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by

Pedro V. Martel, Richard H. Bernsten, and Michael T. Weber

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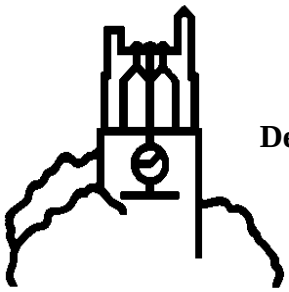

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EXECUTIVE SUMMARY

Since the early 1980s, Honduras' agricultural sector has stagnated. In the early 1990s, the government initiated a structural adjustment program expecting to accelerate economic development. In 1992, the government enacted the Law of Agricultural Modernization and Development, which called for market liberalization and a complete restructuring of the agricultural research and extension system. These reforms directly affect the bean subsector, and have implications for the region, since beans are a major source of proteins and a tradable good throughout Central America. While the National Bean Research Program has developed several improved varieties (with international collaborators), its research priorities have been set with little empirical knowledge about farmers' and market's characteristics and their effects on the adoption process.

To identify constraints and options to increase bean subsector's productivity, 239 farmers and 57 city traders were surveyed, and a rapid appraisal of the El Salvadorian market was conducted. Data were analyzed with descriptive statistics, logistic analysis, and linear regression analysis.

This research shows that farmers' socioeconomic characteristics, production environments, and institutional factors all affect the varietal adoption process. Catrachita and Dorado, two recently released varieties, were planted by 23% and 20% of the farmers, respectively. Adoption rates varied across administrative region, topographical region, and farm size. Catrachita and Dorado were planted by 27% of Mideastern farmers, and only by 16% and 7% of Northeastern farmers, respectively. In the hillsides, 76% of farmers planted Catrachita but only 24% in the flatland. Catrachita was planted by 19% small and medium farmers, and 32% large farmers. At the market-level, traders paid farmers US$ 0.63/kg for Seda (traditional variety), whereas Catrachita and Dorado only commanded a price of US$ 0.56/kg and US$ 0.53/kg. Price differences were partly due to demand from El Salvador. Thus, market links also have important implications for the adoption of new varieties, especially links to Central American markets. Similarly, competitiveness of the Honduran bean subsector is highly dependent on policy makers' and plant breeders' ability to adjust to market participants' demands.

CONTENTS

Section Page

LIST OF TABLES

LIST OF ACRONYMS

BGMV	Bean Golden Mosaic Virus
CRSP	Bean/Cowpea Collaborative Research Support Program
DICTA	Directoire of Research Technology and Agricultural Science
GOH	Government of Honduras
IHMA	Honduran Institute of Agricultural Marketing
IMF	International Monetary Fund
LAM	Agricultural Modernization and Development Law
Lps	Lempiras (Honduran currency)
MRN	Ministry of Natural Resources
NAC	National Agricultural Census
NBP	National Bean Program
PROFRIJOL	Swiss-funded Regional Bean Program
SAP	Structural Adjustment Program
USAID	United States Agency for International Development
WB	World Bank

1. INTRODUCTION

1.1. Problem Statement

Since the late 1980s Central American governments[1] have adopted structural adjustment programs (SAPs) in the expectation that these reforms will revitalize their economies, thereby accelerating economic development. The agricultural sector is a key target of these reforms which encompass a gradual elimination of the marketing parastatals throughout the region (Herrera and Jimenez 1992, redefinition of the agricultural ministries' research and extension roles, and a progressive move towards an integrated Central American free trade zone.

Recent reforms implemented in Honduras are illustrative of structural adjustment policies promoted by the World Bank (WB), International Monetary Fund (IMF), and the United States Agency for International Development (USAID). In 1992, the Honduran Congress enacted the Agricultural Modernization and Development Law (LAM) which, when fully implemented, is expected to have a positive impact on the agricultural sector. Supporters of the LAM anticipate that the proposed reforms (i.e., price control deregulations, virtual elimination of the marketing parastatal role as a grain buyer/seller, and the promotion of a free trade agreement with the rest of Central America) will result in a more efficient allocation of financial, land, and human resources across commodity subsectors. Subsectors with regional and national comparative advantage are expected to surge; those with a marked comparative disadvantage will eventually decline in importance.

As a complement to these price and trade policies, the LAM proposes that the government reduce its financial support to agricultural research and extension services. Under the LAM the Directoire of Agricultural Research, Science, and Technology (DICTA) will be in charge of coordinating and promoting agricultural research and technology transfer programs with the expectation that the private sector will eventually respond by providing these services (La Gaceta 1992).

Due to donors' recommendations to rapidly implement a comprehensive SAP, the LAM was created with little empirical knowledge about existing micro-level relationships which affect the performance of specific commodity subsectors and the overall performance of the agricultural sector. Therefore, the Honduran government (GOH) is still trying to "come to grips" with how to implement parts of the LAM without alienating a large part of the population that consists of small farmers and poor urban consumers. For instance, the role of DICTA to date has been passive and its operating procedures not clearly understood among researchers within the Ministry of Natural Resources (MRN). Similarly, in late 1994, the government was still trying to indirectly maintain low basic grain prices through an export ban to Central America.

This paper uses a subsector approach to analyze some of the existing micro-level relationships which affect the performance of the Honduran bean (*Phaseolus vulgaris*) subsector, one of the

[1] Although Panama and Belize belong to the Central American region, in this paper Central America refers only to Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua, unless otherwise specified.

most dynamic commodity subsectors in Honduras. Beans constitute an important source of nutrients for both rural and urban consumers and are an important cash crop for over 109,000 bean growers (Secretaría de Planificación 1994). Therefore, through its effect on consumer and producer prices, the performance of the bean subsector has important political ramifications.

In 1994, annual per capita bean consumption was estimated at 12 kg (8 g of protein/person/day), second only to corn (108 kg; 28 g of protein/person/day). Moreover, official data highlight the relevance of beans as a cash crop. In 1992-1993 bean farmers sold approximately 55% of total production. The political sensitivity of beans was highlighted during the last quarter of 1993 (a presidential election year) when, in an effort to keep bean prices from spiraling upward, the GOH imported beans from the People's Republic of China, and decreed an export ban on beans to Central America. Despite continued efforts by USAID's Bean/Cowpea (CRSP), and the Swiss-funded Regional Bean Program (PROFRIJOL) to strengthen the capacity of the National Bean Program (NBP) to produce yield-increasing technologies, average bean yields in Honduras are still relatively low (690 kg/ha) and extremely variable from year to year.

In light of new empirical evidence regarding the impact of these policies, as the GOH continues to promote the LAM, it needs to reassess its role as a major catalytic force of economic development. Government officials play a key role both as facilitators and enablers of new market conditions, as well as supporters of agricultural research programs which are likely to have high social and economic pay-offs. Furthermore, government officials must recognize that national food price policies have a major impact on the role of technological progress (Krishna 1990), especially in a context where regional competitiveness will drive future investment decisions.

1.2. Objectives

To help improve the bean subsector's competitiveness, agricultural scientists and policy makers must seek to relax both production and marketing constraints. Designing strategies to accomplish this will require a more informed understanding of key production and marketing constraints within the subsector, best understood through the analysis of micro-level data.

The general objective of this paper is to use farm- and trader-level data to analyze existing market linkages and identify constraints facing bean traders and farmers, which limit the subsector's productivity within the context of an evolving regional market. The specific objectives of this paper are to:

1. describe the bean production system, including the salient characteristics of bean farmers and the technologies they utilize;

2. analyze the bean subsector's market structure and its behavior with respect to improved bean varieties;

3. assess the relevance of the Central American market for Honduran beans; and

4. highlight the implications of this analysis for both government policies and future socioeconomic and biological research agendas.

2. THE MODEL AND THE DATA

2.1. A Multi-disciplinary Subsector Approach

This paper employs a modified subsector approach to better understand bean farmers' key farm-level production characteristics and establish the relevance of the existing linkages between farm-level decisions and the market structure. Its goal is to identify constraints and opportunities for increasing the subsector's productivity. The original subsector paradigm was proposed by Shaffer (1973) as the study of "the vertical set of economic activities in the production and distribution of a closely related set of commodities." The vertical set of activities by which a commodity's value is increased includes input provision (including research), extension, farm production, processing, storage, assembly, transportation, wholesaling, retailing, financing, and consumption.

Since it first appeared in the literature, many researchers have modified the subsector approach to accommodate their specific research objectives and resource constraints (Morris 1986; Boomgard et al. 1992; Tschirley 1988). In the Honduran setting, this methodology contributes to generating a greater understanding of the bean subsector by prioritizing the study of productivity constraints and identifying policies to relax these constraints. In addition, it is an appropriate methodology for examining the effects of market conditions on the acceptability and adoption of newly released improved bean varieties. Byerlee and Franzel (1993) point out that the subsector approach generates information especially useful for policy makers and scientists when "a commodity or a region is undergoing rapid changes due to demand and supply factors or policy reforms."

As subject matter research, a subsector study can be adapted to the needs of multi-disciplinary research teams. This is an attractive feature for the present study, in which plant breeders and socioeconomists worked together to define research procedures and prioritize the issues on which the research would focus. For example, to generate insights needed to set priorities for the plant breeding programs, breeders considered it important to better understand the characteristics of production systems within different environments. On the other hand, socioeconomists saw the need to emphasize the potential links between markets and farmers' responses to new technologies, especially given the government's emphasis on market liberalization policies. Designed to incorporate both the interests stressed by plant and social scientists, the information generated by this research agenda is useful both to policy makers and plant scientists.

2.2. The Data

The results reported in this study are largely based on the analysis of primary data collected from farmers and traders in Honduras, using questionnaires developed by the authors in collaboration with the Bean/Cowpea CRSP and Food Security II Projects. As a multidisciplinary study, both plant scientists and agricultural economists were consulted in designing the questionnaire and selecting the farmer sample.

During 1993, the GOH – with the assistance of international donor agencies – conducted a National Agricultural Census (NAC). By April of 1994, data on staple food grains had already been computer digitized and partially analyzed. Therefore, the Honduran NAC represented a suitable and available sampling frame for selecting a sample of farmers.

Preliminary data analysis indicated that only one-third of Honduran farmers planted beans during 1993. Most of the Honduran bean producers were small farmers, traditionally considered self-sufficient, non-commercial farmers. Historical data show that over 60% of bean production takes place in the Mideastern and Northeastern Regions of Honduras. Therefore, given these bean production characteristics, the authors and collaborators decided to conduct the farmer survey in the Mideastern and Northeastern regions of Honduras, stratifying the farmer sample by farm size.

While stratification criteria (i.e., location, farm size) was based on the socioeconomic knowledge of bean farming in Honduras, insights provided by plant scientists were critically important to understanding the bean farmers' production system. For example, scientists had observed that the bean golden mosaic virus (BGMV), the most important bean disease for which scientists had introduced some resistance in the improved varieties, was most prevalent in the low inner valleys of Honduras' Mideastern region. Because scientists considered it important to stratify the farmers' sample across topographical regions, the sample of 215 farmers was distributed across two topographic regimes (flatland and hillside) and three farm sizes categories[2] (Table 1).

On the other hand, trader-level data were collected by visiting major regional markets and generating an ad-hoc sampling frame by asking individual traders to identify other traders who bought and sold basic grains. To represent Honduras's market diversity, five different market areas were visited and traders interviewed in each.

Table 1. Sample Distribution for Bean Farmers' Survey, Mideastern and Northeastern Regions, Honduras, 1994

	Bean Farmers (n) by Farm Size		
Topography	< 2 has	2-10 has	> 10 has
Hillside	26	49	29
Flatland	25	43	43

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

[2] While 239 farmers were interviewed, because of data inconsistencies, most data analysis was performed with a smaller sample of 215 farmers.

These areas included:

a. Tegucigalpa and San Pedro Sula, representing the largest urban-consuming centers of the country (18 traders);

b. Danli, Catacamas, and Juticalpa, the largest cities in the producing Mideastern and Northeastern Regions of Honduras (21 traders);

c. Comayagua, and El Progreso, representing mid-sized cities respectively located in the Central and Northern Regions of Honduras (10 traders); and

d. Santa Rosa de Copan, the largest urban center in the Western Region of Honduras (8 traders).

Based on a preliminary assessment of data provided by these 57 traders, it became clear that El Salvadorian traders play an important role in the Honduran bean market. Therefore, a rapid appraisal of the El Salvadorian bean marketing system was conducted by visiting the main basic grain markets in El Salvador.

3. THE BEAN FARMING SYSTEM

3.1. Characteristics of the Household

In this study the household is the primary unit of analysis. This is because socioeconomists, plant breeders, agronomists, and policy makers need to understand the basic characteristics of the decision-making unit to better design appropriate research and policy initiatives. Using the sample data, this section presents descriptive statistics about four household characteristics which are commonly found to influence the household's decision making process: family size, labor availability, age of the household head, and educational level of the household head.

Among surveyed bean farmers, households averaged 6.3 members (a median of six). However, about 75% of the households had eight members or less and 25% had four members or less (Table 2). In Honduras, larger rural families[3] are commonly thought to have sufficient labor to carry out time-demanding activities such as weeding and harvesting. While a significant positive correlation was found between family size and the number of family members working in the fields[4], larger families did not realize higher bean yields.

Contrary to conventional wisdom, a significant number of female household members participate in some kind of farming activity. While only 7% of the household heads were female, 21% of all female members older than 10 years reported working in the fields, most commonly contributing to harvest and post-harvest activities.

Table 2. Cumulative Distribution of Household Characteristics, 1993-1994

	Cumulative Distribution					
Household Characteristics	<= 10%	<= 25%	<= 50%	<= 75%	<= 90%	Mean
Number of Members	3	4	6	8	10	6.30
Formal Education (yrs)[a]	0	0	1	3	6	1.97
Age (yrs)[a]	32	39	50	61	74	50.78

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.
[a] Formal education (age) of household head.

[3] In this study, "family" is defined as all members permanently living in a household during the 1993-1994 agricultural year.

[4] The correlation coefficient of family size and number of members working in the fields is 0.5491 with a p-value=0.00.

Two other important household characteristics are the age and educational level of the household head. Among the sample, household heads average 50.8 years of age, while their median age was 50 years. As expected, larger farm size was associated with older age. For example, the average age of household heads farming 2 hectares or less was 44.6 years, compared to 50.7 and 55.5 years for household heads with medium and large-size farms[5].

Although education programs have been an important component of the GOH's development policies, literacy is still very low in the rural areas. According to the World Bank, 27% of Hondurans are illiterate with a higher rate of illiteracy in the rural areas (World Bank 1994). Among the sample, household heads had a mean of 1.97 years of formal education (a median of 1.0) and only 25% of the household heads reported three or more years education. While a positive relationship was found between farm size and the household head's education level, its level of statistical significance[6] was low.

3.2. Production Systems Across Seasons

In Honduras there are two well defined cropping seasons, the *primera* (rainy season) and the *postrera* (dry season). The rainfall patterns in these two seasons are markedly different, thus strongly influencing farmers' production patterns. In the *primera,* the rains are more abundant and are distributed almost evenly over a five month period (May through September). In contrast, during the *postrera (*October through January) rainfall is much lower and commonly absent during the second half of the season. Thus, how farmers' production systems differ across the two seasons has important implications for research and extension programs.

This section analyzes farmers' cropping patterns during both the *primera* and *postrera*. To enhance the analysis, farmers are grouped into three categories:

a. farmers who plant beans as a mono-crop;

b. those who plant beans as a mono-crop **and** inter-crop; and

c. those who only inter-crop beans, typically with corn.

In the Mideastern and Northeastern Regions of Honduras, where irrigation systems are scarce, farmers use land more intensely during the *primera* (wet season) than in the *postrera (*dry season). During the *primera, b*ean farmers allocated 54% of available land to crops, compared to only 40% during the *postrera*. Weather also influences the intensity of farmers' cropping patterns. For example, whereas 22% of the farmers planted inter-cropped beans during the

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[5] One-way ANOVA tests showed positive association between farm size and age (p-value=0.00).

[6] One-way ANOVA test showed a positive association with a p-value=0.21 between farm size and education level.

primera, only 3% inter-cropped beans during the *postrera.* Not surprisingly, corn – which requires more water than beans – is grown more extensively during the *primera* when rainfall is more abundant.

Although Honduran agricultural policies have traditionally favored larger farmers, data show that small farmers crop their available land more intensively. During both the *primera* and *postrera*, a strong negative association was found between farm size and cropped land, as a percentage of total land[7]. In addition, during the *primera*, flatland farmers tended to use their land more intensely than hillside farmers[8] (Table 3); mainly because corn, an important flatland crop, is more widely grown at this time.

While exploring how intensely farmers crop available land is important for determining the potential for increasing crop area, an analysis of the different crops farmers produce helps to explain what these farmers perceive as their agricultural alternatives. In terms of planted area, the most important crops grown by bean farmers were corn, beans, and coffee (Tables A-1, A-2, and A-3). While corn was the dominant crop in the *primera*, in the *postrera* beans comprised a larger share of the land than any other crop. Although the share of land planted to corn was not associated with farm size, strong evidence indicated that smaller farmers allocated a larger percentage of their cropped land to beans[9] than did larger farmers. This suggests that under the existing technologies and market environment, farmers can successfully plant corn in larger areas, whereas bean production is restricted to relatively small enterprises (i.e., < 2 hectares). Finally, while coffee is the third most frequently grown crop, it is the most widely grown crop among bean growers who also plant coffee (mainly hillside farmers), respectively accounting for 48% and 45% of total land cultivated by hillside bean farmers during the *postrera* and *primera*[10].

This overview of bean farmer land use provides insights for increasing bean production. It is clear that medium and large-size bean farmers have sufficient land to increase bean production. However, given the riskiness of bean production during the *postrera,* it is unlikely that these farmers will increase their area under cultivation without significant changes in policies/

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[7] Although pasture for cattle is not considered a crop in this analysis, cattle production is an important agricultural activity for only some of the larger farmers in the sample.

[8] During the *primera*, mono-crop farmers in the flatlands farm about 8% more available land than hillside farmers (significantly different at the 16% level), and inter-crop flatland farmers farm about 44% more available land than their hillside counterparts (significantly different at the 1% level).

[9] ANOVA analyses indicate that the percentage of all crop land planted in beans decreases as farm size increases, during both the *primera* and *postrera* (at a 1% level of significance). In contrast, evidence of such a relationship is weaker for corn (38% level of significance in the *primera*).

[10] Among coffee/bean farmers, in the *postrera* the number of hectares of cultivated land under coffee is 22% larger than for beans (1% level of significance). In the *primera* the cultivated land under coffee is 11% larger than for corn (10% level of significance).

Table 3. Proportion (%) of Available Land Planted in Different Cropping Systems[a], Mideastern and Northeastern Regions of Honduras, 1993-1994

	Primera						*Postrera*			
	Mono		Mono/Inter		Inter		Mono		Inter	
Sampling Strata	n	Mean Media	n	Mean Median	n	Mean Median	n	Mean Median	n	Mean Median
All Farmers	108	52% 50%	5	49% 50%	26	64% 53%	186	39% 32%	6	72% 76%
Farm Size in has										
< 2	19	75% 83%	0		10	94% 100	45	60% 57%	4	69% 76%
2-10	46	65% 67%	5	49% 50%	9	48% 46%	77	43% 38%	1	n.a. n.a.
> 10	43	29% 21%	0		7	41% 27%	64	19% 13%	1	n.a. n.a.
Topography										
Flatland	49	56% 52%	2	58% 58%	7	96% 60%	97	40% 32%	0	
Hillside	59	48% 46%	3	44% 50%	19	52% 43%	89	38% 32%	6	72% 76%
Region										
Mideastern	69	50% 47%	4	47% 40%	22	62% 53%	126	41% 30%	6	72% 76%
Northeastern	39	56% 55%	1	n.a. n.a.	4	72% 51%	60	35% 32%	0	

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

[a] Mono-crop farmers only plant beans as a mono-crop; mono/inter-crop farmers plant beans as a mono-crop and as an inter-crop; and inter-crop farmers only plant beans as an inter-crop.

technologies which could enable producers to better cope with the unpredictable nature of rainfall. Moreover, it is important to recognize that hillside farmers – with a potential to grow coffee – have even less incentive to increase the amount of land under bean production than do flatland farmers who are mainly staple grain producers.

3.3. Use of Modern Technologies

In general, farmers apply modern inputs to increase yields (e.g, fertilizers, improved varieties), reduce labor requirements (e.g., herbicides), or reduce the risk of losses from disease and insect attacks (e.g., fungicides, insecticides, improved varieties). Since farmer input choices reflect both their circumstances and assessment of available technologies, policy makers and scientists

must understand how farmers use chemical inputs and improved varieties, as well as how their adoption decisions vary across farm size and topographical environments *(*flatlands, hillsides).

Input use across cropping seasons is an indicator of farmer willingness to make cash investments in one season versus another. In the study area, farmers demonstrated a stronger preference for applying inputs to bean fields during the *postrera*. For example, in 1993, 46% of the farmers applied inputs during the *postrera*, compared to only 35% during the *primera*. These results further confirm the greater importance that farmers place on *postrera* versus *primera* bean production.

3.3.1. Chemical Input Use[11] and Farm Size

Seasonal analysis by farm size helps to clarify the basic characteristics of input users (Table 4). Traditionally, the NBP and policy makers have considered larger farmers to be more progressive. However, these data show no significant association between farm size and farmers' purchased chemical input use. This evidence supports the proposition that, in general, chemical input use is similar for small and large farmers. While this study did not generate the kind of quantitative data required to analyze the level of input use by farm size[12], differences in the intensity of input use across farm size are typically explained by institutional variables such as access to credit and extension services, and proximity to input markets (Mekuria 1994). Thus, greater access to these ancillary services by larger farmers reinforces the already existing institutional bias acting in their favor, and helps to explain the differential behavior of small versus large farmers.

3.3.2. Chemical Input Use and Topography

While beans are more widely grown in the flatlands than hillsides, flatland farmers are not more likely than hillside farmers to use chemical inputs. Rather, the data showed similar proportions of flatland and hillside farmers applying these inputs. For example, while over 40% of both the mono-crop flatland and hillside bean farmers used inputs during the *postrera*; only 30% of their *primera* counterparts did so. This evidence suggests a need to reconsider the conventional belief that larger, flatland farmers are more progressive than smaller, hillside farmers.

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[11] In this section chemical inputs refer to purchased inputs – fertilizers, insecticides, herbicides, and fungicides ("chemical inputs" and "inputs" are used interchangeably). Input use is measured as a dichotomous variable (i.e., use versus not use), rather than by intensity of use. "Input user" refers only to farmers who apply inputs to bean fields.

[12] Data on input use were hard to obtain, especially for insecticides. Since insecticides are frequently purchased as fluid products, it is very difficult to standardize measuring units and concentrations.

Table 4. Bean Farmers (%) Using Chemical Inputs by Farm Size, Topography, and Administrative Region, Honduras, 1993-1994

	Primera				*Postrera*	
	Mono-Crop		Inter-Crop		Mono-Crop	
Farm Strata	(n)	%	(n)	%	(n)	%
Farm Size has						
< 2	(19)	32	(10)	50	(45)	42
2-10	(46)	35	(9)	44	(77)	44
> 10	(43)	30	(7)	43	(64)	48
Topography						
Flatland	(49)	35	(7)	43	(97)	47
Hillside	(59)	31	(19)	47	(89)	43
Region						
Mideastern	(69)	39	(22)	50	(126)	51
Northeastern	(39)	21	(4)	25	(60)	33

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

3.3.3. Chemical Input Use by Administrative Region

While in the past decade basic grain production in the Northeastern Region has increased faster than in the Mideastern Region, Northeastern bean farmers practice more traditional production systems and apply chemical inputs less frequently than do farmers in the Mideastern Region. For instance, among surveyed farmers, about 20% fewer of the Northeastern farmers used inputs than did their Mideastern counterparts, regardless of the production system followed *(*mono-crop, inter-crop). This marked difference in the use of chemical inputs between these two regions may reflect the fact that the NBP has concentrated its research and extension work in the Mideastern region, and that Northeastern farmers have had less access to formal credit services.

It is clear that average bean yields for input users are higher than for non-users. During the *primera*, input users averaged 610 kg/ha; non-users averaged 490 kg/ha. During the *postrera*, the difference was even larger. Input users averaged 690 kg/ha; non-users only 440 kg/ha[13]. This suggests that further analysis of factors that limit chemical input use among farmers could help improve bean productivity in the Mideastern and Northeastern Regions of Honduras.

[13] This yield difference is significant at the 1% level during the *postrera*, and at 18% level of significance during the *primera*.

3.3.4. Farmers' Use of Improved Bean Varieties and Topography

During the past decade, the NBP's most important bean-related research and extension activity has involved the development and release of improved bean varieties. The releases of Catrachita in 1987 and Dorado in 1990 represent the most important achievements of the NBP[14]. While Catrachita was released for its yield potential, it did not tolerate the most virulent bean disease in the inland valleys, BGMV. Further research and trials led to the release of Dorado, a bean variety tolerant to BGMV[15]. Although at the time of this study, Dorado and Catrachita had been widely adopted by farmers in the *altiplano* region of Danli (where the NBP had a pilot program of an artisan bean seed distribution system), there was little empirical knowledge about their adoption in other regions of the country. The rest of this section presents data on farmer adoption of these improved varieties[16] during 1993-1994 across different topographical environments, administrative regions, and farm sizes. This section also analyzes how bean yields vary among adopters[17] and non-adopters of improved varieties.

In Honduras, topographical environments have strongly influenced the adoption of improved varieties. While Catrachita is planted more often by hillside farmers than flatland farmers, Dorado is grown with the same frequency by hillside and flatland farmers. While 37% of hillside farmers used Catrachita, only 11% of flatland farmers planted this variety (Table 5). The difference in Catrachita adoption rates across topographies reflects its low tolerance to BGMV, which is more virulent in the low valleys. On the other hand, Dorado has shown tolerance to this disease. This evidence suggests that as farmers acquire knowledge about the different characteristics of specific improved varieties, they make selective decisions about their use.

3.3.5. Use of Improved Bean Varieties and Administrative Regions

To acquire personal knowledge about the potential of new technologies, farmers must be exposed to them. Therefore, it is logical to expect that farmers in regions where there is greater access to modern technology are more likely to adopt new technologies. In Honduras, the evidence shows that farmer adoption of improved varieties is influenced by proximity to ancillary services such as extension and research activities. As expected, the use of improved varieties is higher in the Mideastern Region where the NBP has concentrated its efforts. While 27% of Mideastern Region farmers grew Catrachita or Dorado, only 16% and 7% of the Northeastern farmers planted Catrachita and Dorado, respectively (Table 5).

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[14] In addition, Don Silvio, a variety bred from similar genetic sources as Dorado, was released in 1993.

[15] Dorado (DOR-364) was also released in Nicaragua and El Salvador under different commercial names.

[16] In this study, improved varieties refer to Catrachita and Dorado unless otherwise specified.

[17] Adopters of improved varieties refers to those farmers who planted either Dorado or Catrachita during the 1993-1994 agricultural year. Non-adopters refers to farmers who planted neither of these two varieties.

3.3.6. Use of Improved Bean Varieties and Farm Size

While there is little evidence that the use of Dorado is associated with farm size, the data indicate that Catrachita adoption is positively correlated with farm size. While 19% of farmers owning 10 hectares or less use Catrachita, 32% of farmers with greater than 10 hectares plant Catrachita (Table 5). This result may suggest that Catrachita has characteristics which favor larger farmers. For instance, both traders and producers have stated that, while Catrachita has undesirable culinary characteristics[18], its appearance is acceptable in some Honduran markets. These traits make Catrachita more acceptable among farmers who tend to sell a larger proportion of their bean production. Nevertheless, it is possible that the association between farm size and Catrachita use is simply due to larger farmers having had more access to it.

Table 5. Farmers Using Improved Bean Varieties (%), Mideastern and Northeastern Regions, Honduras, 1993-1994

	Improved Varieties	
Strata	Catrachita (n=50)	Dorado (n=44)
Administrative Region		
Mideastern (n=144)	27%[a]	27%[b]
Northeastern (n=70)	16%[a]	7%[b]
Topographical Region		
Hillside (n=104)	37%[c]	18%
Flatland (n=110)	11%[c]	23%
Farm Size in has		
< 2 has (n=52)	19%[d]	19%
2-10 has (n=91)	19%[d]	23%
> 10 has (n=71)	32%[d]	18%

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

[a] Significantly different across administrative regions, p-value of 0.04.
[b] Significantly different across administrative regions, p-value of 0.00.
[c] Significantly different across topographical regions, p-value of 0.00.
[d] Positive association between use of Catrachita and farm size, p-value of 0.08.

[18] Farmers and traders reported that Catrachita becomes "mooshy" after cooking, thus losing the characteristic texture proper to traditional varieties. On the other hand, Catrachita is a small, red, round bean preferred in some markets.

3.3.7. Improved Bean Varieties and Yields

The data show that the yield performance of improved bean varieties is influenced by environmental conditions. While bean yields of Dorado adopters versus non-adopters were significantly higher only during the *postrera*, yields were significantly higher for Catrachita adopters only during the *primera.* Although Catrachita appeared to be a higher yielding variety during the *primera* and Dorado during the *postrera*[19] (Table 6), this result may be partly due to a season-pathogen interaction. While environmental conditions during the *postrera* are more suited to the BGMV vector (white fly), fungal diseases are more prevalent during the *primera*. Thus, Dorado performs relatively better than other varieties when the virus is present. In addition, higher bean yields among Dorado adopters during the *postrera* may be influenced by the use of chemical inputs. While there is no significant association between input users and Catrachita adopters during the *primera*, a significant association exists between Dorado adopters and input users during the *postrera* (70% of Dorado adopters also apply other chemical inputs). This suggests that higher average bean yields among Dorado adopters are in part due to greater chemical input use.

Although it is clear that the environment-variety interaction is an important factor in farmers' adoption decisions, farmers' varietal choices are influenced by additional factors. At first glance, farmers' initial varietal selection criteria appear to be similar to the objectives guiding a typical plant breeding program. In the Mideastern and Northeastern Regions of Honduras, a large proportion of farmers reported that their primary reason for planting a variety was its high yield potential. Among farmers who planted Dorado or Catrachita, 40% listed their yield potential as

Table 6. Bean Yields Among Adopters of Improved Bean Varieties, Mideastern and Northeastern Regions, Honduras, 1993-1994

	Adopters		
Season	Catrachita	Dorado	Non-Adopters
Primera	620[a] kg/ha	430 kg/ha	430[a] kg/ha
Postrera	600 kg/ha	730[b] kg/ha	520[b] kg/ha

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

[a] Significantly different between adopters vs. non-adopters, p-value of 0.09, (t-test).
[b] Significantly different between adopters vs. non-adopters, p-value of 0.03, (t-test).

[19] In Table 6, yields for Catrachita and Dorado adopters are reported separately (i.e., an adopter of both varieties is not taken into account in the computation of averages). However, these results may underestimate the yields of the improved varieties because they represent an average bean yield which includes all traditional varieties planted by improved variety adopters.

the first reason for adopting the varieties. Similarly, among farmers who grew all other varieties, 35% identified yield potential as the primary reason for selecting their preferred variety. Farmers' second most frequently cited selection criterion – resistance to BGMV – is closely related to yield potential. For example, 19% of Dorado adopters reported BGMV resistance as their first selection criterion, while 21% of Catrachita growers listed some kind of resistance as their primary selection criterion (i.e., no specific reference to a single disease). Among farmers growing other varieties, 21% reported an ability to escape droughts (i.e., a short physiological maturity period) as their primary reason for selection. During the *postrera*, since almost one-half of the respondents stated that weather-related problems (i.e., droughts) represent the most limiting production constraint, these results show that farmers introduce risk parameters into their decision-making process when selecting a specific variety. In turn, this suggests that promising lines should continue to be evaluated under risky environments as a means for simulating farmer conditions.

4. THE BEAN MARKETING SYSTEM

The performance of a commodity subsector is strongly dependent on the linkages between its production and marketing systems. A better understanding of this relationship will enable Honduran policy makers to fine-tune government-initiated institutional reforms focused on market-level changes. This section describes the relationship between the bean marketing and production systems, highlighting important implications for researchers and policy makers.

4.1. Farm Sales

In Honduras, little research has been conducted on the sales behavior of basic grain farmers. Conventional wisdom assumes that small farmers are self-sufficient, and that beans are not an important commercial crop. This section describes bean farmers' sales behavior, disaggregated by farm size, analyzes the importance of bean sales relative to total farm sales, and assesses the relationship between farmers' commercial orientation and the use of improved varieties.

Bean farmers may be classified into three groups, according to their commercial orientation:

a. non-sellers – the 18% who did not report any farm sales;

b. non-bean sellers – the 32% who reported selling farm products other than beans; and

c. bean sellers – the 50% who sold beans.

Fifty percent of the sampled bean farmers reported no bean sales (i.e., non-sellers plus non-bean sellers). Of these households, over one-third (40% of the non-sellers and 35% of the non-bean sellers) found it necessary to purchase beans because they did not produce enough to meet their household requirements. This finding – that 19% of the total sample of bean-producing households were net buyers – contradicts the notion that all bean farmers are self-sufficient. It also suggests that seasonal price fluctuations can have a major impact on the real incomes of rural net buyers, who typically purchase beans late after harvest when prices are highest.

For the 50% of the bean farmers who sold beans, their mean income from total farm sales was lempiras (Honduran currency) (Lps) 10,400 (median was Lps 3,800), as shown in Table A-4. By including non-farm income, their mean income rose to Lps 15,000 (median was Lps 5,400). The remainder of this section analyzes the characteristics of these bean sellers, focusing on differences by farm size, topographical region, and whether or not they planted improved bean varieties.

In analyzing farmers' market orientation, it is important to distinguish between bean sellers and net bean buyers. While 15% of bean sellers purchased beans between May 1993 and April 1994,

none bought more beans than they sold during the agricultural year[20]. Therefore, all bean sellers were net sellers of beans. Nevertheless, not all bean sellers are equally market-oriented. While some only sold surplus beans (i.e., beans produced in excess of the household's demand), others grew beans with the clear intention of selling them. This suggests that a portion of the net sellers are residual sellers (not strongly market oriented). To better understand bean sellers' market orientation, three variables are studied: total bean sales in kilograms and lempiras, proportion of beans sold as a percent of total production; and percent of total farm sales from beans.

Among bean sellers, the net quantity sold averaged 830 kg (a median of kg 360), which generated a mean income from beans of Lps 3,400 (a median of Lps 1.200). As expected, there is a significant positive association between farm size and total bean sales[21]. On average, small farmers (<= 2 has) sold 260 kg, equivalent to a mean bean sale income of Lps 950. In contrast, average sales for medium and large farmers were 800 kg and 1,200 kg, respectively (respective mean incomes of Lps 3,000 and Lps 5,300). Moreover, bean sales are associated with topography. Hillside bean sellers sold an average of 530 kg (a mean income from beans of Lps 2,050). Flatland farmers sold almost twice this amount, averaging 1,060 kg and earning a mean of Lps 4,400. These data support the hypothesis that small farmers and hillside farmers are more likely to be incidental or residual bean sellers[22].

Analysis of the sales behavior of market-oriented versus incidental sellers further supports the above hypothesis. To define market-oriented and incidental bean sellers, the median amount of beans sold was taken as the cut-off point. Thus, farmers who sold less than 364 kg were considered incidental sellers, whereas those who sold more than 364 kg were considered market-oriented sellers. Using this classification, only 32% of small farmers are market-oriented, compared to 50% and 65% of medium and large farmers (Table 7). Similarly, a higher proportion of flatland bean sellers are market-oriented (65% versus 35% for hillside sellers).

However, it is also important to determine the relative importance of these bean sales. On average, bean sellers marketed 50% of the beans they produced, and bean sales accounted for 64% of total income from farm sales. Comparing bean sales percentages by farm size indicates that medium size farmers sold a higher percentages of their bean crop than either small or large farmers (55% compared to 44% and 48%). Additionally, flatland bean sellers sold a higher percentage of their bean crop than hillside sellers, supporting the previous finding that larger and flatland farmers sell more beans.

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[20] Farmers were asked to recall their bean purchases and sales for two distinct time intervals: from *primera* 1993 until before the planting of *postrera* 1993-1994, and from the planting of *postrera* 1993-1994 until April of 1994 (the month before the survey started).

[21] ANOVA-tests of net kg and net Lps sold, by farm size, had respective p-values of 0.05 and 0.05.

[22] A comparison of average bean sales by small and large hillside and flatland farmers supports this assertion. Small hill-side farmers sold 210 kg and small flat-land farmers sold 310 kg (p-value = 0.14). In contrast, large hill-side farmers sold 690 kg and large flat-land farmers sold 1,450 kg (p-value = 0.14).

Table 7. Market-Oriented and Incidental Bean Sellers by Farm Size and Topography, Honduras, 1993-1994

	Market-Oriented Sellers		Incidental Bean Sellers	
Bean Farmers Strata	%	(n)	%	(n)
Farm Size in has[a]				
Small < 2	32	(7)	68	(15)
Medium 2-10	50	(22)	50	(22)
Large > 10	65	(26)	35	(14)
Topography[b]				
Flatland	65	(40)	36	(22)
Hillside	34	(15)	66	(29)

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

[a] Chi-Square test shows positive association with farm size (p-value=0.04).
[b] Chi-Square test shows significant association across topography (p-value=0.00).

On the other hand, for small and hillside farmers bean sales account for a higher proportion of total farm income than for large farmers (Table 8). This suggests that, although large farmers and flatland farmers are more market oriented (in absolute terms), bean sales are a relatively more important source of farm income for incidental sellers (who are more likely to cultivate smaller farms in the hillsides). Therefore, efforts to increase smaller and hillside farmers' bean yields – which are positively correlated to net sales – would greatly benefit them by expanding their sales opportunities and ability to achieve food self-sufficiency through increased market-orientation.

Section 3 confirmed a positive correlation between farmers' use of improved varieties and bean yields. Clearly, improved varieties represent a feasible technological alternative for improving farmers' well-being, especially if varieties are available that perform well under different environmental conditions. Moreover, farmers who plant improved varieties sell more beans than those who do not. On average, bean sellers who adopted improved varieties marketed 1,080 kg of beans, whereas those who planted traditional varieties marketed only 660 kg[23]. While these results suggest that the greater yield potential of improved varieties may expand economic opportunities for improved variety adopters, the next two sections explore market disadvantages commonly associated with the improved bean varieties.

[23] Using a t-test for independent samples, these figures were found different at p-value=0.191.

Table 8. Beans Sold (%) and Proportional Contribution of Bean Sales to Farm Income by Farm Size and Topography, Honduras, 1993-1994

	Percent of Beans Sold		Percent of Sales From Beans	
Bean Farmers Strata	%	(n)	%	(n)
Farm Size (has)				
Small < 2	44[a]	(23)	90[b]	(23)
Medium 2-10	55[a]	(42)	65[b]	(42)
Large > 10	48[a]	(39)	48[b]	(38)
Topography				
Flatland	53[c]	(61)	57[d]	(60)
Hillside	46[c]	(43)	74[d]	(43)

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

[a] Using One-Way ANOVA test, significant positive association with farm size (p-value=0.14).
[b] Using One-Way ANOVA test, significant positive association with farm size (p-value=0.00).
[c] Using t-test for independent samples, significantly different across topography (p-value=0.11).
[d] Using t-test for independent samples, significantly different across topography (p-value=0.02).

4.2. Bean Market Structure

4.2.1. The Marketing System at the Farmer Level

This section analyzes the marketing links between sampled bean sellers and other market participants, focusing on two aspects of farm-level trading activities: the types of traders with whom farmers transact, and the geographical distribution of sales.

Since implementation of the Law of Agricultural Modernization and Development, which proposed reducing the role of the Honduran Institute of Agricultural Marketing (IHMA), the popular media has portrayed private grain traders as middlemen who take advantage of uninformed, uneducated farmers by setting unfairly low farm-gate prices. Moreover, officials from the Ministry of Economics have argued that traders in the major cities decrease consumer welfare by colluding to set non-competitive, high, rent-seeking prices. Moreover, policy makers, arguing that the existing market information system is inefficient, have proposed that the government publish market prices for each level of the marketing system, in order to help farmers and consumers make better decisions about food sales and purchases. Although there exists little empirical evidence to substantiate these assertions, the analysis presented in this section helps to inform these issues.

In general, farmers sell their beans to local village store traders (*pulperos*), regional traders or intermediaries, city wholesalers (*bodegueros*), or neighbors and/or relatives. Survey data show

that 77% of sales were made to regional traders, while wholesalers bought 11%. Neighbors and *pulperos* accounted for the remaining 12% of bean purchases[24]. As expected, these sales take place at either the farm-gate or in a nearby village (93%), suggesting that farmers without widespread access to market information, in places where there is only a low level of trader competition, could encounter traders who set buying prices at lower levels than in competitive markets.

However, the survey data only partly support this assumption. When asked why they sold beans to a given trader, farmers reported that the trader was the only one in the region at the time of the transaction (27%), paid the highest price (27%), lent him/her money before the harvest (12%), or was a friend or relative (8%). These results suggest that in at least 39% of the cases, farmers had limited market options, since there was only one trader in the region or the farmer had to honor a loan. Although farmers selling beans to potentially colluding traders received a lower price on average than farmers selling beans to other traders (Lps 3.81/kg versus Lps 4.06/kg), the difference in price is not statistically significant[25]. In addition, given that most farmers who sold beans to potential colluders were in remote areas (68%), this difference may actually reflect higher transportation costs to remote areas[26]. Moreover, hillside farmers, who generally live in remoter areas, received lower average bean prices (Lps 3.78/kg) than flatland farmers (Lps 4.12/kg)[27]. Thus, while there may be a potential for traders to collusively buy beans at lower price levels in remote areas, the data suggest a need to better understand the cost structure among different traders in the marketing system before concluding that the price difference is due to collusion.

4.2.2. The Marketing System at the Trader Level

To map out the Honduran bean marketing system, 57 traders were interviewed in the major trading cities of Honduras. Wholesalers[28] in these cities were interviewed because they were considered the best source of information for determining how beans are transferred from the farm-gate to consumers[29].

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[24] In this section, "sales" and "transactions" are used interchangeably. Either refers to a single transaction whereby a farmer sells beans, unless specified otherwise.

[25] A t-test for a comparison of means shows a p-value of 0.28.

[26] Remote areas are defined as villages which are two or more driving-hours from a major trading center.

[27] A t-test for a comparison of means shows a mean difference of Lps 0.34/kg, at a p-value of 0.11.

[28] Bean wholesalers are defined as traders who normally buy more than 130 kg of beans, have a fixed sales point in the city (normally close to the major city market), and normally sell in quantities greater than 45 kg. However, they may also sell smaller quantities to end consumers.

[29] Given the time constraint, no independent truckers (intermediaries) were included in the trader survey.

Data collected from farmers and wholesalers indicate that intermediaries (independent truckers and wholesalers in the production cities) are an important link in the transfer of beans from the farm-gate to large city consumers (Tegucigalpa and San Pedro Sula). In fact, all of the wholesalers in the largest cities reported buying beans mainly from intermediaries. Seventy-two percent of interviewed traders from the largest cities also reported buying beans occasionally from producers who traveled to the main market.

While 95% of traders located in the production zones reported purchasing beans from farmers who arrive at the main market, only 62% reported purchasing beans from independent truckers. At the time these wholesaler interviews were carried out, the *primera* harvest had recently taken place in the Mideastern Region. In Danli (Mideastern Region), the survey team observed farmers who visited the main market and searched for different traders in an effort to find the trader who would pay the highest price, and/or a transporter who would charge the lowest price for hauling beans from the farm-gate to the city. In contrast, bean farmers in the Northeastern Region visited market towns less frequently. In Juticalpa and Catacamas, cities located in the less densely populated area of Olancho, wholesalers traveled to the farms using their own trucks or bought beans from independent small truckers.

This suggests that in the main production areas, farmers who live closer to the major trading towns receive a fairly competitive price. It is also logical to expect that farmers, who determine price levels through market visits, communicate this information back to relatives and neighbors in the villages from which they come. These results further support the evidence that farmers in more accessible areas receive higher prices than farmers living in more remote regions.

Additional results highlight the importance of intermediaries in the Honduran bean marketing system. Most traders interviewed in the largest cities and mid-sized cities (84% in large cities like Tegucigalpa and San Pedro Sula versus 90% in mid-sized cities like Comayagua and El Progreso) buy beans at their place of business. These traders cited market competitors and the cost of transport as the two main reasons for buying beans primarily at their place of business in the city. Wholesalers argued that if they traveled to the farming areas to buy beans, other competitors would reduce their market share by buying beans from incoming intermediaries. Likewise, city wholesalers claimed that because intermediaries have greater expertise in buying beans from the production areas, they can gather and transport beans from the farming areas at less cost than a city wholesaler.

The final link in the marketing chain (farm-gate to consumer) involves the market participants to whom wholesalers sell beans. Most traders (79%) reported selling beans directly to consumers. As expected, since wholesalers in the largest cities are more specialized, only 67% reported selling beans directly to consumers. However, virtually all wholesalers in the largest cities (94%) sold beans to retailers. Thus, the primary role of the wholesaler in the largest city is to

provide retailers with enough beans throughout the year[30]. In contrast, in the mid-sized cities and small cities in the production areas, wholesalers both sell directly to consumers and supply retailers with beans throughout the year.

While less frequently mentioned, traders who purchase beans for subsequent resale in El Salvador represent an alternative market for wholesalers. Over 50% of all interviewed traders reported selling beans to El Salvadorian traders, these export-oriented sales were more common among traders residing in the largest cities (61%) and the production areas (61%) than among traders in mid-sized cities (41%). However, these figures may under-represent the magnitude of bean transactions with El Salvador. At the time of these interviews, traders in San Pedro Sula were more reluctant to talk about transactions with El Salvador than were traders in Tegucigalpa. This was mainly because officials of the Ministry of Economics in San Pedro Sula were stricter about penalizing traders who violated a January 1994 bean export ban to any Central American country. Later interviews in El Salvador confirmed the hypothesis that bean trade with El Salvador was more prevalent than reported by traders in San Pedro Sula. For example, several traders in El Salvador confirmed that they had bought beans from traders in San Pedro Sula who, when interviewed, had denied having conducted any transactions with El Salvadorian traders.

4.3. Bean Preferences in the Market

While the NBP and the Bean/Cowpea CRSP-Zamorano have focused on breeding improved varieties that mitigate key production constraints (e.g., multiple disease tolerance), lead researchers at these institutions have given priority to developing improved varieties that incorporate attributes preferred by end-users (processors, traders, consumers). For instance, in selecting varieties for the Mideastern and Northeastern Regions, the breeding program screens out genetic materials outside the acceptable small, red bean market classes. Moreover, the NBP has released small, black bean varieties for the Western and Central Regions where black beans are in higher demand. Despite this, little documentation exists as to the preferred market attributes of beans among farmers or traders, or how these preferences are reflected in the market prices of different bean varieties.

This section examines bean quality preferences, as expressed by farmers and traders, and provides the background needed to analyze the trade-offs between bean quality and price[31]. Data were elicited both from farmers (net sellers of beans) and traders in the same way. First, farmers

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[30] In Tegucigalpa and San Pedro Sula, market informants reported that some large traders specialized in storing beans solely for the purpose of supplying smaller wholesalers throughout the year. These traders are able to profitably store beans for future sale by financing their purchases through the formal banking system at lower interest rates than those available to farmers in the informal financial market.

[31] While the preferred market characteristics of beans include both physical and chemical properties, the analysis of chemical characteristics is beyond the scope of this paper. However, as information about a particular variety spreads in the market, both traders and farmers associate varieties with specific, non-physical properties.

and traders were asked to list what they consider the three most important market attributes of beans. This information was used to determine how well farmers could identify market preferences and obtain better information about preferred market attributes for beans. Additionally, both traders and farmers were shown samples of eight bean varieties. These samples included three recently released improved varieties and five traditional varieties, including a small black bean variety. Farmers were asked to rank, in order of preference, the three varieties they could sell most easily at the highest price. Similarly, traders were asked which varieties they would buy and what prices they would offer. Finally, traders were asked to identify which varieties they would sell to traders from other Central American countries. This information was used to determine price differences across bean varieties. In addition, the information can be used by bean researchers to further determine which non-physical characteristics influence market preferences.

Survey data showed that farmers distinguish four broad market preference categories. First, farmers said that traders strongly prefer red beans, especially lighter-colored red beans. Second, according to farmers, traders desire a good-quality bean (i.e., beans with no impurities, low humidity content, stocks containing only one variety of bean, and stocks not physically damaged from weevils or harvesting). Third, farmers reported that traders consider culinary characteristics, like softness and flavor. Finally, farmers prefer to sell small, somewhat elongated beans. Thus, the opinion among bean sellers was that traders look mainly for a good quality red bean (Table A-5).

Data collected from bean traders confirmed that bean farmers are well informed about market preferences. However, traders reported that they consider general good-quality characteristics (i.e., no impurities, free of weevils, and sun dried) more important than color characteristics[32] (Table A-6). Cleaner beans command a higher price because they reduce the cost of processing, and traders' preference for dry, weevil-free beans reflects their propensity to store beans.

The farmers' assessment of bean varieties confirmed that bean sellers accurately identify trader preferences. The eight bean varieties included in the sample may be grouped into five general market classes: 1) a small black bean was used to represent black beans; 2) Dorado and Don Silvio – both improved varieties – to represent small, dark-red beans; 3) Catrachita – an improved variety – to represent small, round, red beans; 4) Chile and Cuarenteño to represent small, red beans; and 5) Zamorano and Seda to represent small, light-red beans. Both farmers and traders agreed that the most marketable varieties were the small, light-red beans. A majority of bean sellers (56%) reported that small, light-red beans were most marketable, followed by small reds (20%), and Catrachita (18%). Similarly, most traders considered small, light-red beans the most marketable (62%), followed by small reds (20%), and Catrachita (18%).

As expected, traders priced Seda and Zamorano the highest. In contrast, they gave the small black bean and the two dark-red varieties – Dorado and Don Silvio – the lowest market prices

[32] This suggests that although some traders buy black beans, most beans in the market belong to the small, red market class.

(Table 9). While most traders reported a buying price for Seda, only a portion of the traders reported a price for the rest of the varieties. Nonetheless, these price data were used to compare market prices across different varieties, using a paired comparison of prices for two different varieties to assess the statistical significance of the price spread.

The prices of Dorado and Catrachita – the most widely grown and traded improved varieties – were compared with the average price of Seda, the most preferred traditional variety. Traders consistently priced Seda higher than the improved varieties (19% higher than Dorado; 12% higher than Catrachita)[33].

Most traders priced Dorado lower than the other varieties, because Dorado is a small dark-red bean which, according to traders, customers are less willing to purchase when small light-red beans are available in the market, even when light-red beans are priced higher. Traders argued that, early after harvest, the markets are flooded with high quality small light-red beans. Thus, the bulk of small, dark-red beans are not sold until light-red bean stocks are low, causing the price of small, light-red beans to rise sufficiently high so that customers are then willing to buy *lower quality* small, dark-red beans. Traders also argued that the need to carry over small, dark-red beans for later sale increases storage costs, which are covered by paying suppliers a lower price at harvest.

Table 9. Average Intermediary Price for Different Bean Varieties in Major Markets, Honduras, August 1994

	Average Bean Price	
Bean Variety	Lps/kg	(n)
Seda	5.06	(55)
Zamorano	5.03	(30)
Cuarenteño	5.02	(30)
Chile	5.00	(20)
Catrachita	4.67	(25)
Dorado	4.53	(31)
Don Silvio	4.30	(17)
Small-Black	3.67	(23)

Source: Survey of Honduran Bean Traders, 1994, Bean/Cowpea CRSP and Food Security II.

[33] A t-test for paired samples showed that Seda commands a higher price than Dorado and Catrachita at a p-value of 0.00 in both cases.

On the other hand, bean traders argued that Catrachita – a small, round, red bean – is priced lower than Seda because demand is limited. While Honduran customers purchase Catrachita, El Salvadorian customers do not. According to those interviewed, El Salvadorian traders are willing to buy any small, red beans, except Catrachita – mainly because of its unacceptable cooking characteristics[34]. This opinion coincides with what farmers reported as the least desirable characteristic of Catrachita.

In addition to explaining the price difference between Catrachita and Seda, this information confirms that the El Salvadorian market is an important source of demand for Honduran beans. While official data recording the transfer of beans from Honduras to El Salvador is unreliable, making it difficult to estimate the volume of trade, a majority of the traders (58%) said they had sold beans to El Salvadorian traders at least once during the past year. Furthermore, these traders agreed that Seda (or similar varieties) was the preferred bean type among El Salvadorian traders. A comparison of the wholesale price of Seda destined for Honduran versus El Salvadorian markets, suggests that traders expected to sell Seda at a 16% price premium to customers in El Salvador[35].

4.4. The Market Performance of Improved Varieties

While farmers highlighted "yield potential" as the most desired characteristic of the improved varieties, most also reported poor market performance as their least desired characteristic. In addition, the data confirm that improved varieties command a lower market price than traditional varieties. As in the case of modern rice varieties in Southeast Asia (Unnevehr, Duff, and Juliano 1992) and corn in Africa (Rubey, Ward, and Tschirley 1995), undesirable market attributes may limit widespread adoption of higher-yielding cultivars, especially if the greater yield potential can only be observed under specific conditions (e.g., optimal rainfall, high disease pressure).

This section presents two scenarios for analyzing the market performance of the improved varieties. It first compares the gross revenues of improved versus traditional beans grown during the *primera.* It then compares gross revenues of both bean types when grown during the *postrera*. This analysis incorporates several assumptions. First, it assumes that the farm-level and trader-level data accurately reflect yield and price differences between traditional and improved varieties. Second, while the price data presented in the previous section were collected after the *primera* harvest, it assumes that relative prices remain the same for the *postrera* harvest. Third, it assumes that the costs of production for traditional and improved varieties are the same. Fourth, it assumes that all traditional varieties, including Seda, produce similar yields and that

[34] Catrachita acquires a "mooshy" consistency after being cooked, a not necessarily undesirable characteristic to Honduran urban consumers who prepare refried beans.

[35] A paired sample t-test for a comparison of means shows that the price difference was statistically significant at a p-value of 0.00.

the price of Seda represents the market price for traditional varieties. Finally, the unit of analysis is one hectare, planted to traditional and improved varieties (Table 10).

Table 10 shows that Catrachita generated higher gross revenues than the traditional variety during both the *primera* and *postrera* (28% higher during *primera*, but only 3% higher during the *postrera*). On the other hand, Dorado generated higher gross revenues than the traditional variety only during the *postrera.* Compared to traditional varieties, Dorado produced only 83% as much gross revenues during the *primera,* but earned 16% higher gross revenues during the *postrera*.

This analysis suggests that while the improved varieties have a higher yield potential than traditional varieties, farmers may discount this advantage since improved varieties command a lower market price. Overall, gross revenue differences between improved and traditional varieties are not very high, especially since variable costs (i.e., cash input costs) may be higher for improved than traditional varieties. This implies that the returns to planting improved varieties may be considerably lower in the absence of production constraints like BGMV. For instance, if Dorado users perceive that the Bean Golden Mosaic Virus is not, or has ceased to be, a production constraint, these farmers return to planting higher-priced traditional varieties.

Table 10. Comparison of Bean Revenues for Traditional Versus Improved Bean Varieties, Honduras, 1994

Variety	Average Yield (kg/ha)	Bean Price (Lps/kg)[a]	Gross Revenues (Lps./ha)
	Primera		
Traditional	430	5.06	2,176
Catrachita	620	4.51	2,796
Dorado	430	4.25	1,828
	Postrera		
Traditional	520	5.06	2,631
Catrachita	600	4.51	2,706
Dorado	720	4.25	3,060

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

[a] Prices for traditional varieties are 12% and 19% higher than for Catrachita and Dorado.

Subsequently, in the absence of BGMV-tolerant Dorado, the virus could potentially resurge and cause unexpected production losses for previous Dorado adopters. This simple analysis highlights the importance of understanding the relationships between a farmer's production system, the market with which a farmer transacts, and the National Bean Research Program.

4.5. The Honduran-El Salvadorian Bean Marketing System

A Central American Free Trade Treaty, signed in 1991 by the region's presidents[36], was enacted to improve the economic welfare of regional consumers and producers. When fully enacted, bean producers in countries with a comparative advantage will receive higher prices while consumers in net bean-importing countries will pay lower prices[37]. Also, during the last five years all Central American countries have started to privatize their grain marketing parastatals and have eliminated price controls on staple food grains. Moreover, since 1990, the wars which disrupted inter-regional trade during the 1980s have subsided. In Nicaragua, the Sandinista government allowed democratic elections (1990), after 10 years of continuous fighting, and in El Salvador the Government and the guerilla movement signed a peace accord (1992).

While these socio-political events have improved the trading environment among the countries in the region, official records documenting the effects of the trading rules on trading flows are not readily available. In the case of staple food grains, neither Honduras nor El Salvador keeps accurate official data of trade flows between the two countries. However, all governments have agreed to report basic staple grain prices. Yet, despite this commitment, formal analysis of these data is difficult due to inconsistencies in the price collection methods across countries. First, prices are reported in terms of a Central American dollar equivalent. National currency prices are converted to the standard Central American price using the official exchange rate, which in Honduras (before 1993) was much lower than the parallel exchange rate. Second, all countries do not report price data consistently. For instance, in the case of Honduras and El Salvador, several data points are missing. Third, between and within countries, there are inconsistencies as to the precise date of data collection. Finally, in the case of beans there are several market classes, each of which commands a different market price. In Honduras and El Salvador, the official records report only a single price for red beans despite market recognition of different classes of beans.

Therefore, as an alternative to using inter-country price data to assess the integration of the Honduran and the El Salvadorian bean markets, this paper presents evidence collected during a rapid appraisal (September 1994) of the El Salvadorian marketing system. This appraisal consisted of visits to three markets in El Salvador, during which information was elicited about trading links with Honduras and other Central American countries. The three markets were: the

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[36] Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica.

[37] This assumption assumes that the free trade treaty is honored by all signing parties.

city market in San Salvador (the capital); the farmers' market in San Vicente; and the wholesalers in San Miguel, the largest city in the eastern section of El Salvador.

As previously mentioned, a large proportion of Honduran bean traders identified El Salvadorian traders as important customers. Likewise, bean traders in El Salvador identified Honduras as an important supplier of beans for the national market. All traders[38] reported buying beans from three different sources: national intermediaries, the Honduran market, and the Nicaraguan market. In fact, some traders in San Salvador and San Miguel reported buying most of their beans from Honduras and Nicaragua. In San Salvador, wholesalers and retailers differentiated bean into three market classes: the El Salvadorian pink-bean, the Honduran bean, and the Nicaraguan bean.

El Salvadorian traders reported buying Honduran beans through several channels. In San Salvador, most traders reported purchasing beans from large traders who had previously bought large quantities of beans from Honduras for sale to smaller traders. Some traders also reported arranging transactions with Honduran traders over the phone. They place an order to a Honduran supplier who buys beans on the Honduran market and arranges delivery or waits for the beans to be collected. According to traders, these pre-arranged transactions considerably reduce the transaction costs, benefitting both the supplier and the purchaser.

In contrast, since San Miguel is located in eastern El Salvador, 80 kilometers from the Honduran border, these traders travel to El Salvadorian border towns. There, they purchase beans from intermediaries who have bought beans in a Honduran border town, or somewhere else along the border. Traders argued that this type of transaction was common because, at the time of the interview, Honduran customs authorities prohibited bean exports to El Salvador. In addition, some traders in San Miguel pre-arrange purchases from Honduran traders.

Finally, in San Vicente a third type of trader was interviewed – intermediaries (truckers) who travel around the country selling beans on specific market days in different cities. As in San Miguel, these truckers purchase Honduran beans from traders in bordering towns. Also, as in San Miguel, these intermediaries claimed that, due to the transaction costs associated with crossing the border, it was less expensive to purchase Honduran beans in El Salvador than in Honduras.

A recurring theme raised during the El Salvadorian trader interviews was the high transaction costs[39] incurred at the Honduran border. Given these restrictions, some El Salvadorian traders argued that it was less expensive to purchase beans from Nicaragua – with whom El Salvador

[38] In total, 15 traders were interviewed.

[39] Traders reported the most important transaction cost to be the bribes they had to pay to Honduran officials and/or the cost of crossing the border through non-official crossing points.

has no borders – than from Honduras. While the nature of the official trade restrictions[40] – which created an incentive for bribes and other parallel market trading activities – was somewhat ambiguous, Honduran policy advisors contended that, according to the free trade treaty, these restrictions should not be occurring[41]. This is a clear example of how newly drafted trading rules need to be monitored to ensure their fulfillment, especially when these rules encompass a complete turn-around from the trading rules previously in force.

In addition to informing the structure of the Honduran-El Salvadorian marketing system, El Salvadorian traders were asked about their bean preferences. When asked to price the eight bean samples described previously, San Salvador traders expressed a marked preference for small, light-red beans; San Miguel traders were indifferent between small, light-red and small, dark-red beans, reflecting San Miguel traders' links to markets in San Salvador and El Salvador's Eastern region markets where small, dark-red beans are preferred.

In contrast, these traders reported that Honduran beans are commonly priced lower than El Salvadorian and/or Nicaraguan beans since Honduran beans are usually of lower quality (i.e., more dirt and foreign matter). This suggests that either Honduran traders do not believe that the returns to processing justify the additional cost, or that in a competitive market, Nicaraguan traders and El Salvadorian producers are adjusting faster to market requirements.

[40] A customs official reported that Honduras' new President had enacted an executive decree restricting the trade of beans and other goods among Central American countries.

[41] By March 1995, the Honduran government had posted signs at its borders, announcing the terms of the free trade treaty between Honduras and other Central American countries, which allowed unrestricted trade in several commodities including beans.

5. CONCLUSIONS AND IMPLICATIONS FOR FURTHER ACTION

This study supports the following conclusions and implications, which are categorized according to their impact on policy makers, plant scientists, and agricultural extensionists.

5.1. Implications for Policy Makers

As Honduras' agricultural modernization program (LAM) is implemented, it is important to understand the economic opportunities currently available to small and medium-size farmers who comprise the majority of Honduran farmers. Official government and primary data show that beans and corn are important sources of food and income for a large share of Honduran farmers. Beans, a major source of proteins for rural and urban consumers, are also a primary source of cash income for farmers and an increasingly important tradeable good in the Central American region. However, as with the rest of the agricultural sector, for beans to continue to make a positive contribution to Honduras' economic development and remain competitive in the Central American region, productivity must be increased at both the production and marketing levels. To increase the productivity of the bean subsector, appropriate government incentives are required, especially transparent market rules and norms, as well as research policies which take into account the circumstances of subsector participants (traders, farmers, food processors).

First, while public research funds have been significantly reduced, policy makers must recognize that the subsector's regional competitiveness is highly dependent on the availability of appropriate technologies which increase farm-level and market-level productivity, without significant increases in production/marketing costs. Therefore, it is important that the existing government-funded research program continue to work in close cooperation with the internationally funded research programs (Bean/Cowpea CRSP and PROFRIJOL) to relax key production and marketing constraints. Examples include the need to develop high-yielding bean varieties with more market-acceptable characteristics and water-conserving agronomic practices.

Second, this study has shown that while beans are an important cash crop for farmers, there are significant price differences across bean qualities and across different regions. Therefore, it is important that decision makers at the Ministry of Natural Resources and Ministry of Economics implement a fluid and accessible market information system (e.g., daily radio broadcasts of producer and consumer prices) to collect and publish bean prices for different market classes and different regions. This information will help farmers, consumers, and traders to make better-informed decisions, especially in regions without adequate access to large city markets.

Third, it is clear that the Central American market represents an important economic opportunity for Honduran bean producers and traders. Policy-makers must understand that the regional competitiveness of Honduran beans is directly affected by regional trading policies. Restrictive regional export/import policies may create production disincentives which, in the long run, reduce the regional competitiveness of Honduran beans, leading to more volatile prices within

the national bean market. Additionally, restrictive trading rules may create disincentives for investment in value-added activities (such as food processing) which, if expanded, could further exploit regional market opportunities.

5.2. Implications for Plant Scientists

Both the nationally- and internationally-sponsored research programs in Honduras are undergoing significant structural and institutional changes. As these changes take place, researchers and administrators are being asked to carry out only those projects with the largest potential for impact. This study highlights some implications for bean researchers.

First, as research activities continue to evolve, it is important to highlight the need for supporting integrated research efforts between social scientists and plant scientists. This cooperation helps both plant scientists and socioeconomists to better comprehend the evolving competitive position of the bean subsector within a larger food system. In addition, it serves as an example for other agricultural commodity studies to follow.

Second, as shown by official government data, bean production takes place primarily in the Northeastern, Mideastern, and Northern Regions. To date, the bean research program has given highest priority to relaxing the BGMV production constraint, which has greatly benefitted producers in the Mideastern Region where BGMV is most prevalent. However, less attention has been paid to addressing the constraints that limit the productivity of Northeastern farmers, who produce the largest proportion of Honduran beans. For Northeastern farmers, weather-related production problems (like low rainfall) are most important, especially during the *postrera*. This finding supports the bean research program's recent decision to expand its research agenda to develop drought resistant varieties and water conserving agronomic practices in an effort to relax water stress-related production constraints.

Third, bean production patterns differ markedly between *postrera* and *primera*. During the *postrera,* beans are typically grown as a solo crop, whereas during the *primera* they are inter-cropped with corn, the primary staple crop. Therefore, plant breeders should join with agronomists and socioeconomists to study alternative ways for increasing the productivity of the *primera's* bean/corn production systems. Increasing corn productivity would enable farmers to supply their corn needs using less land, thereby releasing land and other resources for reallocation to *primera* bean production.

Fourth, the performance of available technologies varied markedly across topographical regions. While flatland bean farmers obtain higher yields and sell a larger proportion of their bean crops than hillside farmers, beans are nevertheless an important crop for hillside farmers. Therefore, researchers must give priority to developing technologies which increase productivity in the often neglected hillside environments. More sustainable production alternatives are needed in these areas to not only reduce soil degradation, but also insure hillside farmers more equitable access to new technologies.

Fifth, farmer yields are much lower than the "yield potential" reported in extension publications (1,700 kg/ha), and far below the yields obtained at experiment stations (over 2,400 kg/ha) using improved bean varieties. This suggests a need to initiate research to identify the most important technical and socioeconomic constraints that prevent farmers from achieving higher productivity, and to determine the profitability of applying inputs at the levels required to achieve the "potential yields."

Sixth, given the government's commitment to market liberalization as a vehicle for promoting economic development, plant breeders need to pay greater attention to the linkages between farmers' production decisions and the market. Both farmers and traders have expressed concern about the market acceptability of improved varieties like Catrachita and Dorado. Thus, when selecting among promising lines for advancement and eventual release, the bean breeding program must give greater attention to the potential effect of market preferences on the acceptability and widespread adoption of new improved bean varieties.

Finally, in order to take full advantage of evolving market conditions, the bean research program must strengthen its linkages with private sector participants (i.e., food processors and Central American traders). For example, establishing a "private sector bean research advisory committee" would help insure that bean research priorities respond to changing market conditions.

5.3. Implications for Agricultural Extensionists

As the Ministry of Agriculture's agricultural extension program is restructured in conformance with the government's agricultural modernization program, fewer public resources and personnel will be available to provide extension services to farmers in the widely dispersed bean-producing areas. Several findings from this study have important implications for the agricultural extension program.

First, while farmers in the Northeastern Region have achieved higher bean yields than Mideastern farmers, Northeastern farmers have had less access to modern technologies (improved varieties, chemical inputs) than their Mideastern counterparts. Since higher bean yields in the Northeastern Region may be partly due to an expansion of the agricultural frontier, they may not be sustainable in the long run. Hence, with greater access to modern technologies, Northeastern farmers would likely be able to both increase their bean yields and develop a more sustainable production system. Therefore, policy makers should give priority to expanding agricultural extension services and providing greater access to modern/sustainable technologies to farmers in the Northeastern Region.

Second, distribution of improved varieties among bean farmers has been an important concern among policy makers. In Honduras, a large proportion of farmers were found to gain access to improved varieties through informal distribution channels such as relatives and friends.

Therefore, the extension program should continue seeking ways to improve the artisan seed production/distribution system.

Finally, Honduran farmers have, on average, limited formal education. Therefore, the extension service should take into account farmers' educational level when developing agricultural education materials. Greater attention should be given to creating graphic extension bulletins and providing practical training in the use of technologies that have been tested under farmer conditions. Unless a greater effort is made to more effectively communicate the results of agricultural research to the typical farmer with limited resources and minimal formal education, efforts to increase the productivity of the bean subsector will be severely constrained.

APPENDIX

Table A-1. Proportion (%) of Cropped Land in Different Crops, Mono-Crop Bean Farmers, Mideastern and Northeastern Honduras, *Primera* 1993

	Crops for Mono-Crop Bean Farmers in *Primera*			
Bean Farm Categories	Beans	Corn	Coffee	Other
Farm Size ha				
<2 (n=19)	46%	51%	1%	1%
2-10 (n=46)	26%	55%	16%	3%
>10 (n=43)	18%	61%	18%	3%
Topography				
Flatland (n=49)	26%	64%	6%	4%
Hillside (n=59)	26%	51%	22%	2%
Region				
Mideastern (n=69)	29%	59%	8%	4%
Northeastern (n=39)	21%	53%	26%	1%

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

Table A-2. Proportion (%) of Cropped Land in Different Crops, Inter-Crop Bean Farmers, Mideastern and Northeastern Honduras, *Primera* 1993

	Crops for Inter-Crop Bean Farmers in *the Primera*			
Bean Farm Categories	Corn	Coffee	Bean/Corn	Other
Farm Size ha				
<2 (n=10)	19%	2%	74%	5%
2-10 (n=9)	29%	14%	53%	5%
>10 (n=7)	37%	30%	25%	8%
Topography				
Flatland (n=7)	40%	8%	45%	6%
Hillside (n=19)	22%	16%	56%	6%
Region				
Mideastern (n=22)	26%	10%	57%	7%
Northeastern (n=4)	32%	37%	31%	n.a.

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

Table A-3. Proportion (%) of Cropped Land in Different Crops, Mono-Crop Bean Farmers, Mideastern and Northeastern Honduras, *Postrera* 1993-1994

	Crops for Mono-Crop Bean Farmers in the *Postrera*			
Bean Farm Categories	Beans	Corn	Coffee	Other
Farm Size ha				
<2 (n=45)	92%	3%	3%	2%
2-10 (n=77)	74%	5%	16%	5%
>10 (n=64)	69%	8%	16%	6%
Topography				
Flatland (n=97)	82%	9%	4%	4%
Hillside (n=89)	71%	2%	22%	4%
Region				
Mideastern (n=126)	84%	5%	6%	4%
Northeastern (n=60)	62%	7%	27%	5%

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

Table A-4. Median Bean Farmers' Income Records by Commercial Orientation Group, Mideastern and Northeastern Honduras, 1993-1994

	Commercial Orientation Grouping					
	Non-Sellers		Non-Bean Sellers		Bean-Sellers	
Sources of Income	n	Lps	n	Lps	n	Lps
Total Income	38	1,800	69	4,000	108	5,400
Total Farm Sales	38	0	69	2,600	108	3,800
Gross Bean Sales	38	0	69	0	108	
Net Bean Sales	12	-280	23	-280	108	1,200

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.

Table A-5. Farmers' List of Traders' Most Preferred Bean Characteristics, Honduras, 1994

	Farmers Ranking of Traders Preferences (%)		
Traders' Most Preferred Characteristic[a]	Most Preferred	Second Most Preferred	Third Most Preferred
Red Beans[b]	44%	20%	11%
Good Quality[c]	46%	56%	52%
Culinary[d]	1%	2%	5%
Shape of Grain[e]	5%	13%	6%
Other	3%	4%	3%
Did not List	0%	4%	22%
All[f]	99%	99%	99%

Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP and Food Security II.
[a] A respondent was categorized as choosing good quality as the most preferred (second, or third most preferred) characteristic if, for instance, he/she answered clean, dry, and not damaged beans as preferred characteristics.
[b] Light red beans.
[c] For instance clean, dry, not damaged beans.
[d] Characteristics such as softness.
[e] Such as small elongated beans.
[f] 1% of the bean sellers did not respond this question.

Table A-6. Traders' Most Preferred Bean Characteristics, Honduras, 1994

	Traders Ranking of their Bean Preferences (%)		
Traders' Most Preferred Characteristic[a]	Most Preferred	Second Most Preferred	Third Most Preferred
Red Beans[b]	9%	19%	9%
Good Quality[c]	74%	62%	52%
Culinary[d]	3%	5%	2%
Shape of Grain[e]	9%	5%	3%
Other	5%	3%	3%
Did not List	0%	5%	31%
All	100%	99%	100%

Source: Survey of Honduran Bean Farmers , 1994, Bean/Cowpea CRSP and Food Security II.
Footnotes: See table A-5.

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