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The Influence of Household Composition upon a Diversified Tropical Hillside Farming Project in the Dominican Republic

Carlton Pomeroy, Doctoral Student

Amy Gough, Graduate Student

University of Florida

Matt Baker, Professor

Texas Tech University

Peter Hildebrand, Professor

University of Florida

Abstract

*The purpose of this study was to evaluate the impact that introduction of passion fruit (*Passiflora spp.*), mapuey (*Dioscorea cayenensis*), and ñame (*Dioscorea rotundata*) had on the livelihood system of small hillside farmers in the Los Cacaos region of the Dominican Republic. The researchers used a mixed methodology approach to identify cash, food, credit, and labor associated with the livelihood system of six households with varied compositions, and to examine the influence of the traditional agricultural system versus the adoption of alternative crops (passion fruit, mapuey, and ñame) upon simulated models of the six households. The analysis revealed that households with more labor availability exhibited greater potential for increasing annual year-end cash upon adoption of the selected crops, particularly passion fruit. No households selected mapuey. Findings support the importance of examining household composition when developing and tailoring alternatives and conducting on-farm trials for low resource farmers.*

Introduction

The face of agriculture in the Dominican Republic has changed dramatically during the latter part of the last century. Agriculture employed some 60% of the population in 1960 and was reduced to 18% in the year 2000 (Banco Central, 2000). Men held most of the agricultural jobs in the late 1990s. These jobs were among the lowest paid in the country. In spite of male predominance of employment in the agricultural sector the vast majority of farm women contributed to the family's earnings (Aleman & Santana, 1996). In the 1990s some 20% of the rural households employed in agriculture were female single heads of household. In addition to time-consuming domestic tasks, these women often have to carry out physically demanding labor such as harvesting and processing crops like cotton, coffee, tobacco, and tomatoes (Leonard, 1995; PAHO, 1986). Single women are further handicapped by the traditional exclusion of women from mechanized or skilled agricultural work. The overall well being in the countryside has decreased with the shift in the economy and the limited attention and investment in agriculture (Aleman & Santana, 1996).

The result has been food insecurity, poverty, environmental degradation, and often dependency on relatives outside the country (Ferguson, 1993; Library of Congress, 1989). Ferguson (1993) described the situation by saying that: "Many families have at least five children and some as many as ten or fifteen. Rice is now very expensive, and people are lucky if they eat meat once a week on Sunday" (p. 63). The level of the food insecurity can be put into perspective by examining the caloric intake of the population. According to Perez Luna (1979), groups that earned less than \$50 per month have a caloric intake of 1,324 calories per day and 28 grams of protein per day. These figures represented 50% of the population. The six percent that made more than \$300 per month have a caloric intake of 3,150 calories per day and 86 grams of protein per day. By comparison, a male weighing 70 kg needs 2,530 calories per day to function (Chambers, 1997) and a minimum of 1,550 calories per day to survive (Chambers, 1997). Children have been severely affected by malnutrition as measured by their physical development (Mancebo, 1984; Bruce, 1984). According to these statistics, the poor in

the Dominican Republic have been very food insecure.

In the Dominican Republic, the Center for Planning and Ecumenical Action (CEPAE) is a Non-Governmental Organization (NGO) founded on October 27, 1970 (CEPAE, 1996). Believing that agriculture is part of a rural system of knowledge as well as part of a social system of communal food, the agro-ecology team from CEPAE utilizes participatory approaches towards development. The focus of this research is to examine the results of a CEPAE crop diversification project introduced in the village of Los Cacaos in the Province of San Cristobal, Dominican Republic.

With coffee constituting the primary crop of Los Cacaos, the farming calendar is composed of the coffee production season from November through March and the non-coffee season from April through October. Coffee production is dependent upon family labor, as well as an influx of Haitian and Dominican laborers. Production during the non-coffee season remains dependent upon household labor to produce maize, rice, plantains, bananas, cassava, yams, and beans in the tierra blanca (land not in coffee production used for all other production needs). Following food security, a major goal of farming households is the generation of year-end cash for discretionary spending during the season preceding coffee harvest. Constraints to increasing this discretionary year-end cash include deteriorating soil quality (Ledema, 1996) and unstable coffee prices driven by the international market (Carrasco, 1991).

One important institution in the area is ASOCAES (Association of Coffee Producers of Los Cacaos). ASOCAES processes, transports, and sells coffee of its members. They also provide a variety of community services such as food credit (for the non-coffee season) and a reduced cost pharmacy. In 1991, an accord, signed between the CEPAE and ASOCAES, initiated a demonstration plot showcasing hillside sustainable agriculture. The objective was to generate a valid reference for the diversification of small and medium-scale coffee producers. The project had the following goals: (1) generate money during the non-coffee season, (2) improve food security, and (3) introduce low cost techniques to prevent soil erosion and enhance soil fertility.

In order to achieve these goals, plantains (*Musa paradisiaca*), bananas (*Musa acuminata*),

passion fruit, mapuey and ñame were introduced to create food and cash in the short term. Macademia (*Macademia tetraphylla*), zapote (*Pouteria sapota*), carambola (*Averhoa carambola*), mandarins (*Citrus reticulata*), and avocados (*Persea americana*) were also introduced to provide a potential source of cash further in the future. Hardwood species of oak (*Cataalpa longisiligua*) and palm heart (*Columbrina ferruginosa*) were presented as alternative sources of firewood and for sale as lumber. Additionally, a minimum till system using planting with the contour, composting, and maintenance of maximum ground cover was introduced as an alternative soil management program to minimize erosion.

Theoretical Framework

The theoretical framework for this study is centered upon the complex and diverse livelihood systems of low resource farmers and utilizes the framework of sustainable livelihood systems. The International Institute for Sustainable Development defines sustainable livelihoods as being:

Concerned with people's capacities to generate and maintain their means of living, enhance their well being, and that of future generations. These capacities are contingent upon the availability and accessibility of options, which are ecological, socio-cultural, economic, and political and are predicated on equity, ownership of resources and participatory decision making. Both the notions of sustainable development and sustainable livelihoods incorporate the idea of change and uncertainty. (Singh & Titi, 1994; p.31)

The framework recognizes that there are numerous biophysical and socio-economic forces and factors that affect family-level livelihood systems. Biophysical factors for example include topography, rainfall, soil quality, drainage, insects, disease, and local natural resources (abundance of wildlife and availability of forest resources). Examples of socio-economic forces and factors include land ownership, farm size, farming practices, gender roles, religious and cultural influences, length of time residing in the area (local or indigenous knowledge), vocational identity, family composition, cash needs (clothing, schooling, transportation, etc.), and family health. Numerous external forces and factors have a

direct influence upon the health and viability of these livelihood systems, including availability and access to crop and livestock markets, technology (including external inputs to enhance crop and/or livestock production), communications, transportation, electricity, education, and health care. In addition, environmental disturbances, opportunities for off-farm income, and labor availability all impact livelihood systems. The sustainable livelihood systems framework attempts to balance the socio-economic, political, and ecological development of rural areas through participatory change that identifies and intervenes in the livelihood system without destroying the long-term well being of the local culture or ecology (Ahmed, & Doeleman, 1995; Barg, Pollock, Hardi & Hardi, 1994; Bebbington, 1993; Chambers, 1987; Chambers, 1991; Chambers & Conway, 1992; Clark, 1993; Singh & Titi, 1994).

An evaluation of the CEPAE crop diversification project in Los Cacaos showed that passion fruit (32.2%), mapuey (26.7%), and ñame (27.7%) were the most widely utilized crops providing the highest substantial economic benefits (Pomeroy, 2000). This brings up a series of questions regarding the presented crops. Do trends exist amongst the adopters? If so, can these trends be characterized to decode the diversity of this agro-ecosystem (Sullivan, 1999)? Under what circumstances were the participants secure economically? This study will concentrate on the last question, determining the conditions resulting in economic security.

Prior research has shown that farm size (Weil, 1970; Parsatharathy & Prasad, 1978; Reiche, 1995; Hernandez, 1995), availability of labor (Hicks & Johnson, 1974; Harriss, 1972; Aliviar, 1972; Spenser & Byerlee, 1976; Weil, 1970; Reiche, 1995; Urrea, 1995; Sullivan, 1999; Anderson, 1999), and supply constraints (Clay, 1975; Duff, 1978; Vyas, 1975) are factors that may affect the adaptability of new technologies. These constraints will be considered in this analysis.

Purpose and Objectives

The purpose of this research was to evaluate the capacity of passion fruit, mapuey, and ñame to increase economic stability within the existing farming system. Chambers (1997) defined economic stability as: “adequate stocks and flow of food and cash to meet basic needs and to support well being” (p.10). In this study economic stability is reached when selected households experience either an increase in year-end cash for discretionary spending or a reduction in costs due to participation in CEPAE’s program, resulting in the household’s ability to cover annual expenditures. Therefore, economic security is measured through year-end cash potential for each specific household. The following objectives guided the study: (1) identify cash, food, credit, and labor associated with the livelihood system of six households with varied compositions, and (2) examine the influence of the traditional agricultural system versus the adoption of alternative crops (passion fruit, mapuey, and ñame) upon simulated models of the six households with varied compositions.

Methods

The researchers used a combination of qualitative and quantitative methodologies in addressing the objectives. The quantitative portion consisted of a 29-item questionnaire completed by 90 members of the ASOCAES. Face and content validity of the instrument were established by a panel of experts at the University of Florida and individuals involved in the project from the Dominican Republic. Post hoc Cronbach’s alpha estimates of internal consistency ranged from $r = 0.83$ to $r = 0.94$ on the three Likert-based constructs assessing perceptions of the program’s impact upon economic stability, soil erosion prevention, and capacity to adopt specific innovations.

The qualitative elements of the study included individual interviews conducted with three members of the agro-ecological team from CEPAE, 105 members from ASOCAES, two members from the National Institute of Hydraulic Resource and two members from the Autonomous University of Santo Domingo (UASD) that implemented the program. These interviews concentrated upon the role of the organizations in the diversification process. The final source of information was through existing records including letters, agreements, and

evaluations between CEPAE, UASD, INDRHI, and ASOCAES.

Data were collected during the summer of 1999. Descriptive statistics and linear programming were used to summarize and analyze the data. Linear programming was used to model the livelihood systems (including production options, available land (crops), labor availability, cash available, and cash and consumer needs). According to Hildebrand and Araujo (1997) a linear program requires the following information: (1) "The farm and non-farm activities and options with their respective resource requirements and any constraint on their production, (2) the fixed requirements and other maximum or minimum constraints that limit family or farm production, (3) cash costs and returns of each activity, and (4) a defined objective or objective functions" (p.7).

Findings and Related Discussion

The initial objective was to identify cash, food, and labor required by six households selected due to their varying compositions (Table 1). In order to understand the existing livelihood systems of producers in the region of Los Cacaos a typology of the households in the community was created utilizing the data from the survey. The typology was created by utilizing the different combination of household members categorized by age and sex, which fell within two standard deviation points of the means from the sample. The typology therefore represented the majority of the household types in the sample.

This background information was used to calculate household expenditures and available labor. The annual cash needs of each household were calculated by accounting for each household member's expected monetary requirements for transportation, clothing, school fees, and other necessities (Table 2). Alternatives exist in the linear programming model for either producing or purchasing all required crops for the various household scenarios.

Table 1

Family Composition of Six Households

Household	One	Two	Three	Four	Five	Six
Adult Male	1	1	1	1	1	0
Adult Female	1	1	1	1	1	1
Adolescent Male	0	0	0	2	3	0
Adolescent Female	0	0	0	2	3	0
Young Children	0	1	4	2	0	1

Table 2

Annual Cash¹ Needs of Six Households²

Household	One	Two	Three	Four	Five	Six
Trimester 1	6,080	6,480	7,680	7,280	6,680	3,440
Trimester 2	8,320	8,720	9,920	10,760 ³	12,860 ³	4,560
Trimester 3	8,320	8,720	9,920	9,520	8,920	4,560
Year End	22,720	23,920	27,520	27,560	28,460	12,560

¹ Reported in Dominican Pesos; ² Includes transportation, clothing, purchased food, and other necessities;

³ Includes school costs

As presented in Table 3, the annual availability of labor (in days) for the six households was calculated by totaling available weekly work hours, and subtracting responsibilities characteristic of different household members as determined by gender or

age (i.e., cooking, cleaning, child rearing). These household characteristics also assisted in determining required household consumption needs. Households four and five demonstrate the highest annual available labor for agriculture with 776 and 1,517 hours respectively. This

labor is directly correlated with the number of adults (two adults in each) and adolescents (four in household four and six in household five). Households one, two, and three displayed limited labor availability, (399, 347, and 297 respectively) due to a household composition of two adults and varying numbers of young

children (zero in household one, one in household two, and four in household three). Each additional child reduces the female agricultural labor available. The annual amount of household labor available for the female-headed household was 127 days.

Table 3

Annual Days Available for Agricultural Labor in Six Households

Household	One	Two	Three	Four	Five	Six
Trimester 1	161	133	124	393	604	42
Trimester 2	118	107	86	191	456	42
Trimester 3	118	107	86	191	456	42
Year End	399	347	297	776	1,517	127

The per person daily consumption of eggs, coffee, pigeon peas, bananas, plantains, maize, peppers, rice, beans, and cassava was used to estimate the annual pounds of consumption required per household. Consumption requirements were adjusted to accommodate the various needs of men, women, adolescents, and children.

The second objective of this research was to examine the differences in production activities (crop selection), land combination, and resources utilized (family and hired labor) of each of the six households utilizing both the traditional agricultural system and with the inclusion of the alternative crops of passion fruit, mapuey, and ñame. In the traditional agricultural system, all households produced crops for both consumption and sales. Specifically, coffee, bananas, and cassava served as the strongest year-end cash generators for discretionary spending. All households produced and sold coffee in relationship to the amount of family labor available. Bananas were intercropped with coffee; therefore the amount of bananas produced was directly dependent upon the amount of land in coffee production. With the exception of household number four, all households produced enough cassava for family consumption and cash sales.

Household four devoted land to plantains rather than cassava, a result of labor constraints of that household. Similarly, household one also experienced labor constraints and produced a very small amount of cassava. Finally, with the exception of household five, all households produced and sold a minimal amount

of plantains as a cash generating activity. Due to the high amount of available labor in household five, this household was able to grow the more labor-intensive and profitable crops.

The selection of some crops over others represented the livelihood choices that were made in households according to the typology. Those crops produced by the linear program were then compared to those crops produced in that typology. The researchers found that there was a correlation between the crops produced in the linear program and the survey respondents. There was further confirmation from key informant interviews conducted with members of ASOCAES. The informants stated that the availability of family labor and cash to purchase labor and other inputs were key factors that affected their decisions (in terms of which crops they should produce). The producers were not only motivated by subsistence production but also looked for price and production stability. Labor was, however, one of the major factors influencing their crop selection.

Upon introducing the alternative crops of mapuey, ñame, and passion fruit into the model, none of the households selected mapuey due to the highly labor intensive activities involved in production. Only household five selected passion fruit, also highly labor intensive. Households one and two, with slightly less available labor, selected a comparatively moderate amount of passion fruit, and significantly more ñame. Households three and six, with significantly less available household labor selected only ñame.

These general selection preferences reflect available labor and cash of each household. In order to accommodate these introduced crops, all households either eliminated or severely reduced previous cash generating crop activities. Cassava production was eliminated or reduced in all households. Upon eliminating this cash generating activity, households were able to devote land and labor to either passion fruit or ñame. With the exception of household five, all households drastically reduced plantain production and eliminated selling any plantains. Household five produced the same amount of plantains, however it did not produce plantains as a cash generating activity. Maize production was significantly reduced, and maize required for animal feed and household consumption was purchased.

Once again the crops from the linear program were then compared to those crops produced in that typology and found that there was a correlation between the two. The key informant interviews as well as the surveys identified money (to be used to hire labor) as a major factor influencing their decisions. One example was a female-headed household with one young child. She stated; "I would like to plant passion fruit but imagine my responsibilities with four young children. If I had access to money I could hire my cousin to plant the crop and I could manage the harvest."

Other households with grown children were able to plant labor-intensive crops such as passion fruit. One male-headed household with four adolescent children benefited from the production of the crop. Slowly the gentleman was able to introduce more and more land into the production. He stated; "The diversification into passion fruit has been very beneficial. I have four children and the boys have been able to help with clearing land and the girls with the harvest. This has allowed us to progress."

These statements give great insight into the connection between the production of the new crops and the overall economic stability of the households. Both serve to show the importance of looking at household composition when setting up the program and its connection to the program's success and failure. This also explained the differential preference of different households for some crops over others.

Implication and Recommendations

The researchers consider the risk in 'generalizing' these findings to households beyond the sample. Having said this, the researchers consider these findings to be 'transferable' to only households that display similar characteristics, constraints, and labor availability as those explored here. The crop diversification project introduced crops to the Los Cacaos area that can be economically beneficial. Production of either passion fruit or ñame resulted in increased year-end cash potential. However, the risk involved for these farmers may make the adoption of the crops slow. Upon utilizing the introduced crops, farmers may not simply eliminate traditional crops to replace them with passion fruit and ñame. Rather, farmers may add small amounts of these introduced crops to avoid greater risk involved with lack of diversification. The alternative crops would be economically beneficial to households one through six. The amount of benefit was tied to the labor available as well as cash and food needs as determined by household composition.

The systems approach used in the project recognized that low resource farms are complex and diverse. The models recognized the importance of the connection between, crops, the environment, local economics, culture, and politics. The crop diversification project in the Dominican Republic was conducted with small producers that often live as far as two hours away. They produce on mountainsides with severe slopes with varying soil acidity and quality. Power and control have been shared among members of the diffusion system, clients have controlled the local systems, and innovations have generally diffused through interpersonal networks. Local units have decided which innovations should be adopted on the basis of their informal evaluations, hence allowing for a high degree of reinvention among adopters. The use of on-farm trials allows the technology to be tested in multiple environments. In this way the cultural and ecological diversity are built into the process. The project therefore achieved appropriate solutions (considering ecology, culture, politics, and food security) while empowering the community and developing inter-institutional linkages between the project's stakeholders, (including the government and non-government organizations).

As a result of this study, the following recommendations are forwarded. First, development professionals should not isolate any single constraint (e.g. land, labor) and overemphasize an intervention based upon the constraint. This research demonstrates the intricacy of all inputs on the system. By examining multiple factors, and the interaction of such factors, a more explicit diagnosis of the working system will be possible. Secondly, household composition should be used as an indicator in the initial stage of the project. By obtaining the participation of households with different compositions the project will include a diverse cross section of participants (available labor, cash needs, etc.). This inclusion will allow a wide variety of perspectives to be shared, thus identifying constraints such as labor and cash. These data reveal that household needs are very diverse and are based to a large degree upon family composition. Finally, development professionals must use extreme caution when they advocate expansion of agricultural production or the introduction of a single crop or enterprise. The survival of the livelihood system often is dependent upon an existing diverse farming system.

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