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DEVELOPMENT STRATEGY AND GOVERNANCE DIVISION

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DSGD Discussion Paper No. 26

Geographic Space, Assets, Livelihoods and Well-being in Rural Central America: Empirical Evidence from Guatemala, Honduras and Nicaragua

Jeffrey Alwang, Hans G.P. Jansen, Paul B. Siegel and Francisco Pichon

2033 K Street, NW, Washington, DC 20006-1002 USA • Tel.: +1-202-862-5600 • Fax: +1-202-467-4439 • ifpri@cgiar.org
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ABSTRACT

This paper uses an asset-base framework to analyze the determinants of rural growth and sustainable poverty reduction for the three poorest countries in Central America: Guatemala, Honduras and Nicaragua. High inequalities in the distribution of productive assets among households and geographical areas in all three countries are likely to constrain how the poor share in the benefits of growth, even under appropriate policy regimes. Heterogeneity of conditions within each country requires complementary analyses of spatial determinants of growth and well-being, analysis of household-level assets, and how household livelihood strategies, conditioned on spatial attributes and asset bases, ultimately determine well-being outcomes. Using a combination of GIS mapping techniques, quantitative household analysis, and qualitative analyses of assets and livelihoods, the authors generate a description of rural territories that recognizes the differential effects of policies and asset bundles across space and households. They identify the combinations of human, natural and physical, social and location-specific assets that matter most to raise household well-being and take advantage of prospects for poverty-reducing growth.

In all three countries, investments have generally been directed toward more favored areas, and people outside these areas have been left behind. However, while economic potential has a strong spatial pattern in all three countries, area economic potential does not automatically translate into improved well-being for all households. The authors found a strong overlap between economic potential, poverty rates and poverty densities in Guatemala and Honduras, but not in Nicaragua. This implies that while in Guatemala and Honduras public investments should be targeted toward the Western Altiplano and the hillside areas, respectively, in Nicaragua high poverty rates but low poverty densities in the Atlantic zone, and somewhat lower poverty rates but high poverty densities near Managua and other urban centers in the Central and Pacific regions, present a trade-off that makes targeting decisions more complicated.

The asset-base framework has the potential to be an important tool for policy formulation and targeting. Besides their direct effect on well-being, assets have indirect effects through their impact on livelihood decisions that in turn affect well-being outcomes. Agriculture-related assets such as land and livestock, and location effects such as distance to markets and other infrastructure have different effects on well-being depending on the country in question. But low land and labor productivity in agriculture is a major cause of rural poverty, and education has a strong positive effect on well-being in all three countries, even in isolated rural areas. Access to agricultural and community organizations is associated with higher levels of well-being whereas external organizations help promote sustainable agricultural production and often provide the necessary contacts for market-oriented production. The authors also identified a number of interaction effects between different types of assets, including market access, land, credit and education. But agriculture alone cannot solve the rural poverty problem, and livelihoods outside of agriculture are often the most effective means of raising household well-being. Diversified livelihood strategies pay off in the form of higher consumption and income. However, once the asset base is controlled for, the livelihood choice only has a small impact on household well-being. This suggests that, rather than investing in specific "sectors" of the economy, the public sector should invest in assets, particularly human assets.

Geographic Space, Assets, Livelihoods and Well-Being in Rural Central America: Empirical Evidence from Guatemala, Honduras and Nicaragua

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I. INTRODUCTION

Countries in Central America share problems of uneven economic growth and unacceptably high poverty rates, particularly in rural areas. Weak performance of the agricultural sector (Table 1) indicates that distribution of gains from overall economic growth has been uneven. Most of the poor in Central America are found in rural areas, and much of the rural population is poor (Table 2). Although rural poverty rates have decreased somewhat over the past decades, this decrease is largely due to out-migration of the poor and not to expanded economic opportunity in rural areas (de Janvry and Sadoulet 2000). Agricultural growth has not been a strong engine of poverty reduction, and absolute numbers of rural poor continue to increase in several Central American countries (e.g., by about 1 million between 1992 and 2002 in Honduras, Government of Honduras 2003).

Historically stark inequalities in the distribution of productive assets among households and geographical areas in rural Central America are likely to constrain how the poor share in the benefits of growth, even under appropriate policy regimes. Policymakers need to understand the implications of skewed asset distributions in the design of policy: Should regions be targeted for investments to provide and strengthen location-specific assets, or should households be targeted with the hope of enhancing

[1] Jeffrey Alwang is Professor at the Department of Agricultural and Applied Economics, Virginia Polytechnic Institute; Hans G.P. Jansen is a Research Fellow and Coordinator for Central America from the International Food Policy Research Institute; Paul B. Siegel is a Consultant and Francisco Pichón is a Senior Natural Resources Specialist, both from the World Bank. Alwang and Jansen share senior authorship.

their economic mobility and enabling them to participate in productive activities in an increasingly liberalized economy?

Table 1. Selected Data for Central American Countries, 2003

	Pop. (mil)	Ave. annual pop. growth (%) 1993-2003[a]	Share of pop. in rural areas (%)	Per capita GNI (US$)	Ave. annual growth GDP per capita (%) 1993-2003[a]	Agriculture as a share of GDP (%)	Ave. annual growth in agr. GDP per capita (%) 1993-2003[a]
Costa Rica	4.0	2.1	39	4,280	2.3	8.3	0.9
El Salvador	6.5	1.9	41	2,200	1.3	9.4	-1.0
Guatemala	12.3	2.7	54	1,910	1.0	22.3	-0.2
Honduras	7.0	2.7	54	970	0.0	13.5	-0.5
Nicaragua	5.5	2.8	43	730	2.5	17.8	-1.0

Source: World Bank, *Development Economics, Central Database*.

Table 2. Evolution of Poverty and Rural Poverty Rates in Central America

Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua
		Poverty		
22 (1981)	48 (1995)	65 (1980)	75 (1990)	65 (1993)
24 (1990)	48 (1997)	58 (1989)	74 (1997)	65 (1998)
19 (2002)	43 (2001)	52 (2002)	71 (2002)	63 (2001)
Rural Poverty				
28 (1981)	58 (1995)	79 (1980)	84 (1990)	79 (1993)
25 (1990)	62 (1997)	72 (1989)	80 (1997)	73 (1998)
23 (2002)	57 (2001)	61 (2002)	81 (2002)	71 (2001)

Note: Figures in parentheses refer to year.
Source: ECLAC (2003, 2004)

Analysts acknowledge that new strategies are needed to promote sustainable poverty-reducing economic growth in rural Central America. A central theme of this literature is that agriculture cannot serve as the sole engine of poverty-reducing growth, and that balanced and integrated multisectoral approaches are needed (Jansen and Hazell 2005, Morley and Hazell 2003, Cuellar 2003, Echeverría 2001, Valdés and Mistiaen 2001). Such approaches should consider differences in asset endowments across space and across household groups. Variations in environmental conditions, access to infrastructure and services, and effectiveness of public and private institutions dictate a

spatially differentiated rural strategy. Strategies should include provision of key missing assets and increase productivity of existing assets. They should recognize how some assets complement each other and how asset bases, income-earning strategies and well-being are interrelated.

The objective of this paper is to analyze the determinants of rural growth and sustainable poverty reduction for the three poorest countries in Central America: Guatemala, Honduras and Nicaragua. The basic premise is that heterogeneous conditions necessitate complementary analyses of spatial determinants of growth and well-being, and better knowledge about how assets complement one another, and how household livelihood strategies, conditioned on spatial attributes and asset bases, determine well-being outcomes. The study combines geographical information systems (GIS) techniques, quantitative household analysis, and qualitative analyses of assets and livelihoods. The combination generates a description of rural space that recognizes the differential effects of policies and asset bundles across space and households. Countries in the region are rapidly gaining capacity to conduct GIS-based analyses. Concurrently, comparable household-level data are becoming available, mainly as a result of the region-wide Program for the Improvement of Surveys and the Measurement of Living Conditions in Latin America and the Caribbean (MECOVI[2]). GIS-based and household-level analyses, however, are rarely linked in a concrete fashion and, as a result, the power to effectively analyze the spatial determinants of well-being is lost.

Findings show that area economic potential is unevenly distributed and that high rates of poverty persist even in rural areas with high potential. In such areas, many households lack the assets necessary to exploit the area's potential to their advantage. Other areas are characterized by weak economic potential due to poor agro-ecological conditions, remoteness, or both. Investments in these areas should seek to strengthen

[2] MECOVI is a regional program of technical assistance for capacity building to improve living standards measurement surveys (LSMS) in Latin America and the Caribbean. MECOVI is supported by the Interamerican Development Bank (IADB), the World Bank and the Economic Commission for Latin America and the Caribbean (ECLAC). It collects detailed expenditure, income, labor allocation, asset and other household-level information. At the time of our study, LSMS were available for Nicaragua and Guatemala, but not Honduras.

economic mobility (e.g., investments in education and health) and policymakers need to take a long-term perspective. Included among the more important assets are human capital, land and other physical capital, and location-specific assets such as access to roads and markets. The household's livelihood strategy affects prospects for economic progress in all countries; but lack of sufficient assets constrains many from adopting favorable strategies. Households may also lack the right combination of assets needed to take advantage of economic opportunity and improve their well-being.

II. SPATIAL ANALYSIS

In order to obtain a broad view of rural heterogeneity in the three countries, we begin by examining the spatial distribution of poverty and economic potential. This allows us to identify areas that might be conducive to broad-based growth, and to identify potential conflicts between growth and poverty-reduction objectives in rural areas. The spatial distribution of poverty provides information on historical impacts of regional interventions on poverty reduction and provides guidance for targeting future investments and programs[3]. The exact analysis conducted in each case study depends on available data (Table 3), the needs and conventions of the host government.

GIS overlays were used to identify areas of high economic potential (Figures 1, 2 and 3 for Guatemala, Honduras and Nicaragua, respectively). In each country, economic potential varies substantially over space, but is generally higher near major cities and lower in more remote areas. In Guatemala, higher potential zones are found along the South Coast, where export agriculture predominates; in scattered areas of the Western Altiplano, especially coffee growing areas, near Guatemala City; and along the Salvadoran border. The Western Altiplano has been a recent focus of poverty-reduction efforts because of its heavily concentrated indigenous population and because they suffered from historical discrimination and violence, especially through the long period of civil war that ended with the 1996 Peace Accords.

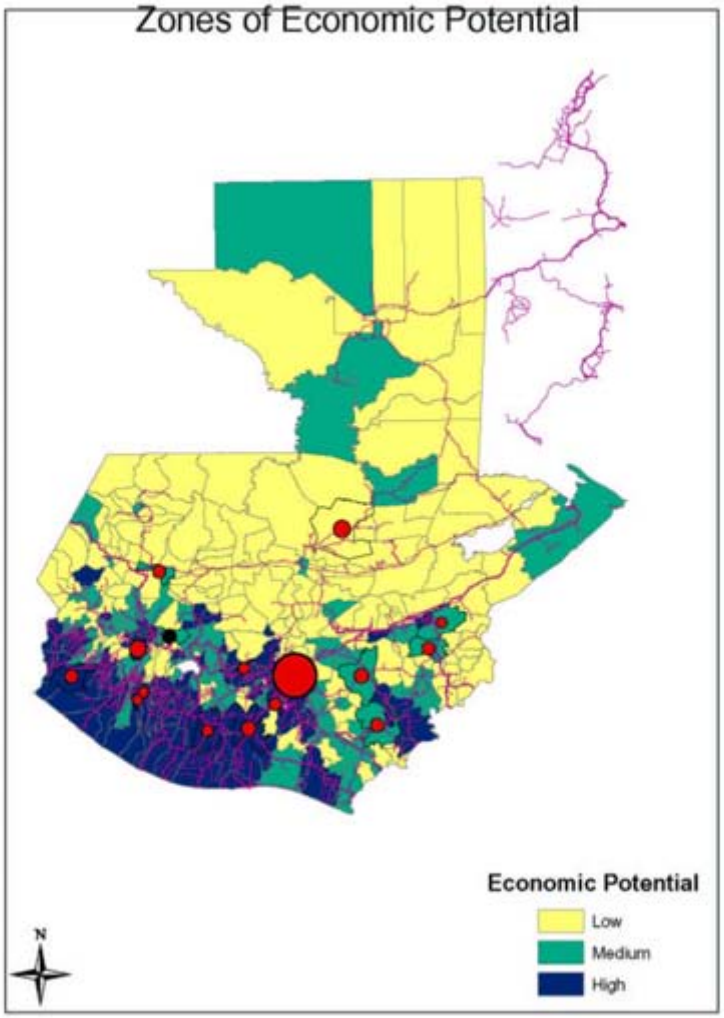
In Honduras, public investments have historically been skewed towards the 55 *municipios* (equivalent to counties) that make up the "T of Development," stretching from the capital Tegucigalpa to the industrial center at San Pedro Sula, and along the northern coast. These *municipios* have relatively good natural capital, so investments there are based on growth potential. Outside the T, public investments (particularly road

[3] A robust literature exists on the targeting of public investments. de Walle (1998) reviews this literature and distinguishes between two general types of targeting. Broad targeting involves allocating public expenditures to those types of services most likely to benefit the poor, such as primary education and basic health services. Narrow targeting refers to identifying broad categories of people and allocating specific expenditures to them. Examples include food stamps and micro-credit schemes. Spatial analysis can be used to more finely tune broadly targeted programs to areas of highest need or impact (for an example, see Bigman and Fofack 2000)

Table 3. Description of Data Sets Used, by Study Component and Country

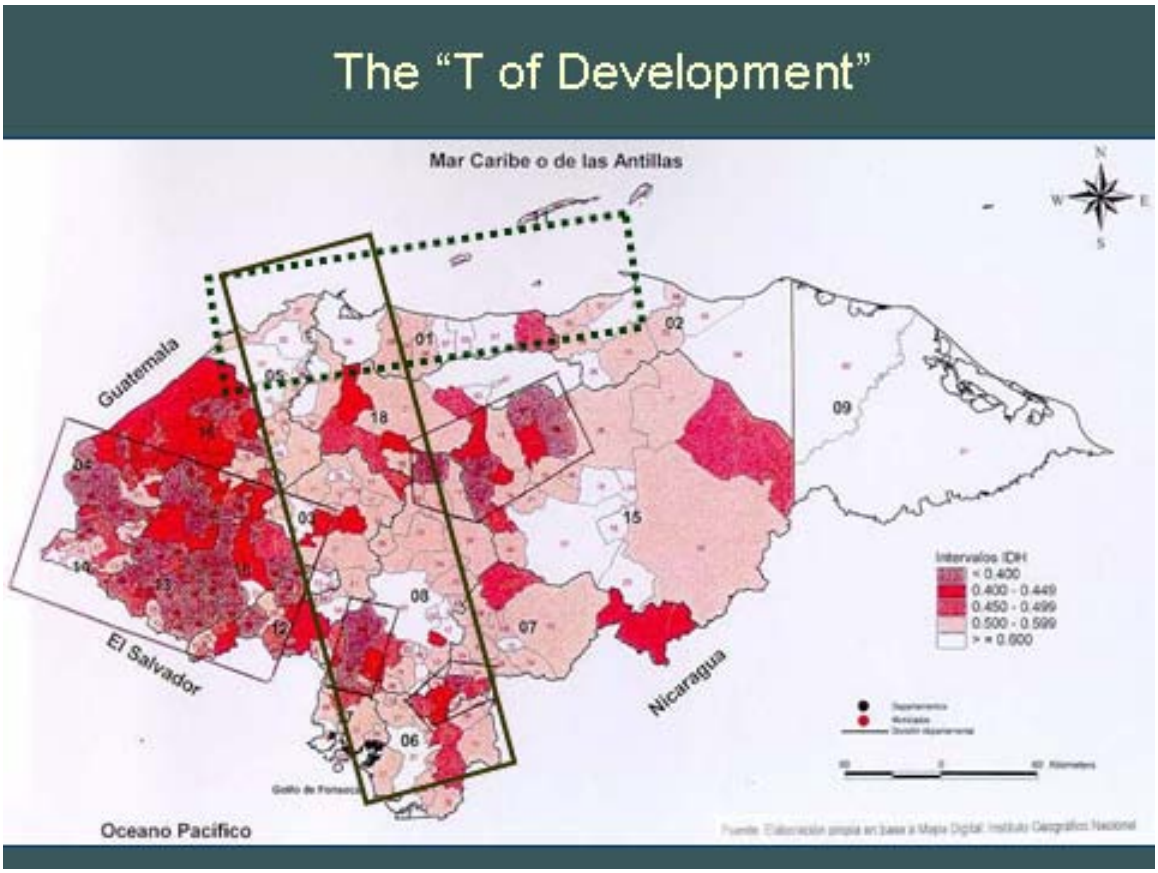
	Country		
Study Component	**Guatemala**	**Honduras**	**Nicaragua**
Spatial analysis	Geographic Information System of the Ministry of Agriculture (MAGA-SIG), various years and sources, supplemented with 2002 population census, a vulnerability assessment conducted by MAGA (GoG/WFP 2002) and the ENCOVI household data (World Bank 2004).	*Sistema Nacional de Información Territorial* (SINIT) and *InfoAgro*, the Ministry of Agriculture's Geographic Information System (GIS) unit, supplemented with the 1988 and 2001 population censuses, and maps from the World Food Program's vulnerability assessment (GoH/WFP 2003).	GIS unit of the Ministry of Agriculture and Forestry (SIGA-MAGFOR); supplemented with population census and ENCOVI household data.
Quantitative household analysis	2000 LSMS, a nationally representative survey of 3,852 rural households (ENCOVI, 2000), augmented with: MAGA-SIG data bases, Census of Agriculture (2003), and Censuses of Population (1994 and 2002).	Two sub-national surveys: (i) conducted in 2000-01 for a land tenure and rural finance study of the University of Wisconsin, in both hillside areas and valleys; (ii) carried out in 2001-02 by the International Food Policy Research Institute in cooperation with Wageningen University and PRONADERS (National Program for Sustainable Rural Development), in hillside areas only. Together they cover parts of 12 provinces, 42 counties, 206 villages and contain observations on 1,225 households (Jansen et al. 2005).	1998 & 2001 LSMS, nationally representative surveys (panel) of 1,350 rural households (ENCOVI, 2000); augmented with data from the census of population and the agricultural census.
Qualitative analysis	Two exercises were carried out. A project stocktaking was undertaken in February 2003 using rapid appraisal methods and explicitly anchored in the asset-base approach with beneficiaries of the Land Fund Project in Quetzaltenango. A general asset and livelihood assessment in San Marcos and Huehuetenango was conducted in April 2004.	The IFPRI household survey was accompanied by qualitative diagnostic surveys in the same 95 communities, executed by local NGOs and supervised by staff from PRONADERS. They involved the characterization and diagnosis of problems, limitations, and opportunities resulting in community profiles (Jansen et al. 2003). Stocktakings for the following World Bank projects: Honduras Rural Land Management project; Project Access to Land (PACTA); and Biodiversity and Priority Areas Project (PROBAP).	Participatory livelihood surveys in 56 rural communities were carried out using facilitators from the *"Programa Campesino a Campesino"* of the National Union of Farmers (UNAG). Facilitators were trained and supervised by RUTA-DFID staff. Stocktakings for the following World Bank projects: Agricultural Technology Adaptable Program Lending (October 2002); the Forestry Development Learning and Innovation Loan (March 2003), and the Rural Municipalities Project (April 2003).

Figure 1. Guatemala: Economic Potential



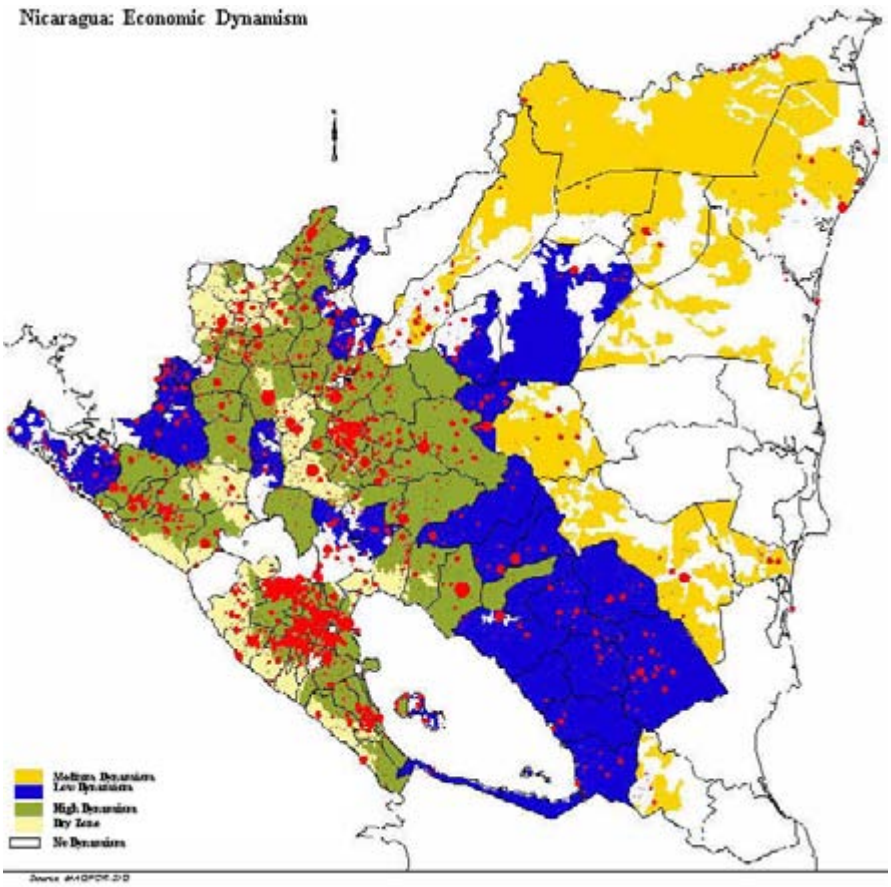
networks and other infrastructure) have been concentrated where agro-ecological conditions are favorable for export agriculture such as coffee (concentrated on small and medium-sized farms in the west) and bananas (mostly on large plantations in northern valleys). Most other rural areas, the hillside areas in particular, where approximately 80 percent of the rural population resides, are found outside the T of Development and have been largely bypassed by public investments.

Figure 2. Honduras: The T of Development



In Nicaragua, the map of economic potential reveals a strong spatial pattern, with high-potential areas located close to the main cities, particularly Managua, and in the Pacific Region with its good soils and infrastructure. Moving away from Managua, the Central Region contains high-potential coffee-producing areas with favorable agro-ecological conditions and good transportation access. The Atlantic Region is most isolated and has only limited economic potential, due both to poor access and low-quality soils.

Figure 3. Nicaragua: Economic Dynamism



The next step in the spatial analysis was to understand the relationship between an area's poverty and economic potential. Two measures of poverty are employed in the analysis: (i) the poverty rate, or the proportion of the population below the poverty line, and (ii) the poverty density, or the number of poor people per square kilometer. Conditions for rural growth often include better agricultural potential, proximity to intermediate and final markets, access to transportation, and higher population densities. These conditions are frequently absent in places where poverty rates are highest ─ but are frequently found in areas with high poverty densities, where population densities also tend to be high. Such considerations suggest that the concentration of investments in

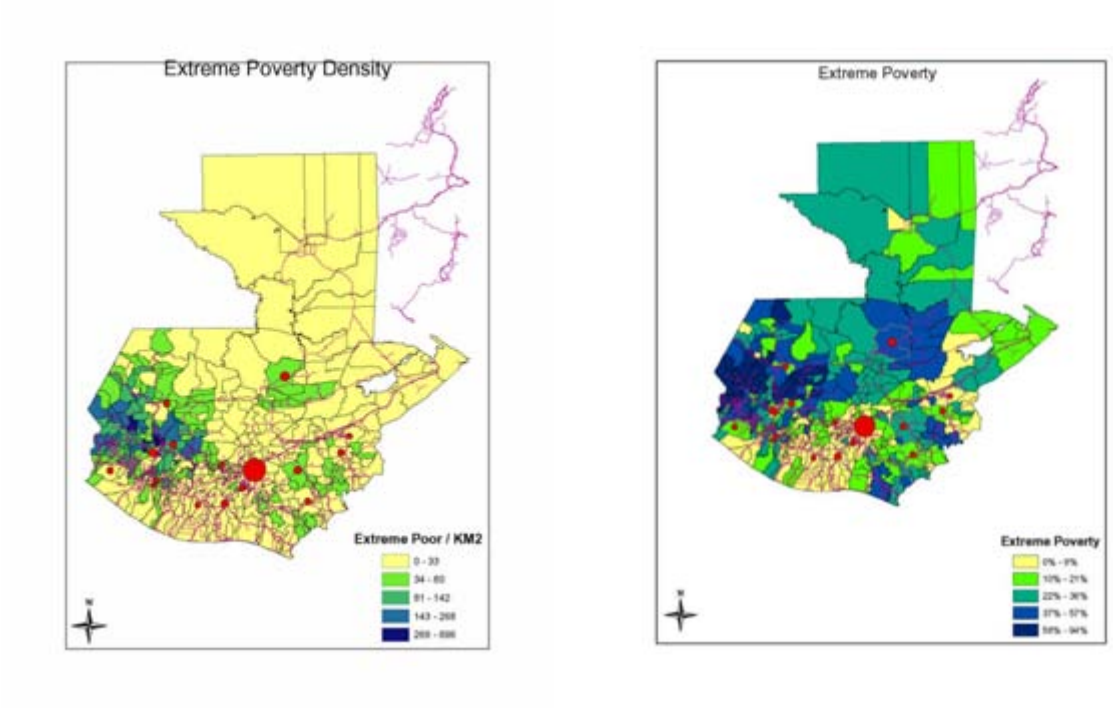
high potential areas may bypass those areas with the poorest of the poor, areas where poverty rates are high but population densities are low[4].

In Guatemala, a geographic correspondence is found between high poverty rate and high poverty density areas (Figure 4). Poverty densities are highest in the Western Altiplano, in the areas around Quetzaltenango and Huehuetenango moving west toward the Mexican border (Figure 4, panel a). These areas have high proportions of indigenous populations and also very high poverty rates. Strategies targeted to such areas will reach many poor people and leakages to the nonpoor should be minimal. The Western Altiplano is an obvious target for poverty-reducing investments, and is especially promising because of its relatively high economic potential. The combination of high population densities, relatively good infrastructure, and relatively good soil suggests that this area may have substantial economic potential. Persistent high rates of poverty (Figure 4, panel b), however, shows that this potential is not being realized ─ and the extent that it is being realized, the poor are not participating.

The overlap between high-poverty rates and high poverty densities in the Western Altiplano means that interventions in these areas will reach significant proportions of the country's rural poor, with minimum leakages to the nonpoor. Some such interventions, however, can bypass the poor, especially indigenous peoples, if they do not address missing assets which may prevent the poor from taking advantage of economic opportunities. An important rural public investment issue is to identify combinations of productive, social, and location-specific assets that best contribute to improved household well-being.

[4] Investments in high-poverty rate areas need not have an explicit targeting mechanism; leakages to the nonpoor are likely to be minimal. Under broad targeting, such leakages increase the costs of reducing poverty (de Walle, 1998). However, because population densities can be low in high-poverty rate areas, targeting of projects is complicated; returns to public investments may be lower due to lack of labor and other inputs and distance to final markets. For social investments in such regions, costs of delivery over space need to be considered. Investments might be placed so as to guarantee a reasonable standard of access, even in low-population areas. Low poverty and population densities imply that relatively few poor people will be reached by fixed infrastructure compared to high-density areas, even if leakages to the nonpoor are small.

Figure 4. Poverty Density (a) and Poverty Rate (b) in Guatemala



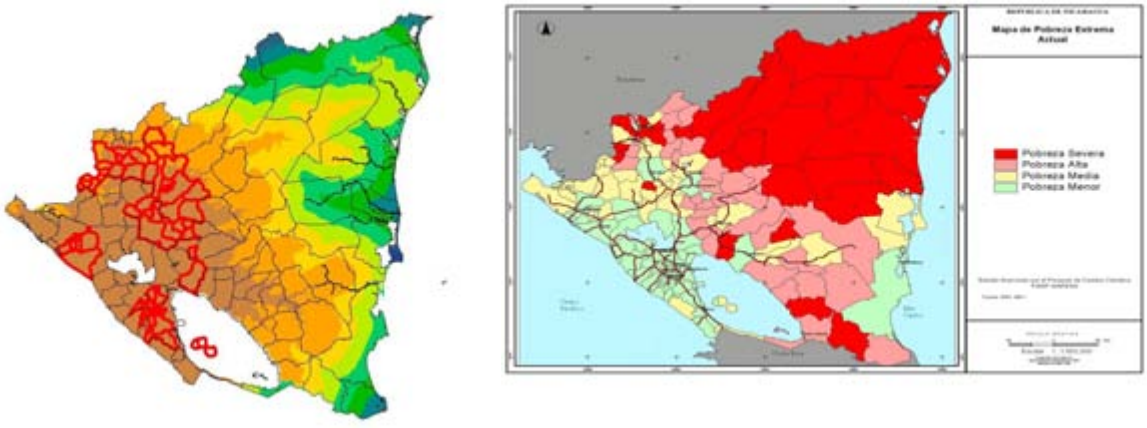
In Nicaragua, a spatial mismatch is observed between areas of high rates and densities of poverty (Figure 5). High poverty-density areas are found in the *municipios* located in the immediate circle around Managua and other urban centers in the Central and Pacific regions (Figure 5, panel a). Areas with the highest poverty rates are found in the Atlantic Region, which is distant from Managua and outside of the zones of highest economic potential (Figure 5, panel b). About half the extreme rural poor reside in the quarter of the country within four hours drive from Managua: the Central and Pacific regions ─ which are recognized as higher economic potential areas. The Central region alone has the highest share of rural people living in extreme poverty; almost two-thirds of Nicaragua's rural extreme poor live there. The spatial mapping at the *municipio* level found a strong correlation among rural poverty, population density, accessibility to Managua, and a range of other variables determining livelihoods, and poverty.

The contrast between Guatemala and Nicaragua illustrates how such simple analyses can be used to inform a territorial approach to rural poverty reduction. In Guatemala, investments in higher potential areas in the Western Altiplano can be growth-

oriented while retaining the potential to reach large numbers of poor people. Analysis at the household level is needed to determine why the poor are unable to participate in economic opportunities, and to help design investments to promote such participation. In Nicaragua, a stark contrast exists between high poverty rate and high poverty density areas. In areas with high poverty densities, investments should be designed to promote participation of the poor in economic opportunity, but special attention is needed to address the problems of poverty in isolated areas along the Atlantic Coast. A household analysis is needed to identify the role of specific assets in determining livelihood strategies and contributing to improved well-being.

Figure 5. Poverty Density (a) and Poverty Rate (b) in Nicaragua

(a) (b)



III. QUANTITATIVE HOUSEHOLD ANALYSIS: METHODS

The Asset-Base Approach

The conceptual framework for the household analysis is anchored to an *asset-base approach* (see Siegel 2005). The asset-base framework includes the following components: *assets* (productive, social, location-specific), the *context* (policies, institutions, and risks), household behavior (*livelihood strategies*), and *outcomes* (measures of household well-being). Household and community decisions, given the context variables, determine outcomes such as household well-being, environmental preservation, and community prosperity. The welfare-generating potential of assets depends on the asset-context interface. Policy reforms and building of assets need to be considered in tandem.

A household's **assets** consist of the stock of resources used to generate well-being (Moser 1998, Siegel and Alwang 1999, Rakodi 1999). Assets include human capital including age, education and training, and family structure; natural capital (e.g., climate, water and land); physical capital (equipment, livestock, and electricity); financial assets (credit); location-specific factors (such as access to infrastructure and social services), and social, political, and institutional assets, including social and political networks, and social inclusion. In the asset-base framework, the poor are "asset-poor" because they have limited or low-productivity assets.

Certain assets are effective only if combined with others, therefore *asset complementarity* matters. For example, access to land has different implications for well-being depending on its location relative to markets and other infrastructure, on access to credit and inputs, and on education of the landowner. Education may have markedly different implications for welfare generation depending on location and the functioning of labor markets and related institutions. Other important determinants of asset productivity include regulatory and legal systems, which determine the security and transferability of assets, and the existence of means of exclusion. These factors are part of the context.

The **context** in which households operate helps determine the welfare-generating potential of assets and prospects for improved well-being. The political, legal, and regulatory contexts affect how assets are managed and whether successful livelihood strategies can be undertaken (Zezza and Llambi 2002). Exposure to risk is also part of the context. The costs of risk management include lower growth due to risk-avoidance behavior and risk-reducing activities (e.g., production of low profitability staple crops for food security reasons), and costs associated with coping (Siegel and Alwang 1999). Policies, institutions, and forces of nature shape the context and themselves may constitute sources of risk.

Household management of its asset portfolio constitutes its **behavior** or **livelihood strategy**. Livelihood strategies refer to the way households use their assets such as land and labor allocations, investments in education, migration, and participation in social capital building. Livelihood strategies include a range of on- and off-farm agricultural and nonagricultural activities (Berdegué, et al. 2001, Corral and Reardon 2001). Asset accumulation and livelihood strategies are important drivers of sustained improvements in well-being.

We are concerned with **outcomes** that reflect household well-being and prospects for growth over time. The asset-base conceptual framework leads the authors to consider a variety of measures of household well-being and to use quantitative and qualitative analyses. In addition to income and consumption, poor rural households are concerned about food security, health status, vulnerability in general, empowerment and self-esteem, participation in community affairs, environmental quality, and hopefulness toward the future.

Econometric Model

The quantitative household analysis builds on the spatial analysis by addressing the issue of how household livelihood strategies and levels of well-being are determined within these heterogeneous rural areas. It begins by regressing household livelihood strategies on basic assets controlled by the household (Table 4 for information on

Table 4. Description of Variables Used in Analysis of Household Livelihood Strategies and Well-being

Concept	Variable Name	Guatemala	Honduras	Nicaragua
Dependent Variable		**Log annual consumption per capita**	**Log annual income per capita**	**Log annual consumption per capita**
Natural assets	Natass1-5	5) Soil quality index	1) Average altitude of farmer's plots (in feet); 2) Annual rainfall in mm (Wisconsin households); 3) Summer rainfall in mm (natural log in income regressions); 4) Water deficit for maize during October-January in mm (IFPRI households); 5) Natural log of soil fertility (Jansen et al. 2005, IFPRI households)	
	Land	Quantity of land, ha.	Quantity of land, manzana (mn, 1 mn = 0.7 ha)	Quantity of land, mn
	Ownland		Quantity owned, mn	
	Landtitle		% of owned land with title	
Human assets	Mhh	(=1 if male-headed)	(=1 if male-headed)	(=1 if male-headed)
	Hsize		Number of household members	
	Deprat	Dependency (=(children+elderly)/total)	Dependency (household members < 12 or > 70 yrs)/(members between 12 and 70 yrs)	Dependency (=(children+elderly)/total)
	Ed1, Ed2	(Ed1=1 if head has primary ed.; Ed2=1 if secondary ed.)	(Ed1= median years of schooling of household members > 7 yrs)	(Ed1=1 if head's education <4 years)
	Ethno	(=1 if family not indigenous)		
	Age		Household head's age in years (natural log in income regressions)	Head's age (years)
	Migrant		IFPRI households: average % of time that an adult lives and works outside the household. Wisconsin households: Total number of man-months spent outside the household by household members	
	Femadult		% of females (>12 yrs) in household	
	Training		(=1 if HH has received agricultural training)	
	Techass		(=1 if HH has received extension visits)	(=1 if technical assistance available in community)
Physical assets	Electricity	(=1 if household has access to electricity)		(=1 if household has access to electricity)
	Assets	Value durable assets (Q.)		Score of durable assets
	Busassets		Value of machinery, equipment and transportation (L.)	Score of business assets
	Livestock	Value of livestock (Q.)	Value of livestock (L.)	Value of livestock (C.)

Table 4. Description of Variables Used in Analysis of Household Livelihood Strategies and Well-being (Contd.)

Concept	Variable Name	Guatemala	Honduras	Nicaragua
Dependent Variable		**Log annual consumption per capita**	**Log annual income per capita**	**Log annual consumption per capita**
Location assets (all variables defined at local level)	Distance	Distance (in travel time to nearest post office)	IFPRI households : Market access (index of travel time to nearest market, natural log of index in income models) Wisconsin households: Distance to daily market in km	Distance (travel time to nearest health center)
	Popdens	No people/km^2	Population density at community level	
	Roads	Quality-adjusted roads/km^2	Road density at community level (=km of roads/km^2)	(=1 if community has access to paved road)
	Capdist		Distance between community and county capital or capital of another county (if closer), in km; Wisconsin households only	
	Popgr	Inter-censal population growth rate		
	Litrate	Literacy rate		
	Orent	Percentage of owners/renters in municipio		
	Perrate	Percentage of land devoted to perennial production		
	Proden	Agricultural producers/land in production		
	Region	Dummy variables		Dummy variables
Social capital	Socap	Mean municipio participation in social, political and other committees	Various dummy variables representing household participation in community, agricultural, savings and loan, and external organizations: Socap1: participation in agricultural organizations Socap2: participation in community organizations Socap3: participation in savings and loans organizations Socap4: participation in external organizations	Mean *municipio* participation in social, political and other committees
Financial capital	Credit		Dummy variable (=1 if household has access to any form of credit)	
Livelihood strategy		See Table 6	See Table 6	See Table 6
Interactions		Ed1*Distance; Land*Distance	Land*Credit; natural log of Land*Distance; Land*Ed1; Ed1*Distance; Ownland*Natass5 (IFPRI households only)	Ed1*Distance; Land*Distance; Land*Ed1

variables included in each country case). These assets encompass the broad classes identified and discussed above (human, natural, physical, financial, locational and social capital). Subsequently the authors model the measure of household well-being as dependent on livelihood strategies and assets. The basic model is:

$$(1) \qquad L_j = f(X_j, Y_j, Z_j)$$

$$(2) \qquad \ln W_j = f(X_j, Z_j, L_j)$$

where L_j represents the livelihood strategy pursued by household j; W_j the welfare measure for household j; and X is the vector of household-specific assets that affects household welfare directly and indirectly through the choice of livelihood strategy; Y is the vector of household-specific assets that affects household welfare only indirectly through the choice of livelihood strategy; and Z is the vector of location assets. The Z-vector contains, in some cases, regional dummy variables, and census segment-level, community-level or *municipio* (county)-level means of variables (such as participation in social capital-building activities, and population density and change). The function f (.) is a generic functional form and we use single equation estimators appropriate to the nature of each dependent variable.

Equations 1 and 2 represent a simple model of livelihood strategy choice and production of household well-being. The latter is measured by consumption expenditures (for Nicaragua and Guatemala) or income (Honduras). Since livelihood strategy choice in equation (2) is an endogenous variable, a simple OLS would lead to a biased estimation. To avoid this problem, we use a two-stage estimation process. In the first stage we estimate the determinants of the livelihood strategy (equation 1). In the second stage, when examining the impacts of household livelihood strategies on well-being outcomes, we use predicted household livelihood class on the right hand side of the well-being regression (equation 2). The variable L^* in equation 2 indicates that the livelihood choice is endogenously determined by unobserved factors. We also allow interactions between some asset variables (to measure the strength of asset complementarity or substitutability). We assure proper identification of the system by including Y_j in equation 1 but not in equation 2.

The household analysis is complemented with qualitative studies that provide additional insights into household- and community-level decision-making processes. The exact nature of these qualitative studies differs by country (Table 3), but all include participatory analyses of livelihoods and community-level analyses of impacts of recent projects. The qualitative assessments were designed to obtain information about which assets community members thought were most important and how they contribute to improved well-being.

IV. QUANTITATIVE HOUSEHOLD ANALYSIS: RESULTS

The first step in the household-level analysis is to categorize the livelihood strategies and understand how household well-being is related to each strategy. Livelihood strategies can be identified and characterized in a number of ways, but we begin by examining the main source of employment for all household members (Table 5). In all three countries, households depending on agricultural activities are worse off than others: poverty rates are higher and mean levels of well-being are lower. Interestingly, the relationship between well-being and type of employment in agriculture varies by country. In Guatemala and Honduras, wage employment in agriculture is associated with the highest poverty rates and lower general levels of household well-being. In contrast, while poverty rates of the self-employed in agriculture in Nicaragua are comparable to those in Guatemala, poverty rates among agricultural wage earners are significantly lower. In Nicaragua, poverty rates among households whose major source of employment is outside of agriculture are about one-half the rates of agricultural households.

Table 5. Indicators of Rural Well-being by Main Source of Employment

	Guatemala			Honduras			Nicaragua		
	Percent obs.	Percent poor	Percent extremely poor	Percent obs.	Percent poor	Percent extremely poor	Percent obs.	Percent poor	Percent extremely poor
Agriculture, self-employed	22.3	74.5	21.5	36.9	87.7	80.6	19.2	71.2	31.6
Agriculture, wage employed	20.5	80.5	29.3	18.8	98.2	96.9	29.8	66.9	26.5
Nonagriculture, wage employed	22.2	52.9	8.5	9.6	85.3	75.7	16.0	35.1	7.4
Nonagriculture, self-employed	10.9	53.3	11.2	3.5	74.7	62.8	21.0	32.2	5.6
Transfers, other	24.6	62.0	16.1	31.2	88.9	82.6	13.9	50.6	13.2

In contrast, while those employed outside of agriculture in rural Guatemala and the Honduran hillside areas are better off than agricultural households, the nature of the

difference is not great. The much higher figures for Honduras compared to Guatemala and Nicaragua in Table 5 reflects the fact that the Honduran data are from surveys taken in the poorest areas of that country. In addition, although some nonagricultural employment tends to have higher returns than agricultural employment, many non-agricultural occupations of the rural poor in the Honduran hillside areas have relatively low returns (e.g., domestic services; see Ruben and van den Berg 2001). Finally, measurement differences (the well-being measure for Guatemala and Nicaragua is based on consumption while for Honduras we used income) also may play a role.

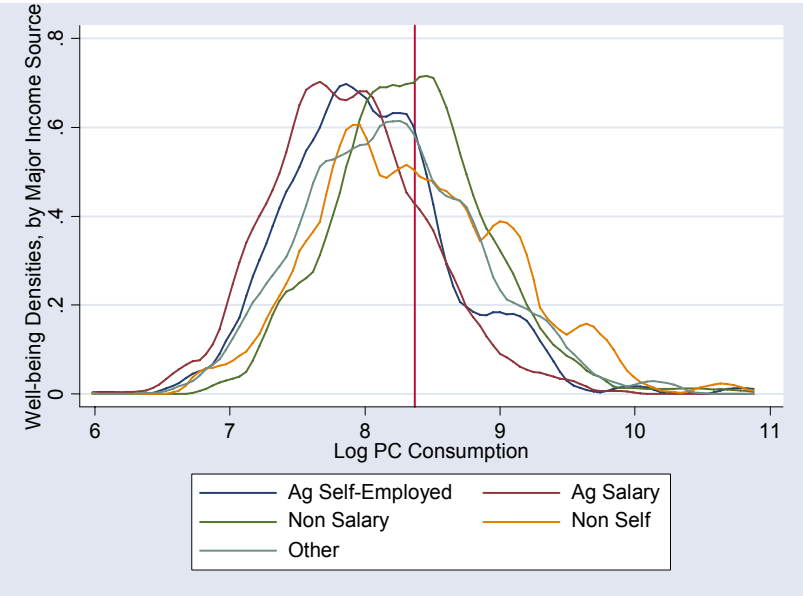
Figures 6, 7 and 8 show the full distribution of well-being by household employment class for Guatemala, Nicaragua and Honduras, respectively. The distributions for the agriculture-based strategy are clearly shifted to the left of the other strategies, consistent with higher poverty among such households shown in Table 5. The nonagricultural employment strategies have lower densities of well-being at the very low end of the distribution, far to the right of the poverty line (shown in the vertical line). They also have a more pronounced rightward skew with higher densities above the poverty line.

For the final classifications of households into livelihood strategy categories, in the case of Nicaragua we used the same categories presented in Table 5 - the major source of household employment - and created five livelihood categories[5]. In the cases of Guatemala and Honduras, we conducted factor and cluster analyses[6] of households to group them into distinct livelihood classes (Table 6). The identification of

[5] The income data from the Nicaragua survey were not of the same quality as that from Guatemala and Honduras. As a result, we chose to focus on employment sources.

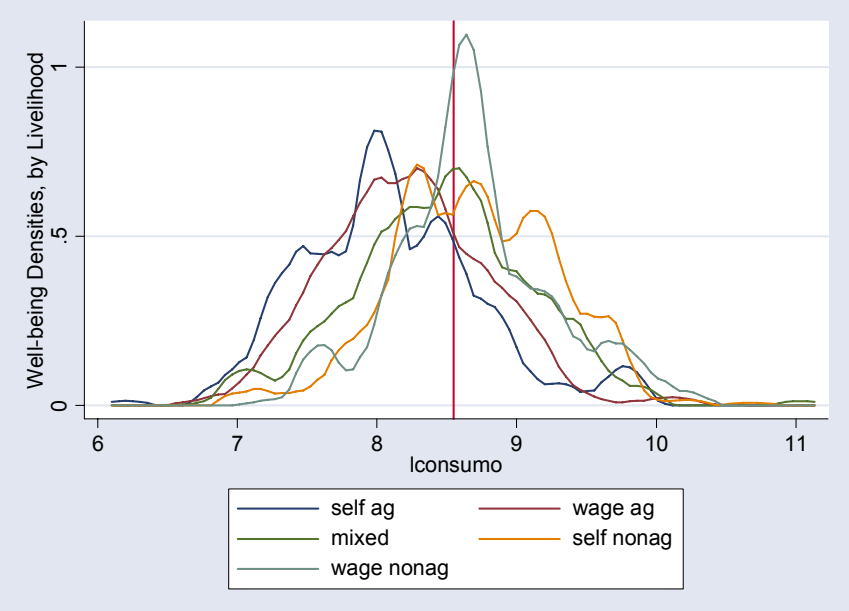
[6] For Guatemala and Honduras, we used a combination of hierarchical cluster and k-means cluster analyses to create livelihood clusters. The hierarchical cluster analysis, used in the first step, efficiently grouped households together. However, hierarchical clustering can give rise to misclassification of observations at the boundaries between clusters and k-means analysis, which is iterative, eliminates these problems (Wishart 1999). In the case of Guatemala, we used intuitively appealing income-share boundaries as a final means of delineating the clusters. In the case of Honduras, the IFPRI households were clustered on the basis of time allocation and land use patterns, and the Wisconsin households on the basis of similar land use patterns and income shares. The cluster analyses for Honduras were preceded by a factor analysis.

Figure 6. Well-being Density by Major Source of Employment Strategy, Rural Guatemala



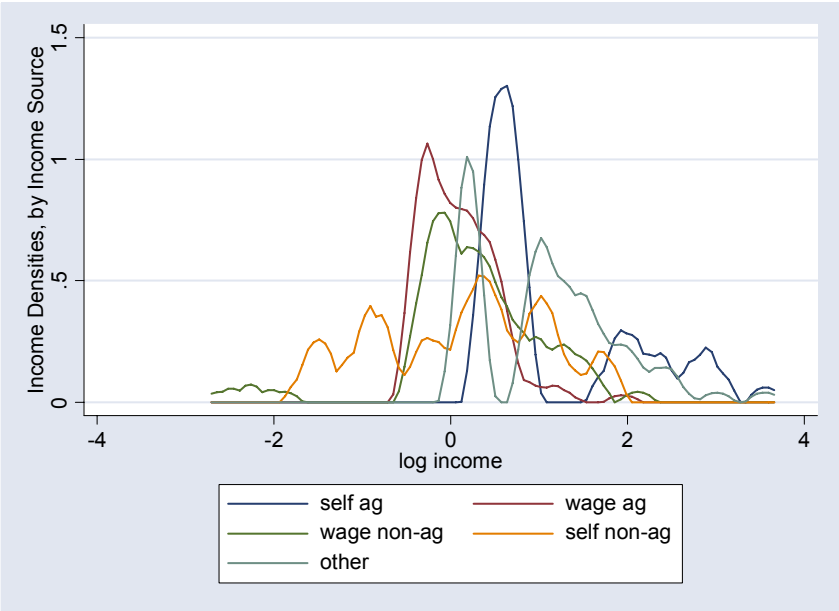
Note: Kernel density estimates using the Epanechnikov kernel.

Figure 7. Well-being Density by Livelihood Strategy, Rural Nicaragua



Note: Kernel density estimates using the Epanechnikov kernel.

Figure 8. Well-being Density by Major Source of Employment, Rural Honduras



Note: Kernel density estimates using the Epanechnikov kernel.

livelihood strategy categories is followed by the estimation of an appropriate version of equation 1, using multinomial logit models. The final step is the estimation of equation 2 for each country.

Determinants of Livelihood Strategies

The results of the multinomial model estimation (equation 1) are shown in Tables 7-10. Together the explanatory variables reflect the main elements of the household asset portfolio. The asset types had different effects on livelihood choices, with some patterns emerging. The model results generally support the use of an asset-base approach as the fit is relatively good and the results are plausible. The variables included in each model were chosen based on availability within the data set, model misspecification tests, and consistency with the asset-base framework[7]. For example, the Guatemala data

[7] Several variants of each equation were examined, including instrumental variable estimates for the "endogenous" variables — education, access to infrastructure, and participation in social capital, quantile regressions, addition of cluster-level variables, etc. The models were subjected to misspecification tests. Reported results are robust to alternative specifications.

Table 6. Description of Livelihood Strategies, Guatemala, Honduras and Nicaragua

Livelihood strategy (LS)	LS1	LS2	LS3	LS4	LS5	LS6	LS7
Guatemala	*Self-employed in agriculture*	*Wage-employed in agriculture*	*Mixed agriculture*	*Mixed*	*Mixed nonagriculture*	*Nonagriculture wage employment*	*Non-agriculture self employment*
	> 60 % of household income comes from self employment in agriculture	> 60 % of income from wage employment in agriculture	> 60 % of income comes from agriculture, but less than 60 % comes from self or wage employment alone	Mixed	> 60 % of income comes from outside agriculture, but less than 60 % from self or wage employment alone	> 60 % of income from wage employment outside of agriculture	> 60 % of income from self employment outside of agriculture
% of Sample	15.2	12.7	10.6	12.6	26.9	16.1	6.0
Honduras (IFPRI)	*Livestock producers*	*Coffee producers*	*Basic grains*	*Basic grains & farm workers*	*Mixed basic grains, livestock & off-farm work*	*Tree producers*	*Vegetable producers*
	Extensive livestock farming on larger holdings at lower altitudes (32 ha on average). Highest income cluster in sample.	Relatively small holdings (average of 3.5 ha), at higher altitudes. Low incomes due to coffee crisis.	The poorest farmers among all livelihood groups. Mostly basic grains production. Small farms (2 ha on average), located at high elevations with steep slopes, geographically isolated, with limited off-farm opportunities.	Smallest landholdings (< 2 ha). Subsistence farmers earning higher incomes than cluster 3 by working outside own farm (mostly in agriculture).	Subsistence farmers with larger land holdings (average farm size > 10 ha). Hire labor and devote more time to livestock. Work outside own farm.	Small holdings, produce fruits, oil palm etc. Located in more favorable agro-ecological areas with high population densities and good access to paved roads. Very poor.	Most labor devoted to working on own farms. Surprisingly poor.
% of Sample	15.6	7.4	18.1	22.6	30.9	3.2	2.1
Honduras (Wisconsin)	*Diversifiers*	*Basic grains & farm workers*	*Livestock*	*Coffee*	*Own business*	*Remittances*	
	Larger farms (average 43 ha), diversified farm operations, off-farm work in agricultural and nonagricultural occupations.	Subsistence farmers very similar to livelihood #4 in the IFPRI sample. Very poor.	Medium-size cattle farms (average 24.6 ha). Little off-farm work but relatively less poor.	Similar to livelihood #2 of the IFPRI sample but larger farms (average 11.6 ha) resulting in somewhat higher incomes.	Own business generates most income, despite relatively large farms (average 38 ha).	Live mostly off remittances, despite average land holdings of 12 ha. Household head is often female. Little off-farm work. Poorest households in the Wisconsin sample.	
% of Sample	13.5	26.1	11.5	28.4	6.8	10.7	
Nicaragua	*Self-employment in agriculture*	*Agricultural wage*	*Self-employment outside agriculture*	*Wage employment outside agriculture*	*Remittances, other*		
	Majority of workers self-employed in agriculture	Majority of household workers in agricultural wage employment	Majority of workers self-employed outside agriculture	Majority of household workers in nonagricultural wage employment			
% of Sample	19.2	29.8	16.0	21.0	13.9		

contain ample information on production patterns within each *municipio*, but less information on natural conditions such as altitude and rainfall. The Honduran data had much detail on these natural conditions, but no comparable census data.

Human Capital

In Guatemala, human capital has strong impacts on household livelihood choice (Table 7). Better educated and non-indigenous households are more likely to dedicate themselves to off-farm activities, whether own- or self-employed or mixed. Secondary education of the household head has a particularly strong impact on choice of a nonagricultural livelihood in rural Guatemala. In Honduras, better-educated families are more likely to adopt a remittances-based livelihood (Table 9). In the IFPRI Honduras sample, which mainly included agricultural producers, education does not have a significant impact on choice of one agriculture-based livelihood strategy over another (Table 8). Male-headed households in the IFPRI sample are more likely to be mixed grain/livestock/off-farm producers compared to basic-grains production (the former strategy is more remunerative). Hillside households with migrating members find it easier to diversify away from basic grains towards more remunerative livelihood strategies based on livestock, coffee or off-farm work. In Nicaragua, male headship is associated with a higher likelihood of adopting off-farm livelihoods, but the household head's education has no significant impact on the livelihood strategy (Table 10). In the Honduran hillsides, households headed by older males are more likely to pursue a diversified livelihood strategy. The latter appears to represent one destination in a household's life cycle: as households become more mature and acquire more land and migrating adults, they seek and are able to diversify.

Higher dependency is associated with a higher likelihood of a nonagricultural livelihood in Guatemala and Nicaragua, but is not significant in the case of Honduras (Table 8).

Table 7. Guatemala: Multinomial Logit Model (Livelihood strategy # 1 - Self-employment in Agriculture as Comparison Group)

	LS 2: Agricultural wage employment			LS 3: Mixed agriculture			LS 4: Mixed			LS 5: Mixed nonagriculture			LS 6: Nonagricultural wage			LS 7: Nonagricultural self		
Variable	**Est.**	**Std. error**	**p-val**	**Est.**	**Std. error**	**p-val**	**Est.**	**Std. error**	**p-val**	**Est.**	**Std. error**	**p-val**	**Est.**	**Std. error**	**p-val**	**Est.**	**Std. error**	**p-val**
Intercept	-10.068	4.609	0.03	-18.362	2.176	0	0.899	3.246	0.78	0.942	3.120	0.76	3.657	4.012	0.36	1.377	3.314	0.68
deprat	-0.082	0.068	0.23	-0.017	0.070	0.81	-0.004	0.065	0.95	0.066	0.057	0.25	**-0.159**	0.086	0.06	**-0.222**	0.073	0.00
mhh	-0.049	0.244	0.84	0.255	0.282	0.37	**-0.542**	0.229	0.02	**-1.620**	0.194	0	**-1.064**	0.250	0	**-0.534**	0.234	0.02
ed1	**0.240**	0.138	0.08	-0.016	0.145	0.91	0.088	0.139	0.53	**0.481**	0.123	0	**0.681**	0.175	0	**0.972**	0.145	0
ed2	0.261	0.513	0.61	0.494	0.516	0.34	0.040	0.534	0.94	**1.563**	0.402	0	**1.918**	0.452	0	**2.443**	0.407	0
ethno	0.130	0.182	0.48	-0.211	0.199	0.29	-0.172	0.181	0.34	**0.416**	0.162	0.01	0.367	0.230	0.11	**0.860**	0.185	0
elect	-0.037	0.148	0.80	-0.116	0.160	0.47	**0.261**	0.148	0.08	**0.837**	0.130	0	**1.134**	0.193	0	**1.080**	0.159	0
land	**-0.049**	0.018	0.01	0.001	0.003	0.78	0.001	0.003	0.75	-0.002	0.004	0.48	**-0.048**	0.025	0.05	**-0.138**	0.035	0
natass1	**0.753**	0.155	0	0.082	0.149	0.58	0.236	0.146	0.11	**0.536**	0.129	0	**0.704**	0.195	0	**0.563**	0.161	0
distance	**-0.002**	0.001	0.07	**-0.002**	0.001	0.08	**-0.002**	0.001	0.08	**-0.003**	0.001	0	**-0.006**	0.002	0.00	**-0.006**	0.001	0
popdens	-0.001	0.001	0.2	-0.001	0.001	0.22	0.000	0.001	0.59	-0.001	0.001	0.35	0.000	0.001	0.75	-0.001	0.001	0.34
popgr	**-0.031**	0.006	0	**-0.011**	0.006	0.08	-0.009	0.006	0.12	-0.018	0.005	0.00	**-0.026**	0.009	0.00	-0.009	0.007	0.17
litrate	1.024	0.857	0.23	-0.933	0.844	0.27	**2.359**	0.813	0.00	-0.032	0.728	0.96	**-4.068**	1.117	0	-0.362	0.886	0.68
roads	1.308	1.222	0.28	2.078	1.286	0.11	0.697	1.205	0.56	1.117	1.057	0.291	1.430	1.373	0.30	1.653	1.152	0.15
perrate	**1.519**	0.410	0	**0.741**	0.447	0.10	0.206	0.414	0.62	-0.199	0.376	0.60	0.609	0.529	0.25	0.490	0.423	0.25
orent	**13.107**	3.267	0	0.766	2.234	0.73	-0.947	1.526	0.54	2.504	1.754	0.15	0.390	2.433	0.87	1.096	1.857	0.56
proden	**0.518**	0.291	0.08	0.255	0.292	0.38	0.069	0.275	0.8	0.066	0.057	0.25	**1.281**	0.285	0	**1.162**	0.256	0
socap	**-0.138**	0.045	0.00	0.020	0.044	0.65	-0.027	0.043	0.53	0.008	0.037	0.83	**-0.118**	0.056	0.04	-0.048	0.044	0.28
Diagnostics of fit	**Mean pred. prob.**	**Act. prop.**	**% Diff.**	**Mean pred. prob.**	**Act. prop.**	**% Diff.**	**Mean pred. prob.**	**Act. prop.**	**% Diff.**	**Mean pred. prob.**	**Act. prop.**	**% Diff.**	**Mean pred. prob.**	**Act. prop.**	**% Diff.**	**Mean pred. prob.**	**Act. prop.**	**% Diff.**
	0.126	0.125	0.2	0.122	0.123	1.0	0.122	0.123	1.0	0.272	0.272	0.1	0.064	0.063	0.6	0.152	0.162	6.6

Notes: Regional dummy variable results not shown.

Table 8. Honduras: Multinomial Logit Model, IFPRI Households (Livelihood Strategy #3 as Comparison Group)

Cluster	1 Livestock producers			2 Coffee producers			4 Basic grains /farm workers			5 Mixed basic grains/livestock/ off-farm work		
No of HH	**58**			**28**			**85**			**116**		
Explanatory variables	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**
intercept	-0.644	2.534	0.799	1.300	2.916	0.656	2.946	1.729	0.088	-3.119	1.795	0.082
deprat	-0.194	0.379	-0.609	-0.677	0.498	0.174	-0.344	0.288	0.232	-0.045	0.269	0.867
hsize	-0.007	0.107	0.944	-0.134	0.135	0.322	0.012	0.083	0.883	-0.403	0.082	0.623
mhh	0.451	0.972	0.642	2.215	1.439	0.124	0.160	0.685	0.816	**2.369**	**0.929**	0.011
femadults	-2.523	1.832	0.169	0.534	1.200	0.789	**-3.347**	1.472	0.023	0.820	1.478	0.579
age	0.009	0.0183	0.642	0.013	0.021	0.525	-0.010	0.014	0.482	**0.029**	**0.014**	0.033
ed1	-0.194	0.154	0.210	-0.226	0.173	0.193	-0.113	0.123	0.357	-0.020	0.119	0.867
migrant	**6.505**	3.084	0.035	**6.760**	3.165	0.033	**6.551**	3.086	0.034	**5.160**	**2.993**	0.085
ownland	0.145	0.092	0.113	0.052	0.113	0.642	-0.162	0.148	0.272	**0.156**	**0.091**	0.086
landtitle	0.846	0.917	0.356	**2.067**	1.004	0.039	0.628	0.927	0.498	0.375	0.803	0.640
natass1	0.001	0.001	0.173	**0.003**	0.001	0.001	0.000	0.001	0.626	**0.002**	**0.001**	0.000
natass3	0.000	0.001	0.910	**-0.004**	0.002	0.068	-0.001	0.001	0.288	0.001	0.001	0.347
natass4	-0.004	0.006	0.515	-0.068	0.067	0.307	**-0.008**	0.004	0.071	-0.007	0.005	0.124
natass5	0.000	0.0004	0.997	-0.000	0.000	0.335	0.000	0.000	0.853	-0.000	0.000	0.817
popdens	-0.002	0.005	0.651	-0.010	0.007	0.135	-0.002	0.003	0.509	-0.006	0.004	0.102
distance	0.059	0.054	0.275	0.042	0.081	0.604	0.040	0.048	0.400	0.050	0.050	0.308
roads	-0.245	0.217	0.260	0.093	0.229	0.684	0.039	0.153	0.797	-0.215	0.153	0.161
busassets	**-0.00006**	0.00003	0.048	-0.000	0.000	0.690	**-0.001**	0.000	0.002	**-0.00003**	**0.00002**	0.080
livestock	**0.00009**	0.00002	0.000	-0.000	0.000	0.922	-0.000	0.000	0.502	**0.00004**	**0.00002**	0.047
credit	0.447	0.601	0.457	-0.285	0.671	0.671	0.477	0.446	0.285	0.624	0.446	0.162
training	-0.171	0.658	0.795	0.385	0.673	0.568	-0.821	0.520	0.114	-0.113	0.470	0.809
techass	0.124	1.015	0.903	-0.377	1.130	0.739	1.320	0.836	0.114	0.165	0.788	0.834
socap1	**3.031**	1.277	0.018	2.221	1.371	0.105	**2.143**	1.249	0.086	**1.963**	**1.125**	0.081
socap2	-0.701	0.611	0.251	0.241	0.748	0.748	-0.209	0.477	0.662	-0.394	0.496	0.427
socap3	**-2.700**	1.336	0.043	-1.358	0.957	0.156	**-1.994**	0.772	0.001	**-1.837**	**0.707**	0.009
socap4	0.800	0.786	0.309	0.857	0.910	0.347	**1.179**	1.729	0.026	0.790	0.537	0.141
Diagnostics of fit	**Mean predicted probability**	**Actual proportion**	**% Difference**	**Mean predicted probability**	**Actual proportion**	**% Difference**	**Mean predicted probability**	**Actual - proportion**	**% Difference**	**Mean predicted probability**	**Actual proportion**	**% Difference**
	0.159	0.165	4.4	0.097	0.078	19.6	0.217	0.238	9.7	0.343	0.325	5.2

Table 9. Honduras: Multinomial Logit Model, Wisconsin Households (Livelihood Strategy #2 as Comparison Group)

Cluster	1 Diversified producers			3 Livestock producers			4 Coffee producers			5 Own business			6 Remittances		
No of HH	**222**			**98**			**242**			**58**			**91**		
Explanatory variables	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**
intercept	-3.659	1.946	0.060	-5.798	2.283	0.011	-3.782	1.866	0.043	-3.823	2.604	0.142	-7.064	2.286	0.002
deprat	-0.089	0.349	0.799	-0.014	0.411	0.972	0.101	0.335	0.763	-0.049	0.533	0.927	0.187	0.375	0.617
hsize	0.034	0.055	0.539	-0.063	0.064	0.322	-0.065	0.055	0.235	0.053	0.075	0.477	0.018	0.064	0.773
mhh	-0.432	0.518	0.404	0.076	0.644	0.906	-0.056	0.529	0.916	-0.332	0.724	0.646	**-1.438**	0.543	0.008
femadults	-0.011	0.015	0.483	0.011	0.017	0.534	-0.001	0.015	0.938	-0.010	0.021	0.644	-0.019	0.017	0.275
age	0.014	0.014	0.286	0.019	0.015	0.207	**0.029**	0.013	0.027	-0.000	0.019	0.984	**0.038**	0.015	0.014
ed1	-0.037	0.103	0.719	-0.086	0.115	0.451	0.138	0.100	0.167	0.169	0.127	0.185	**0.258**	0.113	0.022
migrant	-0.026	0.027	0.333	-0.013	0.324	0.685	0.014	0.024	0.568	0.012	0.030	0.692	**-0.132**	0.054	0.014
land	**0.422**	0.081	0.000	**0.421**	0.081	0.000	**0.390**	0.081	0.000	**0.420**	0.081	0.000	**0.387**	0.081	0.000
landtitle	**1.170**	0.503	0.020	**1.887**	0.542	0.001	0.477	0.504	0.344	0.835	0.617	0.176	**0.971**	0.558	0.082
natass1	0.000	0.001	0.812	0.000	0.001	0.694	0.001	0.001	0.175	-0.001	0.001	0.410	-0.000	0.001	0.831
natass2	0.000	0.001	0.938	-0.000	0.002	0.936	0.002	0.002	0.189	0.000	0.002	0.839	-0.001	0.002	0.713
natass3	0.001	0.001	0.217	0.002	0.001	0.120	-0.000	0.000	0.618	0.000	0.001	0.872	0.001	0.001	0.159
popdens	**0.007**	0.003	0.022	**0.011**	0.004	0.002	**0.011**	0.003	0.001	**0.012**	0.005	0.013	0.005	0.004	0.168
distance	-0.003	0.005	0.531	-0.001	0.005	0.797	**-0.014**	0.005	0.003	-0.010	0.010	0.129	-0.007	0.006	0.217
capdist	-0.002	0.008	0.846	-0.003	0.010	0.790	**0.019**	0.008	0.018	0.003	0.013	0.843	0.006	0.010	0.512
roads	-0.103	0.098	0.293	**0.287**	0.136	0.035	**-0.579**	0.114	0.000	**-0.369**	0.177	0.037	-0.118	0.117	0.311
busassets	0.001	0.217	0.997	-0.000	0.218	1.000	0.001	0.217	0.997	0.001	0.217	0.997	0.001	0.217	0.997
livestock	-0.000	0.000	0.122	-0.000	0.000	0.124	**-0.0001**	0.00002	0.022	-0.000	0.000	0.124	-0.000	0.000	0.184
credit	-0.500	0.355	0.159	0.299	0.406	0.462	**0.798**	0.339	0.019	-0.124	0.495	0.801	-0.142	0.417	0.733
socap1	-0.169	0.900	0.851	-0.137	0.932	0.883	0.914	0.862	0.289	0.465	0.968	0.631	0.407	0.954	0.670
socap2	-0.333	0.350	0.342	-0.571	0.412	0.166	-0.479	0.340	0.159	-0.224	0.485	0.644	-0.680	0.425	0.109
socap3	1.362	0.948	0.151	1.040	1.163	0.371	0.130	1.023	0.899	**2.571**	1.069	0.016	1.229	1.078	0.254
socap4	-0.035	0.793	0.965	0.716	0.812	0.378	0.277	0.691	0.688	-0.393	1.221	0.748	**1.538**	0.761	0.043
Diagnostics of fit	**Mean predicted prob.**	**Actual prop.**	**% Diff.**	**Mean predicted prob.**	**Actual prop.**	**% Diff.**	**Mean predicted prob.**	**Actual prop.**	**% Diff.**	**Mean predicted prob.**	**Actual prop.**	**% Diff.**	**Mean predicted prob.**	**Actual prop.**	**% Diff.**
	0.252	0.269	6.7	0.123	0.119	3.3	0.292	0.293	0.3	0.066	0.070	5.7	0.109	0.110	0.9

Table 10. Nicaragua: Multinomial Logit Model (Livelihood Strategy # 1- Self-Employment in Agriculture as Comparison Group)

	LS 2: Agricultural wage employment			LS 3: Nonagricultural self employment			LS 4: Nonagricultural wage employment			LS 5: Remittances		
Variable	**Est.**	**Std. error**	**p-val**	**Est.**	**Std. error**	**p-val**	**Est.**	**Std. error**	**p-val**	**Est.**	**Std. error**	**p-val**
Intercept	-0.102	0.538	0.849	-0.617	0.542	0.255	0.235	0.534	0.660	**-2.803**	0.565	0.000
deprat	-0.411	0.413	0.320	-0.275	0.472	0.560	-1.044	0.462	0.024	**2.223**	0.499	0.000
mhh	-0.027	0.241	0.911	**1.233**	0.245	0.000	1.090	0.244	0.000	**0.938**	0.242	0.000
ed1	-0.335	0.210	0.112	0.027	0.224	0.904	0.333	0.214	0.120	0.252	0.213	0.237
electricity	**0.461**	0.238	0.053	**0.983**	0.252	0.000	1.189	0.247	0.000	**0.640**	0.249	0.010
assets	-0.141	0.133	0.290	**0.662**	0.105	0.000	**0.723**	0.105	0.000	**0.253**	0.112	0.024
busasssets	**0.000**	0.000	0.026	**0.000**	0.000	0.008	0.000	0.000	0.963	**0.000**	0.000	0.010
livestock	**0.000**	0.000	0.030	**0.000**	0.000	0.013	**0.000**	0.000	0.002	**0.000**	0.000	0.074
land	**-0.051**	0.013	0.000	**-0.019**	0.008	0.022	**-0.035**	0.011	0.002	**-0.017**	0.007	0.016
distance	-0.001	0.001	0.446	**-0.003**	0.002	0.101	**-0.005**	0.002	0.029	**-0.006**	0.002	0.005
techass	-0.181	0.230	0.433	**-1.127**	0.344	0.001	**-0.917**	0.322	0.004	0.020	0.249	0.937
roads	**1.016**	0.258	0.000	**0.644**	0.282	0.023	**1.443**	0.262	0.000	**0.487**	0.285	0.088
socap	**-3.606**	1.377	0.009	**-3.529**	1.533	0.021	**-4.548**	1.554	0.003	-1.817	1.351	0.179
Diagnostics of fit	**Mean pred. prob.**	**Act. prop.**	**% Diff.**	**Mean pred. prob.**	**Act. prop.**	**% Diff.**	**Mean pred. prob.**	**Act. Prop.**	**% Diff.**	**Mean pred. prob.**	**Act. prop.**	**% Diff.**
	.199	.194	2.6	0.141	.132	6.8	0.164	.149	10.1	.141	.156	9.6

Notes: Regional dummy variable results not shown.

Natural Capital

Because of differences in survey instruments, the impacts of different types of natural and physical capital on livelihood choice were examined. In Nicaragua and Guatemala, increased landownership is strongly associated with self-employment in agriculture. In Nicaragua, the results are statistically significant for all livelihood choices, while in Guatemala, they are mostly significant. In Honduras, more land stimulates households to move away from a livelihood strategy based exclusively on basic grains. Among hillside households in Honduras (Table 8), mixed basic grains/wage employment in agriculture (livelihood strategy #4) is more likely as landholding grows. This result is confirmed in Table 9, which also suggests that more land stimulates diversification into coffee, livestock or business. Access to titled land has the same effect but with a stronger magnitude as land ownership without title (Table 9).

Improved soil quality is associated with a higher likelihood of adopting nonagricultural and agricultural wage strategies in Guatemala. This finding reflects the role that more productive soil plays in the development of the nonagricultural economy: increased productivity leads to surpluses, which in turn lead to demands for off-farm activities. More productive soils are also found in coffee-producing areas of Guatemala, where agricultural labor is common (see also the results for the variable 'perrate' in Table 7). In Honduras, fewer problems with water are associated with more off-farm work and less dependence on basic grains. Natural capital has varied impacts on choice of livelihoods, but, in general it is an important determinant.

Location-Specific Assets

Several location-specific assets, including access to technical assistance and distance to key facilities, affect livelihood choices. In Guatemala and Nicaragua, isolation (measured by distance to key facilities) is associated with lower likelihoods of working off the farm, and particularly outside of agriculture. On the other hand, the results from Nicaragua show that access within the community to a paved road, controlling for degree of isolation, is associated with a higher likelihood of households

selecting an agricultural wage and any nonagricultural strategy compared to agricultural self-employment. The results for Honduras (Table 9) show that higher population densities can stimulate households to pursue market production and move away from less remunerative livelihood strategies based on basic grains production for food security.

Community-level measures of social capital (the mean household participation in various committees and organizations) are associated with lower likelihoods of agricultural wage and nonagricultural livelihoods in both Nicaragua and Guatemala. The effect was particularly strong and significant in Nicaragua. This result might be related to reverse causality as more of such committees exist in areas where self-employed producers predominate, but model tests indicate no substantial bias from inclusion of this potentially endogenous variable. In Honduras, membership in agricultural organizations helps households to pursue more diversified and remunerative livelihood strategies whereas participation in credit organizations is largely limited to households that depend on basic grains only (Table 8). On the other hand, the results in Table 9 suggest that credit organizations can be important for nonagriculture-based livelihood strategies.

Determinants of Household Well-being

Rural household livelihood strategies can have major impacts on outcomes such as levels of well-being, rates of poverty, and an area's growth potential. In the asset-base framework, livelihood strategies reflect conscious household decisions about allocation of their primary productive resources, mainly labor and land. But, as shown above, the specific strategy adopted by households depends on other assets, including natural capital and location-specific assets. A major issue is whether the improved assets themselves lead to improvement in well-being, or it is only through adoption of a livelihood strategy. In the cases of Guatemala, Honduras and Nicaragua, livelihoods are closely related to household well-being, but the nature of causality is open to question: do better-off households engage in certain strategies because they are better off, or does the strategy "cause" the household to become better off?

Regression results for equation 2 are presented in Table 11 and show that livelihood strategies, individual assets as well as asset interactions have impacts on rural household well-being[8], with subtle differences across countries.

Table 11. Determinants of Well-being (Structural Model Results), with Livelihood Strategies Included

	Guatemala		Honduras				Nicaragua	
Dependent variable	**Log annual consumption per capita**		**Log annual income per capita**				**Log annual consumption per capita**	
Explanatory variables			**IFPRI households**		**Wisconsin households**			
	Coefficient	**t-statistic**	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
intercept	8.604	30.72	7.449	2.77	7.273	1.69	7.573	55.97
Livelihood Strategies								
LS 1 [1)]			0.074	0.13	-0.299	-0.42		
LS 2 [1)]	0.263	1.54	0.637	1.13			**-1.006**	-5.16
LS 3 [1)]	0.511	1.35			**1.454**	1.94	**0.868**	5.04
LS 4 [1)]	**0.754**	2.32	0.263	0.50	-0.240	-0.42	**0.720**	4.59
LS 5 [1)]	0.343	1.46	0.133	0.31	1.944	1.42	**1.031**	3.88
LS 6 [1)]	-0.265	-0.83			-0.182	-0.20		
LS 7 [1)]	**0.634**	2.73						
Natass2					0.785	1.50		
Natass3			-0.364	-1.33	**-0.617**	-1.86		
Natass4			-0.001	-0.91				
Natass5	**0.057**	3.23	**0.387**	1.93				
deprat	**-0.192**	-20.29	**-0.181**	-2.17	-0.114	-0.88	**-0.774**	-8.63
mhh	**-0.244**	-5.36					**-0.172**	-4.07
hsize			-0.011	-0.45	-0.033	-1.52		
ed1	**0.065**	2.57	0.045	1.00	**0.181**	3.65	0.029	0.77
ed2	**0.388**	7.04						
ethno	**0.246**	10.2						
age			-0.159	-0.85	**-0.593**	-2.30		
migrant			**0.941**	2.06	0.003	0.27		
femadult			-0.453	-1.12	-0.008	-1.57		
training			-0.001	-0.01				
techass			0.087	0.43				
electricity	**0.219**	7.38					-0.007	-0.14

[8] The measure of well-being is per capita consumption expenditures (Nicaragua and Guatemala) or per capita household income (Honduras). Per capita consumption expenditures include the value of own-produced foods, owner-occupied housing, flows of benefits from durable goods, and the values of in-kind transfers. Household income is defined as the sum of the net value of crop and livestock production (revenues minus costs), off-farm salaried work, own business and transfers. Own production, whether consumed by the household or sold, is included in the calculation of household income.

Table 11. Determinants of Well-being (Structural Model Results), with Livelihood Strategies Included (Contd.)

	Guatemala		Honduras				Nicaragua	
Dependent variable	**Log annual consumption per capita**		**Log annual income per capita**				**Log annual consumption per capita**	
Explanatory variables			**IFPRI households**		**Wisconsin households**			
	Coefficient	**t-statistic**	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**	**Coefficient**	**t-statistic**
assets	**0.000**	15.46						
busassets			**0.000**	2.38	0.000	0.19		
livestock	**0.000**	9.21	0.000	0.96	**0.000**	2.77	0.000	3.31
land	0.002	1.75					**0.002**	1.85
ownland			-0.002	-0.16	**0.016**	2.91		
distance	**0.000**	-2.54	-0.162	-1.19	**-0.006**	-1.70	0.001	1.37
popdens	**0.000**	-2.61						
roads			0.007	0.17	**0.080**	2.23		
capdist					0.000	0.03		
socap	**0.017**	2.65					0.105	0.45
socap1			-0.063	-0.28	**0.433**	1.93		
socap2			-0.007	-0.06	-0.059	-0.45		
socap3			**-0.410**	-1.97	0.015	0.04		
socap4			-0.002	-0.01	0.213	0.72		
ed1*distance	0.000	1.44	**0.007**	1.91	**0.001**	1.79	**-0.001**	-2.45
ownland*credit			0.002	0.22	**0.008**	2.42		
land*distance	0.000	-1.66	0.036	0.51	0.061	0.98	0.000	0.86
land*ed1			-0.001	-0.62	**-0.002**	-4.36	0.001	1.14
ownland*soil			0.000	0.78				
N	3852		315		525		1347	
R^2	0.447		0.254		0.345		0.349	

See Table 6 for explanation of livelihood strategy variables. Regional dummy variables not shown for Guatemala and Nicaragua.

Livelihood Strategies

In Guatemala, rural households following a mixed livelihood strategy or one based on self-employment outside agriculture have significantly higher levels of well-being than households that depend on their own farm for most of their income. However, the difference in well-being between self-employed farmers (the comparison group) and wage-employed in agriculture was not statistically significant, suggesting that once the

determinants of livelihood choice and asset ownership are controlled for, the choice itself has only a minor impact.

In Nicaragua, households adopting a self-employed agricultural strategy are significantly better off than agricultural wage workers, but worse off than those adopting a nonagricultural strategy. Even controlling for other assets, the livelihood choice in Nicaragua is a strong and significant determinant of household well-being. Relative to a livelihood strategy based on basic-grains production, households in Honduras that focus on the production of livestock have higher levels of well-being.

Human Capital

Results from Guatemala indicate that education of the household head[9] leads to a 9-15% improvement in household well-being. The findings were not statistically significant in Nicaragua. The results for the IFPRI households in for Honduras show that the estimated coefficient of the average level of household members' education is not statistically significant, but this is probably due to low variation combined with low average values for education of hillside households. The results in Table 9, on the other hand, suggest a strong effect of education on household well-being (elasticity about 0.9).

Household dependency has a strong negative impact on well-being with an elasticity of between -0.2 and -0.3, depending on the country. Headship has remarkably different effects in Nicaragua and Guatemala. In the latter, rural households headed by females are significantly better off than those headed by males. In Nicaragua, male-headed households are significantly better off. The finding in Guatemala is consistent with results from other studies (e.g., Hereford and Echeverri 2003) and may be associated with the high propensity to migrate seasonally in rural areas, particularly from the Western Altiplano. The results from Guatemala also show the impacts of ethnicity in this historically divided nation. Indigenous rural households have mean levels of

[9] We also tested other measures of household educational attainment such as education of the most-educated household member and highest education of an adult. The results consistently show the importance of education.

consumption that are about 30 percent lower than nonindigenous households. This finding holds across all regions of the country and is an important indication of persistent economic and social disadvantage[10]. Results from Honduras show no significant effect of household size on per capita income but older household heads are associated with lower levels of well-being (elasticity of -0.59, Table 9). Hillside households where members spend more time migrating have higher levels of well-being (a doubling of the percentage time spent as a migrant would increase per capita income by 94 Lempiras per year).

Physical and Natural Assets

Physical and natural assets also represent significant determinants of rural household well-being. In Honduras, soil fertility has a strong and significant impact (elasticity of about 0.4) on well-being in the hillside areas where most livelihood strategies are agriculture-based. Access to electricity raises well-being, even in remote rural areas. The qualitative analysis sheds light on the pathways by which access to electricity raises well-being in rural Guatemala. Families reported being satisfied by the convenience afforded by electricity for lighting and television. Without complementary investments to exploit electric power, the presence of electricity in a village did not affect incomes. Widespread installation of monophase versus triphase electricity limits the economic contribution of rural electrification. One village in rural Guatemala, for example, had several sawmills and woodworking shops; these enterprises clearly exploited the availability of electricity. Discussions with village members indicated that the community had a tradition in working with wood *before* electric power was introduced. The skills and experience already existed in the village, so access to electricity complemented existing assets and allowed for additional income-generation.

Household assets, business assets, livestock and land were also associated with higher levels of well-being, but their effects differed substantially by country. The

[10] Even controlling for level of education, language ability, landholding, and other tangible and productive assets, indigenous households have access to fewer opportunities than the nonindigenous. This result is clearly a product of social exclusion.

elasticity of well-being to higher values of household assets ranged from a low of about 0.12 in Nicaragua, to about 0.35 in Guatemala. In Nicaragua, the presence of business-related assets (such as stocks of items, display cases, etc.) helped raise well-being, but the elasticity was only 0.08, indicating only a weak well-being response to increased value of such assets. But in the Honduran hillsides, this elasticity is much higher at about 0.40. Livestock was a statistically significant asset in all three countries, even though not in the Honduran hillsides. But elasticities were low, less than 0.09 in Guatemala and Nicaragua and 0.05 in Honduras. More detailed analysis shows that in the eastern and northern areas of Guatemala, livestock ownership was a significant determinant of well-being, but its impact was more muted in other areas.

Land assets are positively associated with increased well-being in rural areas of all three countries, but the well-being/land elasticity is relatively small in magnitude in Nicaragua and Guatemala with low levels of significance. On the other hand, the results for Honduras in Table 9 suggest a much higher elasticity of well-being to land ownership (about 0.35). The impact of land ownership on household well-being depends critically on two factors: its location and its productivity.

Location-Specific Assets

Interactions between market access and landholdings (land*distance) were barely significant in Guatemala and insignificant in Nicaragua and Honduras. The Guatemala result suggests that the benefits of larger landholdings are smaller as households become more remote from infrastructure. In the case of Guatemala, also the uninteracted term (distance) was strongly significant and negative, confirming that more remote households in Guatemala are significantly worse off than others. A similar result, though less significant, was obtained for Honduras where the significant and positive coefficient for road density confirms the negative influence of isolation on well-being. A significant negative coefficient for the interaction term for education and market access (ed1*distance) in the case of Nicaragua points towards a synergy effect, that is, households with higher levels of education are better able to take advantage of market

access. This result is contrasted by the findings from Honduras, which suggest that schooling and market access act as substitutes, i.e., schooling can to some extent compensate for lack of market access and vice versa. Schooling may also be able to compensate to a certain extent for the lack of access to land. The positive and significant coefficient of the (ownland*credit) variable confirms the widely held notion that land ownership facilitates credit access.

Social capital has a strong positive effect on household well-being in Guatemala, Nicaragua and Honduras. Guatemalan and Nicaraguan households located in communities with higher average participation in community organizations have significantly higher well-being than households who with lesser participation. The results for Honduras suggest that participation in agricultural organizations increases well-being and that savings and loans organizations in the hillside areas focus on the poorest households that rely mostly on basic grains production for their livelihoods. The qualitative analysis at the community level (Jansen et al. 2003) also reveals a positive influence of external organizations on well-being: some of these organizations play a key role in promoting sustainable agricultural practices among hillside farmers while others are crucial for making the necessary marketing contacts to enable farmers to switch to more remunerative livelihood strategies.

V. SUMMARY AND CONCLUSIONS

Economic potential has a strong spatial pattern in all three countries: geographic location is important, but area economic potential does not automatically translate into improved well-being for all. Investments in Guatemala, Honduras and Nicaragua have generally been directed toward more favored areas and people outside these areas have been left behind. We found a strong overlap between economic potential, poverty rates and poverty densities in Guatemala and Honduras, but not in Nicaragua. In Guatemala, investments should be targeted toward the high-poverty density areas of the Western Altiplano, with special attention to providing missing assets to allow participation by disadvantaged groups. Indigenous households are being discriminated against, and pro-active efforts are needed to improve educational attainment and to integrate the indigenous into the market economy. Discrimination also needs to be addressed directly.

In Honduras, overlap between high poverty rates and high poverty densities in some hillside areas means that investments there should reach significant proportions of the country's rural poor, and hillside areas should therefore be a major target of national rural poverty reduction strategies. Investments in human resources and increased mobility should be a high priority. In Nicaragua regional trade-offs exist: investments targeted toward high-potential areas have potential to benefit many poor people, but leakages to the nonpoor are likely. Concurrent efforts to address poverty more directly in less-favored areas are needed, and these investments should focus on strengthening household asset bases and on increasing economic mobility. In all cases, policymakers need to take a long-term perspective and build the ability to adapt to changing economic circumstances and participate in a liberalized economy.

Asset bases are important determinants of household well-being and our findings show that the asset-base framework has the potential to be an important tool for policy formulation and targeting. Besides their direct effect on well-being, assets have indirect effects through their impact on livelihood choice. Education and training have a strong

positive effect on well-being in all countries, even in isolated rural areas. Impacts of education can be greater when migration and economic mobility are enhanced.

Agriculture-related assets such as land and livestock have different effects on well-being depending on the country in question. For example, while both Nicaragua and Guatemala have a relatively small well-being/land elasticity, landownership in Honduras has a much stronger direct effect on well-being, and it also increases the likelihood that a household follow a livelihood strategy that is more remunerative than basic grains farming. Location effects, such as distance to markets and other infrastructure, vary in the different cases. In Guatemala and Honduras, market access has a strong, statistically significant positive effect on well-being, even controlling for the livelihood decision. Results for Honduras show that good market access may, to some degree, substitute for a lack of education, and also point towards the importance of landownership for access to credit. In rural Nicaragua distance does not have a strong direct effect on well-being, but its effect is felt through interactions with other assets such as land and education. Distance from markets in Nicaragua makes land more important and education less important. Participation in agricultural organizations is associated with higher levels of well-being whereas external organizations help promote sustainable agricultural production and often provide the necessary contacts for market-oriented production.

Access to assets affects livelihood decisions, which in turn affect well-being outcomes. Low land and labor productivity in agriculture is a major cause of rural poverty, and production of basic grains on less than two hectares of land with low-input rainfed agriculture is not a poverty exit strategy. Those remaining in the sector need to be more efficient, productive and competitive and be put in a position to make the switch to more profitable livelihood strategies. But agriculture alone cannot solve the rural poverty problem, and livelihoods outside of agriculture are the most effective means of raising household well-being. Diversified livelihood strategies pay off in the form of higher consumption and income. However, once the asset base is controlled for, the livelihood choice only has a small impact on household well-being. The implications of this finding are that the public sector should invest in assets, particularly human assets,

and not necessarily in specific "sectors" of the economy. Assets that yield returns in multiple occupations and livelihoods will better enable households to gain from a liberalized economy.

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