and the land poor tend to dominate plantation wage work. Data on household income sources for different land endowment categories is found in Table 4. Household participation in, and earnings from, plantation wage work is highest among households with no land

or with less than 1 ha, with statistically significant decreases in participation and earnings as land endowments increase ( $p = .000$  for both participation and earnings).

Table 5 lists the distribution of income sources by wealth categories. Households were assigned a qualitative wealth ranking based on a number of key assets: property ownership (yes or no), quantity of land ownership, vehicle ownership, cattle ownership, and quality of house. The relationship between household wealth and plantation wage work generally follows a U-shaped pattern in which the least and most wealthy households have the highest rates of participation in, and income from, plantation wage work. The highest rates of participation in plantation wage work are in the lowest category (48%) and the highest (41%) ( $p = .082$ ). There is significant variation in plantation income between categories ( $p = .000$ ) with the lowest category receiving the highest average income from plantation wage work, and the highest wealth category having the second highest average. Likewise, these two categories also have the highest rates of household income contribution from plantation wage work ( $p = .023$ ) than the middle two quartiles, with the lowest category being the most dependent upon this income source (49%). The highest participation rates in animal and crop sale, by contrast, fall within the middle two wealth categories.

Regression analyses are found in Table 6. The logit regression model was built to predict whether or not a household participated in plantation wage work in the month prior to the survey. According to the model, which was robust and accounted for 34% of the variation in plantation wage work participation, households with more adult males were more likely to seek plantation work (*male workers*;  $p = .002$ ), as were younger households, and those who had recently moved to the region (5-year migration ( $p = .039$ ), head age ( $p = .022$ )). Conversely, the more land and vehicles a household owned, the less likely its members were to work on a plantation (*number of vehicles* ( $p = .007$ ), *number of hectares* ( $p = .018$ ), and *number of parcels* ( $p = .020$ )).

Table 6 also shows the results of an ordinary least squares (OLS) regression model, which was constructed to shed light on which households, among those that worked on plantations, earned the most. The model is robust ( $F = .000$ ) and explains almost half of the variation in total plantation-derived income (adjusted  $R^2 = 0.48$ ). This regression yielded one significant positive predictor, *male workers* ( $p = .000$ ), indicating that one extra male worker in a household translates into an extra 58,038 more colones (approximately US\$ 120) earned from plantation wage work per month. Three other variables proved to be significant. According to the model, households headed by single women, with younger heads, and with less land all earn more income from plantation work than those with older and male household heads and with less land. Specifically: 1 extra year of age for the household head translates into 1410 fewer colones per month that the household will earn from plantation wage work. In addition, the OLS model predicts that a household headed by a male will earn 32,987 fewer colones per month than a female-headed household, and every hectare of land the household owns means it will earn 8538 fewer colones per month from plantation wage work.

<sup>3</sup> The exchange rate at the time of the survey was 483 colones to one US dollar.

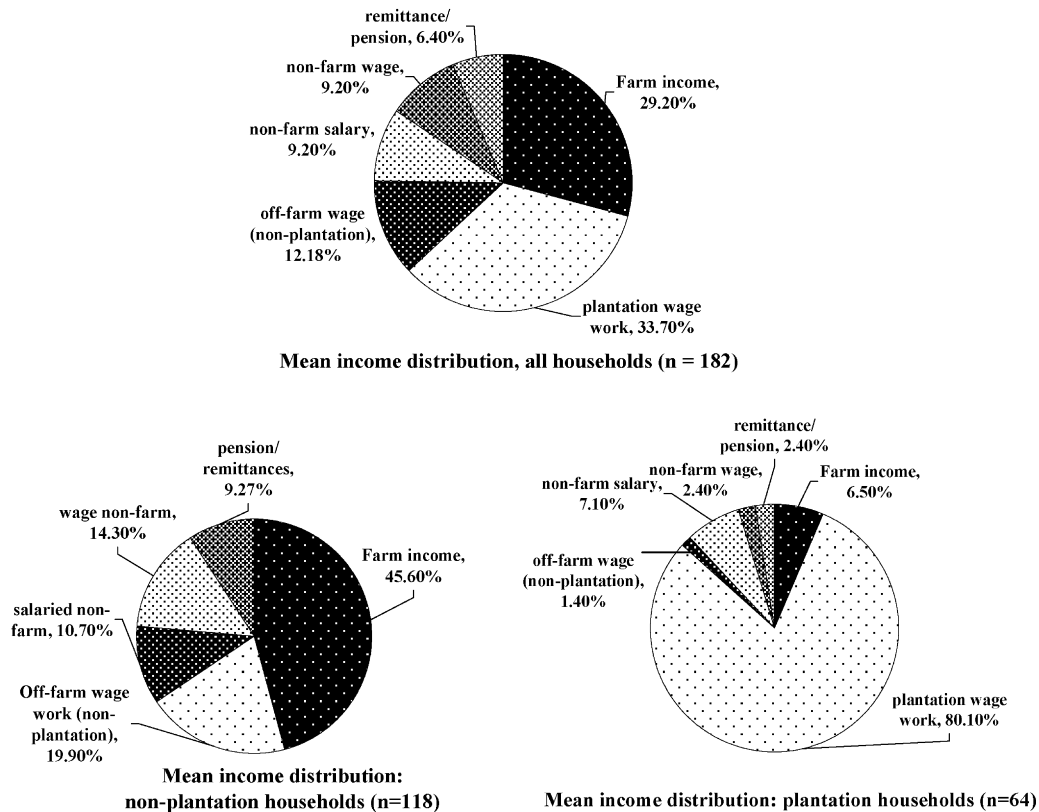


Fig. 3 – Mean income distributions for all households (top), non-plantation households (bottom left), and plantation households (bottom right).

## 5. Discussion

### 5.1. Conditions of plantation wage work

Data presented above indicate that households with few land assets tend to engage in plantation wage work. Income from plantation wage work becomes increasingly less important (i.e., it contributes less to their total income, and they earn less from it) to households the more land they possess. Furthermore, households with few land endowments (no land or less than 1 ha) have the highest plantation participation rates as well as the highest monthly earnings from plantation wage work. Regression results further verify this trend. The logit model, which measures the probability of a household's participation in plantation wage work, shows that the number of hectares a household owns is a significant negative predictor of plantation wage work participation. Likewise, the number of parcels a household owns is also a significant negative predictor of plantation participation.

The inverse relationship between land assets and engagement with the plantation economy indicates that plantation wage work in the Dos Novillos watershed appears to follow a pattern shown in a number of studies conducted on the rural non-farm employment sector, where farm-based assets such as land discourage entry into this sector (Berdegué et al., 2001; Corral and Reardon, 2001). In other words, the land poor are those who rely heavily – effectively specializing – on the work offered by plantations. This appears to go against a num-

ber of findings in the household livelihoods literature, which posits wage work as a supplement to agricultural based livelihoods (e.g., Ellis, 2000). Instead, the types of workers in the plantation sector appear to follow rural employment trends in which wage work is the dominant livelihood activity with little household income coming from own-farm agriculture (Rigg, 2006).

In addition to lack of land, it appears that the household life-cycle plays a strong role in determining a household's engagement in plantation wage labor: the younger the head of household, the more likely it is that members of that household sought work on a plantation, and earn more from it. The number of male workers in a household, however, was a significant positive predictor across both regression models ( $p < .01$  for both), indicating that, while older households tend not to engage in plantation wage work, households with children of working age are more likely to work in plantations. This indicates that plantation work is not the domain of the youngest households, but rather of 'middle age' households with relatively young adult males, who constitute excess household labor in the watershed. Thus, plantation wage work appear to be absorbing excess labor in the watershed.

### 5.2. Circumstances of plantation specialization

Our results indicate that households engaging in plantation wage work tend to have more specialized income sources rel-

**Table 4 – Income sources by land endowment**

	No land	<1 ha	1 > 8 ha	>8 ha
<b>Household participation rates</b>				
N	39	63	38	42
% plantation participation <sup>***</sup>	59	46	21	10
% animal sale participation <sup>***</sup>	2.5	7.9	23	28
% crop sale participation <sup>***</sup>	7.6	6.3	34	40
% self-employment participation <sup>**</sup>	2.6	20	7.8	4.8
<b>Household income sources</b>				
N (percentage n) <sup>a</sup>	39 (37)	63 (58)	38 (32)	42 (34)
Mean plantation income <sup>***</sup>	78,704	63,250	27,810	10,942
% of total income <sup>***</sup>	50.8%	44.5%	15.2%	9.4%
Total farm income <sup>b,***</sup>	7820	7325	149,046	202,102
% of total income <sup>***</sup>	3.6%	6.3%	45.6%	59.1%
Animal income <sup>*</sup>	769	1246	73,557	130,333
% of total income <sup>***</sup>	.9%	2.4%	16.1%	27.8%
Crop income <sup>***</sup>	7051	6079	75,489	71,769
% of total income <sup>***</sup>	2.7%	3.9%	29.5%	31.3%
Land rent income <sup>***</sup>	0	79	219	7807
% of total income	0%	.4%	.9%	8%
Non-plantation off-farm income	18,000	13,549	11,805	8095
% of total income	14%	11.5%	9.5%	8.3%
Salaried non-farm income	17,774	31,106	12,126	18,361
% of total income	10.4%	9.6%	4%	9.8%
Wage non-farm income	14,041	18,076	18,500	838
% of total income	8.6%	12.7%	9.5%	1.8%
Self-employment income	466	16,682	14,210	2333
% of total income	.3%	10.3%	6.4%	3.4%
Remittance/pension income <sup>***</sup>	10,461	1555	5026	571
% of total income <sup>*</sup>	12.3%	4.6%	8.9%	.1%
Total income	147,268	151,657	238,745	251,053

<sup>a</sup> Sample sizes for percentage income averages are in parentheses; income percentage averages exclude households that reported no income from the previous month.

<sup>b</sup> Sum of animal and crop income.

\* ANOVA *p*-value < .10.

\*\* ANOVA *p*-value < .05.

\*\*\*ANOVA *p*-value < .01.

ative to households that do not, with plantation income being the dominant source (see Table 3 and Fig. 3)<sup>4</sup>. One factor that appears to lead to a household's specialization in plantation wage work is the gender of the household head. While the gender of the household head did not appear to be a significant determinant of entry into the plantation sector, it is an important determinant of income earned among those that did earn plantation wages, all else held equal. This indicates that female-headed households that participate in plantation wage work are more invested in this type of income source than male-headed households.

The wealth levels and land endowments of plantation households appear to follow another trend found in the

non-farm sector: a U-shaped relationship between household wealth and earnings from this sector, with low-income households obtaining the highest share of their income from non-farm employment. In other words, non-farm employment is often the domain of the poorest and wealthiest households, with poor households the most dependent upon this sector for survival. A number of case studies have shown this to be the case in Latin America (Deininger and Olinto, 2001; Feldman and Leones, 1998; Reardon et al., 2000) and parts of Asia (Adams, 1994; Garcia and Alderman, 1993). These studies describe a pattern in which low-income and high-income households both engage in the non-farm sector, but in different types of employment. Since many of these low-income households also lack land endowments, non-farm employment becomes a means of survival and not a source of on-farm investment and productivity gains. The lack of access to agricultural endowments, sufficient credit, and access to social networks means that non-farm workers under these conditions are often caught in a 'poverty

<sup>4</sup> We should point out, however, that the wealth endowments of households that engage in plantation wage work is fairly diverse. There is, therefore, some diversity of income sources among households within each of these wealth categories.



**Table 5 – Income sources by wealth categories**

	Bottom	Lower middle	Upper middle	High
Participation rates				
N	42	65	36	39
% plantation participation <sup>*</sup>	48	25	33	41
% animal sale participation <sup>*</sup>	7	23	17	8
% crop sale participation <sup>*</sup>	7	25	28	21
% participate self-employment	7	12	8	13
Monthly income (colones)				
N (percentage N) <sup>a</sup>	42 (35)	65 (53)	36 (35)	39 (38)
Plantation income <sup>***</sup>	78,319	22,403	50,950	51,048
% of total income <sup>**</sup>	0.491	0.189	0.349	0.349
Animal income <sup>*</sup>	1252	113,893	2611	21,230
% of total income	0.042	0.197	0.091	0.129
Crop income	6547	60,543	37,361	25,271
% of total income <sup>*</sup>	0.026	0.189	0.189	0.153
Total farm income <sup>b, **</sup>	7799	174,436	39,972	46,501
% of total income <sup>***</sup>	0.068	0.382	0.278	0.192
Land rent income	0	1282	2766	4059
% of total income	0	0.019	0.026	0.037
Non-plantation off-farm income <sup>***</sup>	32,371	3600	4111	15,451
% of total income <sup>**</sup>	0.236	0.054	0.061	0.119
Salaried non-farm income <sup>**</sup>	0	44,776	4944	20,420
% of total income <sup>**</sup>	0	0.1726	0.029	0.102
Wage non-farm income	10,071	9390	13,755	22,974
% of total income	0.064	0.074	0.063	0.152
Self-employment income	15,285	10,661	7555	2569
% of total income	0.058	0.084	0.058	0.021
Remittance/pension income	4023	2523	8500	2102
% of total income <sup>*</sup>	0.083	0.026	0.137	0.029
Total income <sup>*</sup>	147,868	269,071	132,553	165,124

<sup>a</sup>Sample sizes for percentage income averages are in parenthesis, income percentage averages exclude households that reported no income from the previous month.

<sup>b</sup>Sum of animal and crop income.

\* ANOVA  $p$ -value < .1.

\*\* ANOVA  $p$ -value < .05.

\*\*\*ANOVA  $p$ -value < .01.

trap' from which they cannot escape (Deininger and Olinto, 2001).

Data from this study indicate that this pattern is partially being produced by plantation wage labor. According to Table 5, both the lowest and highest wealth quartiles have the highest participation rates in plantation wage work. These two wealth categories also earn the most money from plantation wage work. Lower wealth households, however, derive little income from agricultural activities, with on-farm income contributing significantly less to their income portfolios than one finds in other households. These data also show that households in the lowest wealth category, on average, derive the highest percentage of their income from plantation wage work (49%), while households in the upper wealth categories receive significantly more on-farm income from households in the lower wealth categories. While a longer term study is needed to confirm this apparent pattern, the results presented here seem to suggest that plantation

wage work is associated with the "poverty trap" mentioned above.

Finally, recent migration to the area is not a significant factor in a household's engagement with plantation wage labor. The variable 5-year migration is a negative predictor in the logit model, indicating that households that moved to the area in the last 5 years are less likely to engage in plantation wage labor, all else being equal. Since plantation wage work in this watershed attracts household that are longer established, but land poor, it appears as if plantation wage work could be a means for the land poor in this area to persist in this watershed, as opposed to migrating to larger cities. This finding is suggestive rather than conclusive, as longer term data on the accumulation patterns of plantation households are needed to confirm this. However, in light of the recent history of this region, in which smallholders have been increasingly abandoning agriculture and migrating to large cities (Kay, 2006), this

**Table 6 – Regression output**

Dependent variable	Regression		
	Logit Plantation participation	OLS Monthly plantation income	
N	168	N	168
$\chi^2$	75.818	F (12, 45)	5.79
Crit $\chi^2$	0.000	F sig.	0.000
Pseudo R <sup>2</sup>	0.34	R <sup>2</sup>	0.575
		Adjusted R <sup>2</sup>	0.476
Left censored obs.			109
Independent variables	Regression		
	Logit Coefficient	OLS Coefficient	
5-Year migration	−1.426**	−27669.78	
20-Year migration	−0.734		
Male workers	1.233***	58038.98***	
Female workers	0.435	12576.84	
Head education	−0.047	−3930.9	
Head age	−0.051**	−1410.318*	
Head gender	0.506	−32987.99*	
Family close agriculture	−0.787		
Family close plantation	0.473		
Number of vehicles	−1.064***	−21720.86	
Number of cattle	0.037		
Store distance	0.284		
Formal credit	0.167	31277.48	
House quality	0.197		
Number of hectares	−0.188**	−8538.956***	
Number of parcels	−1.226**		
Upper watershed	−0.563	−37247.71	
Middle watershed	−0.787	3316.315	
Lower watershed Constant	0.822	154050.2	
* p-Value < .1.			
** p-Value < .05.			
***p-Value < .01.			

initial finding does point to an important area for further inquiry.

## 6. Conclusions and recommendations

This study suggests that wage employment in a plantation is generally not part of a livelihood diversification strategy for agriculture-based households. Instead, an analysis of the asset and income patterns of household that are involved with the plantation economy reveals that this type of employment is a specialization strategy undertaken by households that utilize advantages in human capital (extra male laborers), but often lack significant agricultural assets such as land. Plantation wage work is an important income source for the survival of the rural landless and smallholders that are only marginally engaged in agriculture. While our analysis indicates that a number of relatively land-wealthy households engage in plantation wage work, these households do so as part of a more diversified portfolio of income sources. Finally, the dominance of households with low levels of wealth in plantation wage work opens the possibility that income from plantations is not a strategy for household wealth accumulation, but instead

appears to be a means of survival. While a multi-year study on the accumulation patterns of these households would be necessary to confirm this pattern, our findings to date are consistent with studies elsewhere on the non-farm “poverty trap” in developing countries. Based on the results of this study, we make the following recommendations:

1. *Improved labor force training:* Regression results consistently show that a household's engagement with plantation wage work is driven by male labor availability. Unfortunately, the wages these male workers earn do not necessarily translate into increased household wealth. Programs such as vocational training, that can transform a household's labor pool from unskilled plantation wage laborers into more skilled (and more highly remunerated) laborers, can help households turn this situation around.
2. *Address the needs of female-headed households:* The gender of the household head was not a significant predictor of entry into plantation wage labor. However, female-headed households that do engage in plantation wage work have higher earnings. This suggests the existence of a vulnerable subset of the population that is dependent upon this type of employment. The economic and social needs (health,

education, financial security, etc.) of these households are beyond the scope of this paper. However, this indicates an important avenue of future research and intervention.

3. *Further research on the viability of smallholders:* Small-farm households represent an important segment of the rural population in this area, but it is currently unclear how viable their land use strategies are. It appears that they are not as engaged in plantation wage work as a diversification strategy as some research on household livelihoods would suggest, which still leaves open two key questions. First, what are the long-term income and land-use strategies of these households? Second, are these strategies economically and ecologically sustainable in the long term?

Land use in the Dos Novillos watershed is a mix of small-scale agriculture and capital-intensive agribusiness. However, this analysis indicates that complementary economic interactions between these two forms of land use are minimal. Instead, engagement in plantation wage work is a specialization strategy for households with few agricultural assets and minimal involvement in own-farm agriculture. Therefore, we conclude that the spillover benefits from plantation wage work into other forms of land use are minimal. To the extent that the contribution of plantations to the sustainability of the watershed is through the generation of these benefits, we have found little evidence of this contribution.

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## REFERENCES

- Adams, R.H.J., 1994. Nonfarm income and inequality in rural Pakistan: a decomposition analysis. *J. Dev. Stud.* 31, 110–133.
- Alderman, H., Paxson, C., 1992. Do the poor insure? A synthesis of the literature on risk and consumption in developing countries. Policy Research Working Papers. World Bank, Washington, DC.
- Alderman, H., Sahn, D.E., 1989. Understanding the seasonality of employment, wage, and income. In: Sahn, D.E. (Ed.), *Seasonal Variability in Third World Agriculture: The Consequences for Food Security*. John Hopkins University Press, Baltimore, pp. 81–106.
- Angelson, A., Kaimowitz, D., 1999. Rethinking the causes of deforestation: lessons from economic models. *World Bank Res. Obser.* 14, 73–98.
- Bartra, R., 1993. *Agrarian Structure and Political Power in Mexico*. Johns Hopkins, Baltimore.
- Bassett, T., 1988. Breaking up the bottlenecks in food-crop and cotton cultivation in northern Cote d'Ivoire. *Africa* 8, 147–173.
- Beaumont, P., Walker, R., 1996. Land degradation and property regimes. *Ecol. Econ.* 18, 55–56.
- Bebbington, A., 1993. Sustainable livelihood development in the Andes? Local institutions and regional resource use in Ecuador. *Dev. Policy Rev.* 11, 5–30.
- Bebbington, A., 1999. Capitals and capabilities: a framework for analyzing peasant viability, rural livelihoods and poverty. *World Dev.* 27, 2021–2044.
- Bebbington, A., 2000. Reencountering development: livelihood transitions and place transformations in the Andes. *Ann. Assoc. Am. Geogr.* 90, 495–520.
- Beckford, G., 1983. *Persistent Poverty: Underdevelopment in Plantation Economies of the Third World*. Maroon Publishing, Morant Bay, Jamaica.
- Berdegue, J., Ramirez, E., Reardon, T., Escobar, G., 2001. Rural nonfarm incomes and employment in Chile. *World Dev.* 29, 411–425.
- Blaikie, P., Brookfield, H., 1987. *Land Degradation and Society*. Methuen, London.
- Block, S., Webb, P., 2001. The dynamics of livelihood diversification in post-famine Ethiopia. *Food Policy* 26, 333–350.
- Bluffstone, R., 1993. The effect of labor market performance on deforestation in developing countries under open access: an example from rural Nepal. *J. Environ. Econ. Manage.*, 29.
- Chaudhuri, A., Stenger, H., 1992. *Survey Sampling: Theory and Methods*. M. Dekker, New York.
- Chambers, R., Conway, G., 1991. Sustainable rural livelihoods: practical concepts for the 21st century. IDS Discussion Paper 26. Institute of Development Studies, Sussex, UK.
- Chomitz, K., Griffiths, C., 1996. Deforestation, shifting cultivation, and tree crops in Indonesia: nationwide patterns of smallholder agriculture at the forests frontier. In: *Environment, Infrastructure, and Agriculture Division Policy Research Department*. The World Bank, Washington, DC.
- Clay, J., 2004. *World Agriculture and the Environment*. Island Press, Washington.
- Collier, P., Lal, D., 1986. *Labor and Poverty in Kenya: 1900–1980*. Clarendon Press, Oxford.
- Coomes, O.T., 1992. *Making a Living in the Amazon Rain Forest: Peasants, Land, and Economy in the Tahuayo River Basin of Northeastern Peru*. Ph.D. Dissertation. University of Wisconsin-Madison.
- Corral, L., Reardon, T., 2001. Rural nonfarm incomes in Nicaragua. *World Dev.* 29, 427–442.
- Coxhead, I., Shively, G., 2005. Economic development and watershed degradation. In: Coxhead, I., Shively, G. (Eds.), *Land Use Change in Tropical Watersheds: Evidence, Causes, and Remedies*. CABI Publishing, Wallingford, UK, pp. 1–18.
- de Janvry, A., Sadoulet, E., 2001. Income strategies among rural households in Mexico: the role off-farm activities. *World Dev.* 29, 467–480.
- de Janvry, A., Sadoulet, E., Young, L.W., 1989. Land and labour in Latin American agriculture from the 1950s to the 1980s. *J. Peasant Stud.* 16, 396–424.
- Deininger, K., Olinto, P., 2001. Rural nonfarm employment and income diversification in Colombia. *World Dev.* 29, 455–465.
- DeWalt, K.M., DeWalt, B.R., 2002. Informal interviewing in participant observation. In: *Participant Observation: A Guide for Fieldworkers*. Altamira Press, Walnut Creek, CA.
- Echeverri-Gent, E., 2002. forgotten workers: British West Indians and the early days of the banana industry in Costa Rica and Honduras. *J. Lat. Am. Stud.* 24, 275–308.
- Ellis, F., 1998. Household strategies and rural livelihood diversification. *J. Dev. Stud.* 35, 1–38.



- Ellis, F., 2000. *Rural Livelihoods and Diversity in Developing Countries*. Oxford University Press, Oxford.
- Feldman, S., Leones, J.P., 1998. Nonfarm activity and rural household income: evidence from Philippine microdata. *Econ. Dev. Cult. Change* 46, 789–806.
- Garcia, M., Alderman, H., 1993. Food security and health security: explaining the levels of nutritional status in Pakistan. *Econ. Dev. Cult. Change* 42, 485–507.
- Godoy, R., Wilkie, D., Franks, J., 1997. The effects of markets on neotropical deforestation: a comparative study of four amerindian societies. *Curr. Anthropol.* 38, 875–878.
- Grossman, L.S., 1993. The political ecology of banana exports and local food production in St. Vincent, Eastern Caribbean. *Ann. Assoc. Am. Geogr.* 83, 347–367.
- Grossman, L.S., 1998. *The Political Ecology of Bananas: Contract Farming, Peasants, and Agrarian Change in the Eastern Caribbean*. The University of North Carolina Press, Chapel Hill and London.
- Gwynne, R.N., 2003. Transnational capitalism and local transformation in Chile. *Tijd. Econ. Soc. Geogr.* 94, 310–321.
- Hall, C.A.S., Leon, C., Ravenscroft, W., Wang, H., 2000. Temporal and spatial overview of Costa Rica agricultural production. In: Hall, C.A.S., Laake, P.V., Perez, C.L., Leclerc, G. (Eds.), *Quantifying Sustainable Development: The Future of Tropical Economies*. Academic Press, San Diego, pp. 349–402.
- Hardner, J., Rice, R., 2002. Rethinking green consumerism. *Sci. Am.* 286, 88–90.
- Hernández, C., Witter, S.G., Hall, C.A.S., Fridgen, C., 2000. The Costa Rican banana industry: can it be sustainable? In: Hall, C.A.S., Laake, P.V., Perez, C.L., Leclerc, G. (Eds.), *Quantifying Sustainable Development: The Future of Tropical Economies*. Academic Press, San Diego.
- Harpelle, R.N., 2001. *The West Indians of Costa Rica: Race, Class, and the Integration of an Ethnic Minority*. Ian Randle Press, Kingston.
- INEC, 2000. Instituto Nacional de Estadística y Censos. Características Demográficas, accessed on February 22, 2005 <http://www.inec.go.cr>.
- Jones, J.R., 1990. *Colonization and Environment: Land Settlement Projects in Central America*. The United Nations University, Tokyo.
- Kay, C., 1995. Rural Latin America: exclusionary and uneven agricultural development. In: Halebsky, S., Harris, R. (Eds.), *Capital, Power, and Inequality in Latin America*. Westview, Boulder, pp. 21–51.
- Kay, C., 2006. Rural poverty and development strategies in Latin America. *J. Agrar. Change* 6, 455–508.
- Korovkin, T., 1997. Taming capitalism: the evolution of the indigenous peasant economy in Northern Ecuador. *Lat. Am. Res. Rev.* 32, 89–110.
- Korovkin, T., Sanmiguel-Valderrama, O., 2007. Labour standards, global markets and non-state initiatives: Colombia's and Ecuador's flower industries in comparative perspective. *Third World Q.* 28, 117–135.
- Lanjouw, J.O., Lanjouw, P., 2001. The rural non-farm sector: issues and evidence from developing countries. *Agric. Econ.* 26, 1–23.
- Lansing, D., 2005. Field interviews with plantation workers, July–August 2005.
- Love, T.F., 1989. Limits to the articulation of the modes of production approach: southwestern Peru. In: Orlove, B., Foley, M., Love, T.F. (Eds.), *State, Capital and Rural Society: Anthropological Perspectives on Political Economy in Mexico and the Andes*. Boulder, Westview.
- Mulley, B.G., Unruh, J.D., 2004. The role of off-farm employment in tropical forest conservation: labor, migration, and smallholder attitudes toward land in western Uganda. *J. Environ. Manage.* 71, 193–205.
- Murphy, L.L., 2001. Colonist farm income, off-farm work, cattle, and differentiation in Ecuador's Northern Amazon. *Hum. Organ.* 60, 67–79.
- Netting, R.M.C., 1993. *Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture*. Stanford University Press, Stanford, California.
- Reardon, T., Berdegue, J., Escobar, G., 2001. Rural nonfarm employment and incomes in Latin America: overview and policy implications. *World Dev.* 29, 395–409.
- Reardon, T., Taylor, J.E., Stamoulis, K., Lanjouw, P., Balisacan, A., 2000. Effects of nonfarm employment on rural income inequality in developing countries: an investment perspective. *J. Agric. Econ.* 51, 266–288.
- Rigg, J., 2006. Land, farming, livelihoods, and poverty: rethinking the links in the rural South. *World Dev.* 34, 180–202.
- Rola, A.C., Coxhead, I., 2002. Does non-farm job growth encourage or retard soil conservation in Philippine uplands? *Philipp. J. Dev.*, 53.
- Rose, E., 2001. Ex ante and ex post labor supply response to risk in a low-income area. *J. Dev. Econ.* 64, 371–388.
- Scoones, I., 1998. Sustainable rural livelihoods: a framework for analysis. IDS Working Paper, No. 72.
- Seligson, M., 1980. *Peasants of Costa Rica and the Development of Agrarian Capitalism*. University of Wisconsin Press, Madison.
- SEPSA, 2005. Secretaría Ejecutiva de Planificación Sectorial Agropecuaria. Costa Rica: Boletín estadístico agropecuario nacional, N° 16, accessed on May 28, 2007, <http://www.infoagro.go.cr>.
- Shiva, V., 1991. *The Violence of the Green Revolution*. Third World Network, Penang, Malaysia.
- Smith, C.A., 1984. Local history in global context: social and economic transitions in western Guatemala. *Comp. Stud. Soc. Hist.* 26, 193–228.
- Tabachnick, B.G., Fidell, L.S., 2001. *Multivariate Analysis*. Pearson, Needham Heights, MA.
- Watts, M., 1983. *Silent Violence: Food, Famine, and peasantry in Northern Nigeria*. University of California Press, Berkeley.
- Webb, P., Reardon, T., 1992. Drought impact and household response in East and West Africa. *Q. J. Int. Agric.* 31, 230–247.
- Williams, S., Karen, R., 1985. *Agribusiness and the Small-Scale Farmer: A Dynamic Partnership for Development*. Westview Press, London.
- Zimmerer, K., 1993. Soil erosion and labor shortages in the Andes with special reference to Bolivia, 1953–1991: implications for “conservation-with-development”. *World Dev.* 21, 1675–1699.