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A SOCIO-ECONOMIC STUDY OF THE HONDURAN BEAN SUBSECTOR: PRODUCTION CHARACTERISTICS, ADOPTION OF IMPROVED VARIETIES, AND POLICY IMPLICATIONS

By

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ABSTRACT

A SOCIO-ECONOMIC STUDY OF THE HONDURAN BEAN SUBSECTOR: PRODUCTION CHARACTERISTICS, ADOPTION OF IMPROVED VARIETIES, AND POLICY IMPLICATIONS

By

Pedro V. Martel-Lagos

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, an important source of proteins and tradable good throughout the region. While the National Bean Research Program 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 effect 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 El Salvadorian market was conducted. Data were analyzed with descriptive statistics, logistic analysis, and linear regression analysis.

This research shows that farmers' socio-economic characteristics, production environments, and institutional factors affect 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 hill-sides, 76% of farmers planted Catrachita but only 24% in the flat-land. 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.

DEDICATED

Above all, I dedicate this work and all of the days of my life to God, our Father and Creator.

I also dedicate this dissertation to my wife, Sandra, for all her love, support, and encouragement without which I would have never finish this project. This is as much Sandra's dissertation as it is mine.

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CHAPTER ONE

INTRODUCTION

1.1 Background

The economies of many developing countries are highly dependent on agriculture and natural resources outputs. In Honduras, agriculture accounts for approximately 22% of the Gross Domestic Product (GDP) (World Bank, 1994). If food processing and marketing are included, the total contribution of the food sector increases to about 50% of the GDP (Garcia, M., et al., 1988). In addition, agriculture employs 44% of the Honduran economically active population (MRN, 1994).

In recent years, the salient problems of Latin American economies have been a slow GDP growth during the 1980s and an unequal distribution of resources (Schuh and Brandao, 1990). Honduras has been no stranger to these problems. Honduran total GDP, as well as agricultural GDP per capita, had a negative growth rate during the 1980s (-1.5%). Focusing on the agricultural sector, the latest Honduran Agricultural Census (1993) and the Ministry of Natural Resources (MRN) yearly data show that while land area dedicated to the production of staple food grains has increased, productivity levels have remained steadily low over the last 20 years.

Moreover, while over 60 % of the farms are less than 5 hectares, they only account for 10% of the agricultural land. On the other hand, less than 2% of the farmers (> 100 ha. farms) farm 40% of the land. This pattern of skewed resource distribution is also reflected among food crop farmers. Corn and beans, the two main food staples of

Honduras, are largely produced by small farmers; 36% of corn, and 40% of beans are produced by farmers with less than 5 has.

In Honduras, policy makers have argued that food productivity has been stagnant due to low levels of productivity among small farmers. Therefore in 1992, policy makers concluded that participants in the agricultural sector had not had the proper incentives to invest in higher levels of technology which would bring about higher levels of productivity. Following this conclusion, the Government of Honduras (GOH) and international donor agencies changed their approach toward the agricultural sector. The major sectoral policy reforms expected to positively influence agricultural productivity include: the dismantling of the agricultural marketing parastatal, elimination of price controls, decreased regulation of international trade, decreased support for technology generation and diffusion by the Ministry of Natural Resources (MRN), and the institutionalization of more comprehensive land markets (La Gaceta, 1992).

However, an often overlooked fact is that available technology and supporting services, such as agricultural extension and credit, tend to be conceived to meet the needs of farmers within certain geographical areas. Mainly due to the environmentally specific nature of technology, and the fact that under reduced international and national financial support for credit and extension services; these services are often concentrated in the more politically influential districts. Hence, in this context, agricultural policy decisions are often made with little differential assessment about the underlying nature of the behavior of different participants within the agricultural sector.

Therefore, in order to have bigger technological and policy impact it is critical to envision the agricultural sector as part of a larger economic system. A system in which farmers decision making process is influenced by environmental and socio-economics conditions. To better understand this system, it is necessary to obtain empirical knowledge about the behavior of farmers and other participants in the agricultural sector.

1.2 Problem Statement and Justification for the Study

Beans (Phaseolus vulgaris) are the most important legume crop in Honduras, and constitute an important source of protein for rural and urban consumers. Moreover, beans are viewed as more than simply a source of nutrition. Debates in the popular press emphasize the importance of beans in the Honduran culture and diet. Production, productivity levels, food availability, and competitive performance in the Central American context are at the center of these debates (various newspaper articles, 1993-1995). Aggregate data show that technological progress in the bean subsector has been slow over the past two decades, with population growth out-pacing bean production growth during the period of 1970-1990, thus supporting the concern voiced in the popular press.

During the 1980's and 1990's, international and local support for agricultural research programs in developing countries has decreased. For instance, although beans are still one of the most important crops in Honduras, governmental support for its research has decreased considerably since 1991. As a result several research positions have been eliminated at the Ministry of Natural Resources (MRN), and funds for extension services have been reduced. These events put increased pressure on collaborative research programs such as the Bean/Cowpea Collaborative Research Support Program

(CRSP) and the Regional Cooperative Bean Program (PROFRIJOL) to conduct and finance research targeted for agro-ecological areas which have the potential for rapid productivity gains.

The major emphasis of these collaborative research programs has been to develop varieties with multiple disease resistance, and higher productivity levels. The most important technological contribution of these programs has been to cooperate with the MRN in the release of three small bean varieties. Catrachita, released in 1987, is a highly productive variety but highly susceptible to viral and fungal diseases; and Dorado and Don Silvio, released in 1990 and 1993, respectively, both have high productivity potential and are tolerant to the Bean Golden Mosaic Virus (BGMV), the most virulent bean disease in the low valleys.

Despite these recent technological successes, there is little understanding about the acceptability of these new varieties and its impact upon the overall productivity of the bean subsector. Partly, because it has been implicitly assumed that to improve the productivity of beans in Honduras only production constraints need to be relaxed. Moreover, the socio-economic component of the national and the collaborative bean research programs is very limited. The National Research Program does not have any trained socio-economist, and PROFRIJOL has only one economist for the Central American region. Therefore, bean scientists have very little empirical knowledge about the socio-economic characteristics of bean farmers, and their impact upon productivity.

Furthermore, it is important to study how basic farmer characteristics affect productivity levels. Moreover, given that farmers and scientists production decisions are influenced by environmental conditions, it is important to study the productive performance of bean farmers under different agro-ecological conditions. Understanding production characteristics under different environments, will help bean researchers and policy makers better target their research and policy prescriptions.

In addition, the bean market has been one of the most dynamic socio-economic components affecting the bean subsector during the last five years. Price control deregulations and the implementation of the Central American free trade agreement have been the most important market policy changes since 1990. These policies are expected to generate more technological investment in the most competitive commodities produced in the Honduran agricultural sector. However, no studies have been made to understand the potential effect of market interactions upon the productivity of the bean subsector. Therefore, it is important to understand how market interactions affect the productivity of the bean subsector.

1.3 Research Objectives

The goal of this study is to use a modified subsector approach to gain better empirical knowledge about the socio-economic characteristics affecting the productivity of the Honduran bean subsector; in the context of different agro-ecological environments and evolving technology, policy, and institutional changes.

1.3.1 Specific Objectives

The specific objectives of this study are structured to reflect the information needs of different bean subsector participants, information needed to improve the overall productivity of beans in Honduras. These objectives are:

1. to use secondary and primary data sources to present a comprehensive overview of the bean subsector including information on the historical production patterns of beans in Honduras, historical price patterns, a description of the National Research and Extension Program and the role of the internationally funded collaborative research programs, and a brief overview of the sectoral policies affecting the productivity of the bean subsector;
2. to use primary data to describe field production and socio-economic characteristics of bean farmers in different agro-ecological environments in the Northeastern and Mideastern Regions of Honduras; including farm size, input use, farmers' market orientation, and farmer's demographic characteristics;
3. to analyze what are the most important factors affecting the adoption of improved bean varieties in Mideastern and Northeastern Regions of Honduras;
4. to analyze how production and socio-economic characteristics help identify factors affecting bean yields, with an emphasis on understanding the role of the recently released improved bean varieties;
5. to describe the domestic bean marketing system and analyze the main market level constraints limiting the productivity of the bean subsector, emphasizing farmers

level of participation in the market and the potential effect of market characteristics on the acceptability of improved bean varieties;

6. to analyze the existing links between the Honduran bean marketing system and the larger Central American marketing system;

7. to use the information of this study to highlight the most important implications for policy makers and researchers to increase the overall productivity of the Honduran bean subsector.

1.4 Organization of the Dissertation

This study is organized into six chapters. Chapter two presents the conceptual framework; literature review on factors affecting farmers productivity, and on market level constraints to increasing overall subsector productivity. In addition, chapter two presents a description of the data and the data collection methods used in this study.

Chapter three presents a comprehensive overview of the bean subsector. Including a description of historical pattern of bean production, consumption, and an analysis of the historical price data. Additionally, this chapter includes a description of the Honduran bean research and marketing system.

Chapter four is subdivided into five major sections. These sections present a descriptive analysis of bean farmers in the Mideastern and Northeastern Regions of Honduras. The data used in this Chapter is used to outline a typology of bean farmers using land topography and farm size as the stratifying variables.

Chapter five presents four empirical econometric models. The first two models analyze what are the main factors which affect the adoption of two improved bean varieties. The third and fourth multivariate analysis models study how a set of production and socio-economic variables help explain bean yields.

Chapter six studies in more detailed the role of farmers in the market by analyzing farmers inclination to sell output in the market. Moreover, this chapter analyzes how market acceptability of new improved bean varieties financially affects farmers welfare. In addition, this Chapter studies the interrelation of the Honduran marketing system with that of other Central American countries. Emphasizing the importance of the El Salvadorian bean market. The information in this chapter is designed to inform decision makers about the importance of the Central American market in the performance of the bean subsector.

Finally, chapter seven presents some of the implications of the study's finding for the formulation of different subsector policies. In addition it helps identify areas of priority for future bean research both for socio-economists and agronomists/plant breeders.

CHAPTER TWO

LITERATURE REVIEW AND METHODS

2.1 Literature Review

2.1.1 On the Rapid Appraisal/Subsector Method of Analysis

This study was designed to generate insights needed by decision makers (including scientists and policy makers) to improve productivity in the bean subsector. Thus it falls under the category of subject matter research, as outlined by Johnson (1986), and follows a multidisciplinary research approach. The focus of this thesis is to employ a modified subsector approach to better understand the key farm-level production characteristics of bean farmers, and establish the relevance of the existing linkages between farm-level decisions and the market structure in an effort to identify constraints and opportunities to increasing the productivity of the subsector.

The subsector approach has been used effectively as a tool to conduct subject matter research on the food systems of different countries, including the United States under the NC-117 project. 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 under which a commodity gains value added includes input provision (including research), extension, farm level production, processing, storage, assembly, transportation, wholesaling, retailing, financing, and consumption.

The subsector approach, designed to generate a holistic understanding of the subsector, requires studying both the vertical and horizontal relationships associated with the target food system, including farm-level production activities and linkages to other economic activities (i.e. research, extension, trading, etc.). Moreover, the subsector approach represents a flexible research methodology. Since first appearing in the literature, many researchers have modified the subsector approach to adjust it to the specific analytical objectives and resource constraints that they have faced (Morris, 1986; Boomgard, 1992; Tschirley, 1988).

While this approach has not been employed in the Honduran setting, it represents an appropriate methodology for 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 methodolgy to study the effects of market conditions upon the acceptability and adoption of newly released improved bean varieties. As pointed out by Byerlee (1993), 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."

Initially, subsector studies were conceptualized as long term, intensive analyses, requiring considerable time and financial resources. Reflecting the evolutionary nature of the subsector approach, Holtzman (1986) advocates using rapid appraisal surveys to collect data needed to carry out subsector analyses. While less comprehensive than a formal subsector analysis, Holtzman argues that rapid appraisal techniques provide researchers with sufficient insights to identify key constraints in the subsector and help set the bounds and priorities for subsequent technical and socio-economic research.

Following Holtzman, rapid appraisal surveys were initially carried out to obtain important information which helped to set the bounds of this study. Issues identified through the rapid appraisal include the importance of understanding how production characteristics differ across environmental regions, understanding the nature of market preferences for beans and how they affect the productivity of the subsector, and the need to better understand the impact of Central American markets on traders' preferences for different bean quality characteristics.

2.1.2 The Interaction of Policy Reforms and Supply Response

Governments institute policy reforms in the agricultural sector hoping to relax constraints to using improved technologies designed to increase productivity levels in agriculture. However, these policy reforms are rarely accompanied by a comprehensive understanding of the basic conditions affecting the country's agricultural sector. Therefore what seems, at first glance, like an appropriate policy to promote investments in technology may prove wrong. Thus several economists have argued that to achieve successful technological improvements; it is important to complement these improvements with appropriate institutional changes (Bonnen, 1990; Ruttan and Hayami, 1984; Reardon, 1994).

During the last five years, institutional innovations have been pervasive in Latin America reflecting the influence of donor agencies and creditors in the region. In Honduras, the 1992 Law of Agricultural Development and Modernization (LAM) largely bases its potential impacts on the assumption that more stable agricultural prices (due to price liberalization) will attract more investment into agriculture and thereby raise staple food availability and productivity levels in the agricultural sector. Moreover, as a major component of the LAM, a new set of land reform rules were prescribed. The core of these reforms includes legalizing agricultural land leases, and promoting the development of land markets by establishing a more widespread and inclusive land titling program (La Gaceta, 1992).

However, these institutional innovations were designed with minimal empirical knowledge about the production patterns of small farmers and little evidence of their capacity to respond to macro level incentives -- a key requirement if these reforms are to increase agricultural productivity. While several studies report that bean farmers are self-sufficient non-commercial small farmers using low levels of technology (Curry, 1993; Garcia, 1991), these studies are based on aggregate data which shed little light on the behavior of farmers. Rather, disaggregated data are needed to help better understand and dimistified some conventional knowledge about small farmers. For instance, among Honduran bean farmers Martel and Bernsten (1994) found that even small farmers are significant market participants, selling over one-half of their bean output.

2.1.3 Production and Adoption of Improved Varieties

Production, diffusion, and adoption of improved technologies are part of a continuous process of technological improvement. This process requires that farmers play an important participatory role in determining research priorities at all stages of technological improvement. However, in many cases production of technology takes place as an independent process of the diffusion and adoption stages with little feedback from farmers. Partly because within the research programs there is little input from social scientists who are better trained, than plant researchers, to elicit and evaluate information from farmers. In the process of technological improvement the role of economists has often been viewed as ex-post evaluators of technology adoption (Byerlee and Franzel, 1993; Eicher, 1992).

Thus there is an extensive literature on adoption studies of improved technologies. Feder et al. (1985) present a comprehensive survey of the literature on the different types of adoption studies. These studies include a wide range of models, including those which solely analyze farmers characteristics and the effect of institutional variables such as credit availability on adoption, to those including risk aversion preferences of farmers. Nonetheless, only a few adoption studies include intrinsic characteristics of the technology and its interactions with the farmer's characteristics and the farming system in which the technology is used (CIMMYT, 1993). Characteristics of the farming system which influence adoption of improved varieties include: soil types, rainfall patterns, cropping patterns (i.e. monoculture, intercrop). Intrinsic characteristics of improved varieties which are harder to introduce in adoption models include: growth habits (in the case of beans), consumption characteristics (i.e. culinary characteristics), market acceptability, and percentage of product sold in the market.

While the need to increase bean yields has overshadowed grain quality factors in most research programs, as economic growth increases, and international markets become an important demand component, researchers need to introduce quality criteria within their research programs. Unnevehr et al. (1992) present a set of studies of how the quality of modern rice varieties affect farmers and consumer welfare, and furthermore affects the adoption of these MV's in Southeast Asia. In the past, the most commonly studied quality characteristics of MV have been cooking attributes and post-harvest losses. In Honduras, however, neither of these quality criteria have been included in the bean breeding program.

On the other hand, while the Central American economy has not grown as rapidly as that of Southeast Asia, Godoy and Hockenstein (1992) argue that quality concerns of the bean research program in Nicaragua have focused on meeting the preferences of richer urban consumers. Nonetheless, as trading rules among the Central American countries change to promote free trade, Honduras and Nicaragua are likely to become the main suppliers of small-red beans in the region, and El Salvador the main consumer (Herrera and Jimenez, 1992). This new institutional trading rule creates added pressure on Honduran producers and researchers to pay closer attention to bean quality concerns to achieve higher adoption rates of the new improved bean varieties.

In Honduras, only a few attempts have been made to identify the characteristics of farmers adopting improved bean varieties in the Mideasatern Region of the country (Torres, 1993; Morazan, J. et al., 1989; Viana et al., 1993). However, no formal attempts have been made to model the main determinants of the adoption of improved bean varieties, or to study the possible impact of the Central American markets on the performance of the Honduran bean subsector.

2.2 Data and Methods of Analysis

2.2.1 Rapid Appraisal

A rapid appraisal of the Honduran bean subsector was conducted from November 1993 to January 1994. As previously stated, this rapid appraisal was designed to identify important constraints to increasing productivity in the bean subsector. In addition, the rapid appraisal sought to identify information needed by plant scientists, agricultural extension agents, policy makers, bean farmers, and traders to help improve the productivity of the bean subsector.

To achieve these objectives, the rapid appraisal focused on compiling and analyzing existing secondary data, and conducting personal interviews with different participants within the bean subsector in order to gain insights needed to better understand the dynamics of the subsector. Chapter three summarizes some of the findings of this rapid appraisal.

2.2.2 Farmers and Traders Sampling Techniques

A large component of the results reported in this study are based on analysis of primary data collected from farmers and traders in Honduras. These data were collected from farmers and traders using questionnaires developed by the author 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. The following sections describe the sampling process, the questionnaire design, and survey implementation.

2.2.2.1 Farmers Data and Sampling Design

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 analysis of these data indicated that only one-third of Honduran farmers planted beans during 1993. Additionally, most of the Honduran bean producers were small farmers, traditionally considered self-sufficient non-commercial farmers. Moreover, historical data show that over 60% of bean production takes place in the Mideastern and Northeastern Regions of Honduras. Therefore, having considered these bean production characteristics, the author and his collaborators decided to target the farmer survey in the Mideastern and Northeastern regions of Honduras, stratifying the farmer sample by farm size. The latter decision was taken to insure that the sample included a sufficient number of small, medium and large farmers in order to better understand the production and commercial orientation of different size farmers, to assess the alternative economic opportunities available to different size farmers, and determine why so many farmers did not plant beans.

While these stratifying criteria (i.e. location and farm size) were taken based on the socio-economic knowledge of bean farming in Honduras, insights provided by plant scientists were critically important to understanding the bean farmers' production system. For Example, In Honduras, scientists had observed that bean golden mosaic virus

(BGMV), the most important bean disease and for which scientists had introduced some resistance in the improved varieties, was most prevalent in the low inner valleys of the Mideastern region. Therefore, because scientists considered it important to stratify the farmers sample across topographical regions, the sample was distributed across both flat-lands and hill-sides. In summary, the sample was stratified across three different farm sizes, two topographical regions, and included farmers who did and did not plant beans (Table 2.1).

Although the NAC was the basic sampling frame for this study, previous to the selection of the sampled farmers four steps were conducted to make the actual sampling frame more appropriate for the study's purpose. First the NAC data were used to determine that beans are more intensely produced in the central and eastern sections of the Mideastern Region, and the Northwestern section of the Northeastern Region. Therefore municipalities falling outside this arbitrarily drawn boundaries were excluded from the sampling frame. Second, the NAC divided the country into 2967 segments (clusters) including clusters in the urban areas. Because farmers living in the urban areas were not considered full time farmers they were also excluded from the sampling frame. Third, using NAC data the remaining clusters were classified into bean and non-bean clusters. The criterion for this selection excluded those clusters in which less than 30% of the farmers planted beans. Fourth, the final step was to randomly select 15 hill-side and 15 flat-land clusters, of which five from each category would be replacement segments --if necessary. Once the sampling frame was reduced to 10 clusters per topographical stratum, all farmers were numbered together and a random selection of these farmers was conducted to select the final farmers' sample (Table 2.1).

Table 2.1 Sample Distribution for Bean Farmers' Survey, Mid-Eastern and North-Eastern Regions, Honduras, 1994.

Topography	Bean Farmers			Non-Bean Farmers	
	Farm Size (has)			Farm Size (has)	
	< 2	2-10	>10	2-10	>10
Hill-Side					
Actual[a]	26	49	29	7	1
(Desired)[b]	(30)	(30)	(30)	(15)	(15)
Flat-Land					
Actual[a]	25	43	43	1	3
(Desired)[b]	(30)	(30)	(30)	(15)	(15)

[a] Actual number of farmers in the sample.
[b] Desired number of farmers in the sample.

Although the NAC sampling frame was used to identify non-bean farmers, many of the selected non-bean farmers actually grew beans. Thus, in practice it was very difficult to find non-bean farmers, and it became expensive --both time-wise and financially -- to try to replace farmers who had previously been identified as non-bean farmers, but were actually bean farmers. Similarly, a number of farmers who were initially selected to represent small farmers (farms less than 2 has) actually owned or farmed more than 2 has. Therefore the actual small farmer sample was less than initially projected. Finally, it proved to be more time consuming to visit farmers in the hill-side than farmers in the flat-land areas. Therefore, it was necessary to devise a replacement scheme for hill-side farmers that would help maintain the integrity of the sampling design[1]. At the end of the farm-level data collection process, 239 farmers had been interviewed. Of these farmers, 124 were flat-land and the remaining, 115, were hill-side farmers.

2.2.2.2 Traders Data and Sampling Design

Selecting a sample of traders was more difficult than selecting the farmers sample because in Honduras there is no comprehensive traders' census. While independent consulting groups and the Ministry of Economy and Internal Commerce possess their own lists of traders, as these lists are not regularly or consistently updated they could not be used as a sampling frame. Therefore, in order to collect trader level data, the author visited the major regional markets and generated an ad-hoc sampling frame by asking individual traders to identify other traders who bought and sold basic grains.

To represent the market diversity of Honduras, five different market areas were visited and traders interviewed in each, including: a) Tegucigalpa and San Pedro Sula which represent the largest urban (consuming) centers of the country, b) Danli, Catacamas, and Juticalpa which are the largest cities in the producing Mideastern and Northeastern Regions of Honduras, c) Comayagua, and El Progreso which represent mid-sized cities located in the Central and Northern Regions of Honduras, respectively, d) and Santa Rosa de Copan, the largest urban center in the Western Region of Honduras. As discussed in Chapters Three and Six, each of these markets represents a different level in the marketing channel complex.

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[1] Farmers had to be selected from the replacement clusters, to replace farmers who could not be reached after two visits to the originally selected clusters.

Based on a preliminary assessment of data provided by the 57 traders interviewed as part of the trader level survey, it became clear that El Salvadorian traders played and 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. Information gathered in this rapid appraisal is discussed in Chapters Six and Seven. However, given time and financial limitations, the author did not conduct a formally structured survey in the El Salvadorian market.

2.2.3 Questionnaire Design

While the questionnaire design phase represents an important component of data collection, the time required for questionnaire design is typically underestimated. As eager field researchers, we tend to deal with questionnaire designs as an additional hurdle before facing our ultimate research goal, field interviews with farmers. Similarly we tend to overestimate our understanding of the subject matter, and our ability to easily eliciting the information needed to test our hypotheses.

A considerable amount of time was spent to design the farmer level questionnaire and pretest different options for eliciting information. This was carried out as a team effort in collaboration with plant scientists, and agricultural economists. Previous to training enumerators, the questionnaire was field pre-tested. Following the pre-test, enumerators were trained on how to collect multi-level data, and the specific use of the questionnaire designed for this study. The farm level survey was implemented by six experienced enumerators, and underwent two field tests before it was finalized. The farm-level survey was implemented from May to July of 1994.

The trader level questionnaire was designed as a follow-up to the farmer-level questionnaire, and incorporated some of the questions included in the farm-level questionnaire. Because the researcher had a much better knowledge of the region's mannerism and lexicon, the time invested in the design of this questionnaire was relatively short. Nonetheless, this questionnaire was also pre-tested, one enumerator was trained to implement it, and was implemented during late August and early September of 1994 -- during the rainy season bean harvest.

The farmer questionnaire was designed to collect data on farmers household characteristics, and production conditions with emphasis on understanding the use and acceptability of improved and traditional bean varieties. In addition data on agricultural sale practices were collected, with an emphasis on understanding the structure of the marketing channel, and determining the volume of bean sales. On the other hand, The trader questionnaire was designed to collect data on the personal and basic trading characteristics of traders, the bean pricing behavior of different traders, and about the trader knowledge and acceptability of the improved bean varieties.

2.3 Summary

This chapter introduced the conceptual framework of the subsector approach, and a review of literature highlighting the importance of considering institutional reforms in formulating improved agricultural technologies. Moreover it presented a brief overview of adoption studies underlying the relevance of understanding how intrinsic properties of improved technologies affect adoption. Chapter two also described the survey instruments and sampling techniques to collect primary data.

The subsector approach represents an appropriate methodolgy to study the Honduran bean subsector which in the last five years has been greatly influenced by institutional reforms. It is important to understand farmers' micro-economic behavior to improve upon the recommendations prescribed by policy makers, and better inform plant scientists.

Adoption studies try to explain the adoption of new technologies using farmers' characteristics as explanatory variables, and introducing some variables describing the institutional environment surrounding farmers. Much less attention has been paid to intrinsic properties of the technology itself. In the case of beans in Honduras, very little attention has been paid to quality characteristics as possible constraints to widespread adoption of improved varieties.

Two surveys were conducted during 1994. A production survey of bean farmers in the Mideastern and Northeastern Regions of Honduras was implemented, and 239 farmers were interviewed. Farmers were stratified into three different farm sizes and into hill-side and flat-land farmers. In addition, a trader survey was implemented after the rainy season bean harvest. A total of 57 traders were interviewed in 8 different major Honduran markets. The farmer survey sought to obtain information on factors affecting field level productivity of beans, including factors affecting the adoption of improved bean varieties. The trader survey was designed to obtain information on the structure of the bean market in Honduras, and on establishing the main bean market preferences.

CHAPTER THREE

AN OVERVIEW OF THE HONDURAN BEAN SUBSECTOR

3.1 Demand Analysis

This chapter is based on the rapid appraisal work conducted by the author from November 1993 to January 1994. Using secondary data and data from informal interviews, this Chapter presents a comprehensive overview of the Honduran bean subsector. Chapter three is divided in six sections which include an analysis of bean demand in Honduras (3.1), an analysis of aggregate bean production (3.2), a brief overview of price history (3.3), a discussion of the basic characteristics of the bean marketing system (3.4), a description of the Honduran bean research program (3.5), and an overview of the major policies affecting the bean subsector (3.6).

3.1.1 Beans in the Honduran Diet

Beans are the second most important food staple in not only Honduras, but also in the other northern countries of Central America. In 1988, Hondurans consumed annually an average of approximately 10.0 kg of beans per capita, compared to 13.1, 11.8, and 9.5 kg per capita in Nicaragua, Guatemala, and El Salvador, respectively[1]. In terms of nutrient value, beans contribute 92 calories/person/day and 6 grams/person/day of proteins; making beans the second most important source of proteins in the Honduran diet after corn (14 grams/person/day).

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[1] In Honduras, El Salvador, and Nicaragua households predominantly consume small red beans, whereas Guatemalans consume predominantly black beans. Source: aggregate consumption data for 1988 from IICA, 1992; Honduran population data from the 1988 Honduran population census, and the population data for the rest of the countries is from the World Bank, 1990.

Average data overshadows[2] the greater importance of beans among low income groups and between bean farmers compared to non-bean farmers. For example, data from a 1978-1979 income and expenditure survey showed that beans were a more important source of protein for lower income groups than for higher income households[3].

3.1.2 Consumer Preferences

Consumers preferences for beans are mainly based on color, cooking time, and cooked texture. Honduran beans are broadly grouped into three market (color) classes: small light-red beans, small dark-red beans, and black beans. Despite this diversity, the Government's data collection institutions do not differentiate between bean color classes. Therefore, there exists no basis to determine the amount of red or black beans consumed in Honduras[4]. However, visits to markets in several areas suggest that households in the Northern, Mideastern, and Northeastern Regions consume a significantly larger proportion of small red beans than black beans. On the other hand, in Western and Central Honduras black beans account for over 20% of households' bean consumption.

Although it is difficult to determine the optimal cooking time, consumers prefer quick-cooking beans. Cooking time varies by variety, age, and storage conditions. Additionally, as with cooking time, it is difficult to determine the optimal cooked texture

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[2] In contrast to maize and sorghum which are widely used for animal feed, beans are exclusively used for human consumption in Central America.

[3] Preliminary results from a 1993-1994 USAID-financed income-expenditure and nutritional survey support the findings of the 1978-1979 study.

[4] CIAT agronomist Oswaldo Voysest estimates that 95% of Honduras' beans are small red types.

of beans. Preparation recipes and bean types are typically linked to cooked texture characteristics. Further details of how improved bean varieties fare against these criteria are presented in Chapter 6.

3.1.3 Domestic Consumption

Bean consumption estimates for Honduras are calculated by subtracting from the estimated production the quantity of net exports, seed use, and storage losses[5]. While available data show a stable trend in consumption per capita for the 1980s, averaging 9.7 kg/person, an important caveat of these estimates is the presence of unrecorded intra-regional trade. At the time of these study, customs officials at Honduras/El Salvador and traders from both countries reported that large quantities of unrecorded beans move from Honduras to El Salvador. Therefore under a regime of net unrecorded outflows, these official data overestimate the availability of beans for Hondurans --further discussion of the relevance of Central American markets is presented in Chapter Six.

3.1.3.1 Rural Demand

While aggregate official data do not differentiate between neither urban and rural consumers nor bean farm size, further analysis of official data provides insights on rural demand. Approximately 109,000 farmers (National Agricultural Census, 1994), one-third of the total number of farmers, grow beans. Traditionally, beans have been considered a small farmer's crop, grown mainly for home consumption. Although net-buyers of beans

[5] Estimated human consumption = [estimated production] - [(exports-imports) + seed + storage losses].

cannot be identified from official data, careful disaggregation of these data contribute important insights towards better understanding the structure of bean demand.

First, during the 1991-1992 crop year, farm households sold 55% of the bean harvest, consumed 41%, used 3.9% for seed, and recorded a small proportion as losses (0.1%) (Table 3.1). Second, as expected there is a negative correlation between farm size and the share of beans retained for home consumption. For example, farm-households with less than 3.5 ha keep approximately 50% of their beans for home use, while households with more than 14 ha retained only 35% (Table 3.1).

Third, the average bean enterprise accounts for only a small share of total farm area. Bean fields for farmers with less than 3.5 ha averaged 0.55 ha, compared to 0.72 ha for farmers with 3.5-7 ha, 0.76 ha for farmers with 7-14 ha, 1.31 ha for farmers with more than 14 ha. Assuming an average yield of 700 kg/ha, these data imply that the smallest bean farmers produce 385 kg per farm per season, or 64 kg/household member (assuming an average family size of 6 persons). Although these data suggest that even the smallest bean farmers produce enough beans to meet their households' bean requirements, there are at least two reasons to treat these figures cautiously when analyzing the availability of beans among bean farmers. First, average values fail to reflect the distribution of these data. For example, many small farmers may not produce enough beans to meet their households' demand from their own production, either because their bean fields are too small, or because their yields are too low. Second, several farmers sell a large proportion of beans at harvest to meet their cash constraints, and later repurchase beans to meet household needs. This situation may be accentuated in today's market environment where bean prices are rising faster than other food crops, due to increased demand from neighboring countries.

Table 3.1 Structure of Bean Production and Sales, 1992, Honduras.

Total Farm Size (ha)	Farmers Growing Beans (%)	Share of Total Bean Production (%)	Share of Production Sold[a] (%)	Share of Marketed Surplus[a] (%)
<3.5	57	38.3	34.6	50.0
3.5 to 7	16	14.7	13.0	49.1
7 to 14	12	12.9	12.5	54.0
>14	15	34.0	39.9	65.0
Total	100	100.0	100.0	55.4

[a] The figures under the heading "share of total production sold" take as the base the total amount of beans sold in Honduras, whereas the figures under the heading "share of marketed surplus" take as the base total production by farm size.
Source: SECPLAN. 1994. Encuesta Agricola Nacional, 1991-92 (unpublished).

Fourth, although bean farmers account for a large portion of the rural bean demand, they are not the only rural bean consumers. Non-farming rural households and the two-thirds of the farmers who do not plant beans are also potential bean consumers. In Honduras, a country with a large rural population (50%), less than 5% of farm-gate bean sales are made directly to rural consumers (SECPLAN, 1992). While, this implies that much of the rural demand is met through formal marketing channels, exactly how rural marketing channels function is poorly understood.

Fifth, tastes and preferences are additional components of bean demand. As previously mentioned, although consumers have strong color preferences which vary by region, secondary data assume that all Honduran beans are red, and do not make any distinction of price differences due to color. However, it is not clear to what extent poor consumers, and rural consumers in particular, are willing to pay for the "ideal" characteristics. For example, in 1993 consumer demand was strong for a pale red "China" bean, selling for less than one-half the price of the "preferred" color types. In addition the strength of consumer's color preference appears to vary by region. For example, in Comayagua, black beans sold for 20% less than light red beans, but in Santa Rosa de Copan there was no difference between the price of red and black beans (author's observation, December 1993).

3.1.3.2 Urban Demand

Urban consumers' bean preferences are similar to those of rural consumers, although the demand for high quality small red beans is stronger among the more affluent urban consumers. A substantial share of national bean production moves through the marketing system to urban areas. While urban consumers typically purchase beans in bulk at local markets, urban consumers also purchase packaged beans and processed frozen refried beans are.

3.1.4 Central American Exports Demand

In Central American, the demand for beans is fragmented into two market classes. Consumers in Nicaragua, Honduras, El Salvador and Panama prefer red beans, which account for about 58% of the total beans consumed in the region (Table 3.2). In contrast, Guatemalan and Costa Rican consumers prefer black beans, which account for 42% of total consumption (Herrera and Jimenez, 1992).

As previously mentioned, key informants and export data (Figure 1) provide evidence that Honduras is the dominant bean exporter in Central America. For Honduras, bean exports represent both a promising alternative market opportunity for bean producers, and a source of foreign exchange earnings. Therefore, it is important that Honduras implement policies that will increase the efficiency of the bean subsector, if the country is to continue to exploit regional market opportunities.

For example, reducing transaction costs of recording bean exports may help shed light on the relative importance of the export demand[6]. Additionally, unless producers can expand production in response to the strong export demand, national stocks will decline -- driving up local prices. The latter point was illustrated in Honduras during the *postrera* (dry season) of 1993. In response to this crisis the Honduran Government imported beans from the People's Republic of China, and distributed them at subsidized prices through the government's chain of retail stores, National Supplier of Basic Products (BANASUPRO). This action decreased foreign exchange reserves, increased the budget deficit, and imposed a high political cost on the Government[7].

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[6] Key informants reported that bean exporters are required to obtain both an export permit from the Central Bank and a phytosanitary certificate from the Ministry of Agriculture, before they can legally export beans. These can only be obtained in Tegucigalpa, thereby increasing the transaction costs of recorded exports.

[7] These bean imports were the subject of a number of editorial articles in the media. Both the low quality of the imports, and the inefficiency of the structural adjustment program to deal with food security issues were highlighted.

Table 3.2 Bean Consumption in Central America by Country, 1980/81-1989/90 ('000 mt.).

Country	Total Consumption ('000 mt)	Share of Regional Consumption (%)	Share of Total Consumption (%)	
			Red	Black
Guatemala	85.1	33.0	5	95
Nicaragua	53.5	20.8	95	5
El Salvador	50.1	19.4	100	0
Honduras	44.3	17.2	95	5
Costa Rica	22.4	8.7	30	70
Panama	2.3	0.9	90	10
Total	257.7	100.0	61	39

Source:Herrera and Jimenez (1992).

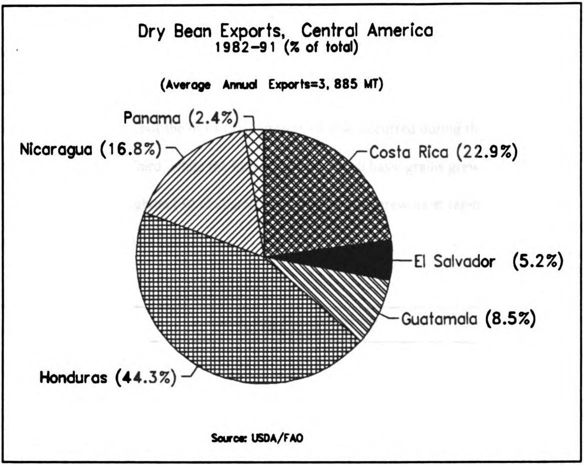

Figure 1. Average % Dry Bean Exports, Central American Countries, 1982-91, Source: USDA/FAO.

3.2 Production Analysis

3.2.1 Harvested Area

Official data (APAH, 1991; SECPLAN, 1993) show that farmers harvested an estimated 74,900 ha of beans annually (1982-92 average), equal to about 15% of the total staple food grains area. In contrast, the estimated area for corn is 347,600 ha (71%), followed by sorghum (51,500 ha, 10%), and rice (17,900 ha, 4%) (Figure 2 and Table A-1).

Analysis of available data for 1981-82 to 1991-92 highlight three key points. First, for all food grains, harvested area varied considerably from year-to-year (Table A-2). Second, during the past 11 years (1982-92), the total area in food grains grew at an annual average rate of 3.9%, but the most rapid growth (9.3%) occurred during the 1989-92 period (Table 3.4). Third, while the harvested area for all basic grains grew during the past 11 years, the sorghum (30.6%) and beans (5.1%) area grew most rapidly, compared to only 3.4% for corn.

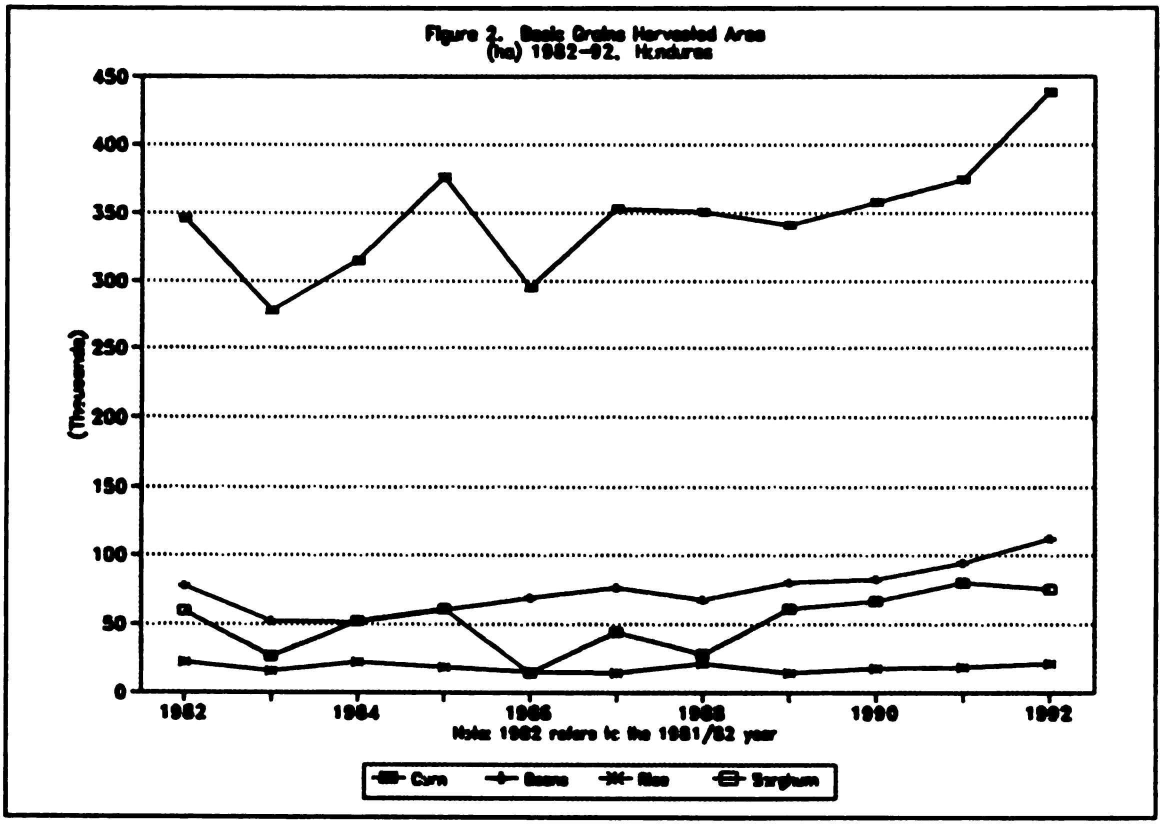

Figure 2. Basic Grains Harvested Area (has), 1982-92, Honduras.

Table 3.4 Average Annual Growth Rate (%) of Harvested Area in Basic Grains, Honduras.

Period[a]	Corn	Beans	Rice	Sorghum	Total
1982-92	3.44	5.08	3.78	30.64	3.94
1982-88	1.75	-0.63	4.11	27.09	0.88
1988-92	5.98	13.65	3.29	35.97	8.54
1989-92	8.89	11.82	16.00	7.74	9.29

[a] 1982 refers to the 1981-82 agricultural year.
Source: SECPLAN. Pronostico de Cosechas de Granos Basicos (various years).

Although official data indicate a significant increase in area harvested to beans (and other basic grains) from 1987-88 to 1988-89, using 1987-88 as a reference year has two limitations. First, due to a severe drought during the 1987-88 agricultural year, much of the area planted to beans was not harvested[8]. Second, after 1987-88 SECPLAN and the Bureau of Statistics and Census (DGEC) expanded the definition of a farmer to include the smallest farmers (< 0.7 ha) in the sample used by the Grain Forecasting unit of the DGEC[9]. This is particularly important for beans, because 12% of the bean farmers cultivate 0.7 ha or less.

Honduran farmers typically plant two crops during the year. While the *primera* (the rainy season) is the most important season for grain production, on average a larger

[8] Galvez, G. personal communication.

[9] Previously, farmers with <0.7 ha were excluded from national agricultural statistics.

proportion (56%) of beans are grown in the *postrera* (Table A-3)[10]. Moreover, although on average beans account for 15% of the total harvested area of basic grains for the entire agricultural year, they account for over 30% of the area harvested during the *postréra*.

In contrast to corn, which is more uniformly distributed throughout the country, beans are concentrated in the Mideastern and Northeastern Regions (Figure 3). Especially, during the *postrera*, beans are the dominant basic staple grain in these two regions. For example, during the period 1987-91, *postrera* beans accounted for an average of 87% and 69% of the harvested area in basic grains for the Mideastern and Northeastern Regions, respectively.

Finally, the bean subsector is dominated by farmers who plant a relatively small area to beans (CRSP, 1991; Stonich, 1992; Curry, 1993). For example, available data show that over two-thirds of the bean farmers (69%) harvest 1 ha or less, and 97% of the bean farmers harvest 3.5 ha or less[11]. However, almost one-third (32%) of the bean area is planted in farms larger than 14 ha (Table A-4).

[10] The data suggest that in recent years bean production may have shifted somewhat from the *primera* to the *postrera*. However, key subsector informants report that this may reflect another weakness of the data published before 1989.

[11] Approximately 91% of a sample of 1,779 bean farmers mono-cropped beans in the *postrera* of 1991-92 (SECPLAN,1994).

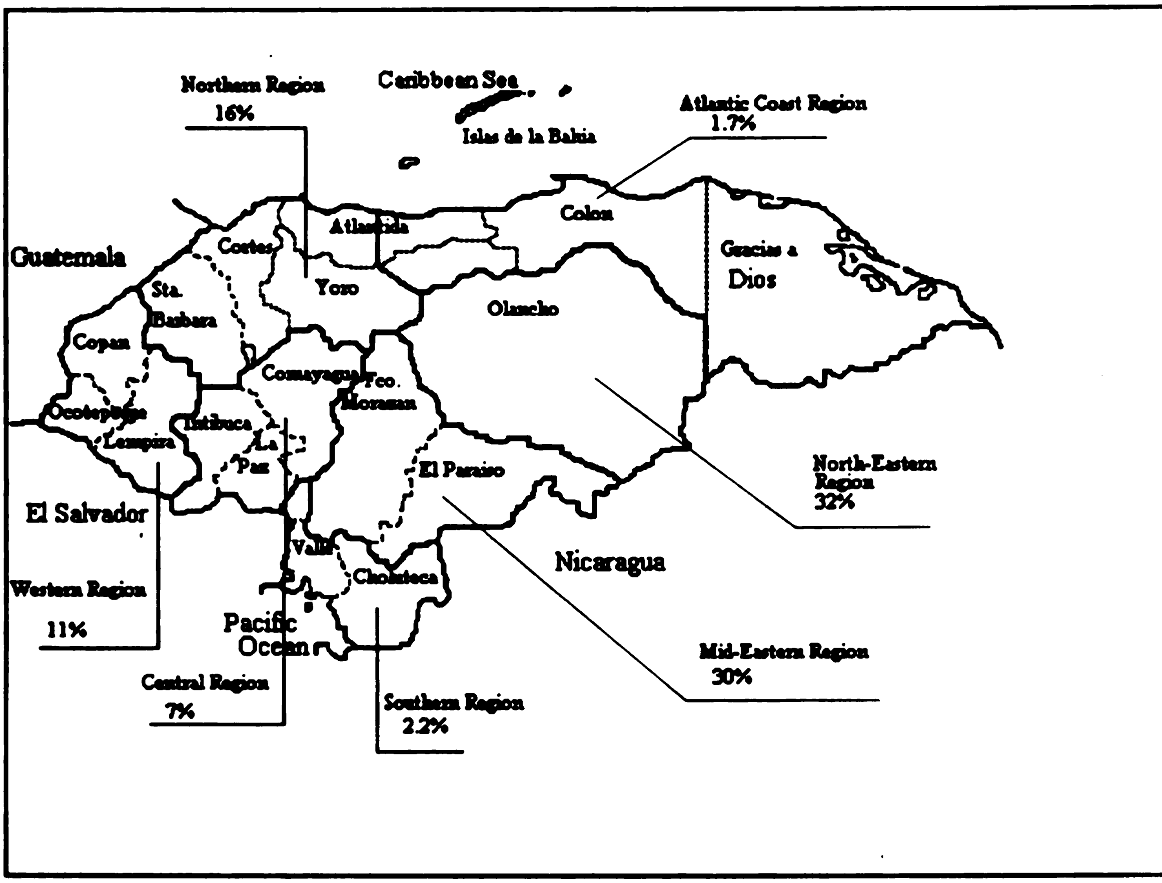

Figure 3. Distribution of Bean Production by Administrative Region, 1989-92, Honduras.

3.2.2 <u>Production</u>

Total bean production averaged 46,020 mt during the 1981-1992 period. As is the case with harvested area, there is no clear time trend for bean production over the 11-year period (Figure 4). However, during the past three years (1989-1992), bean production averaged 66,250 mt, 44% higher than the 11-year average. While it is not readily apparent what has been responsible for this recent growth in production, it may be partially due to changes in the definition of a farmer, as noted earlier. The fact that the trend in the lagged prices (real) of Honduran beans and corn (complement in production) do not follow the trend in bean production for this period, as would be expected (Curry, 1993), further complicates the analysis of production data.

As expected, the seasonal and regional distribution of bean production is largely determined by the distribution of harvested area. Approximately 67% of the national bean output is produced during the *postrera* (SECPLAN, 1993), with two regions, the Northeastern and Mideastern, accounting for 70% of total national production. Additionally, although farmers with less than 3.5 ha (57%) produce 38% of the national output, the small share of farmers with farms larger than 14 ha (15%) account for 34% of total production (Table 3.1).

The Ministry of Natural Resources defines three production systems: the traditional, the semi-technical, and the technical system (MRN, 1988), based on the type of inputs farmers use (i.e., seed, fertilizer, pesticide, herbicide). In the traditional system, farmers sow local varieties and use no additional purchased inputs. Farmers who use one to three modern inputs fall under the semi-technical system category, and farmers who use more than three belong to the technical system group.

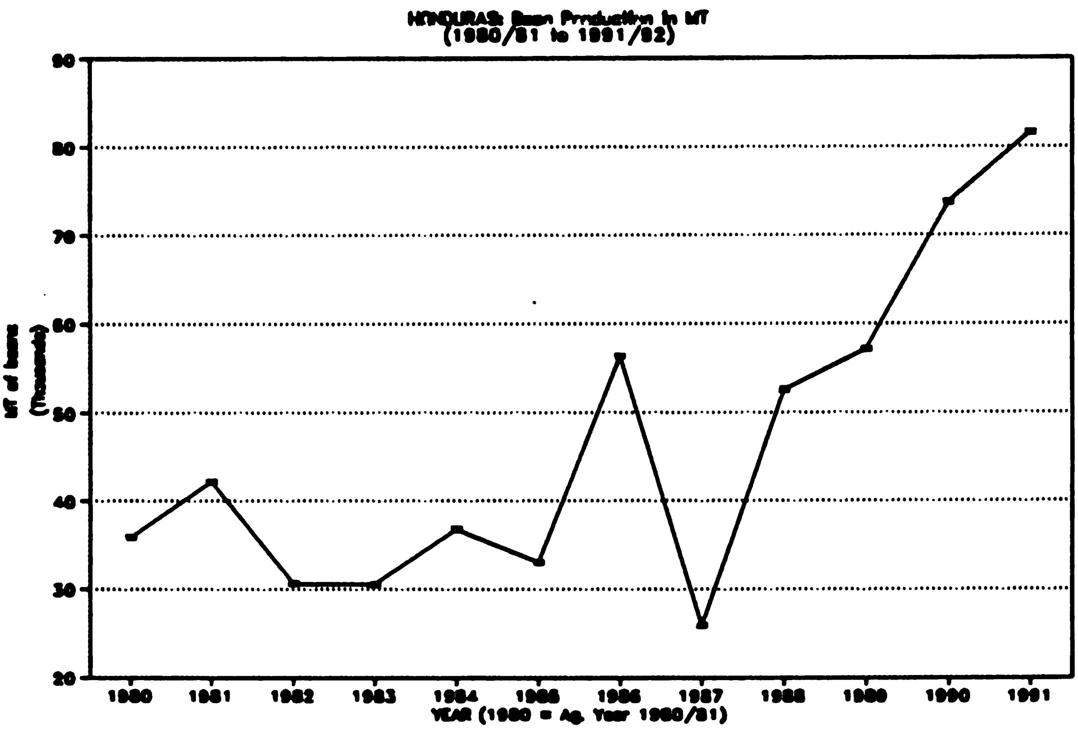

Figure 4. Bean Production (mt), 1980-81/1991-92, Honduras.

However, this stratification of bean farmers fails to capture the variations in bean farming systems that exists among farmers across regions and agro-ecological zones. Available data show that there exist major differences across regions, and visits to several farming regions confirmed that cropping patterns vary even within regions. The following section presents an overview of the predominant characteristics of bean production in the three most important bean-producing areas, the Mideastern, the Northeastern, and the Western Region. These characteristics include farm size, type of beans produced, crop associations, and agro-ecological characteristics. Using survey data, Chapter 4 presents a more detailed analysis of the variability of farming systems across farm size, and topographical regions in the Mideastern and Northeastern Regions.

3.2.3 Farm Size and Commercial Orientation

As noted earlier, over 50% of Honduran bean producers are small farmers. Nationally, almost 20% of the farms with beans are less than 1 ha (total farm area), and approximately 57% are 3.5 ha or less. On the other hand, 15% of the bean farms are more than 14 ha. But average farm size varies by regions. For example, in the Northeastern Region only 34% of bean farms have 3.5 ha or less, whereas in the Mid-Eastern 60% fall under this category.

These regional farm size data suggests a stronger commercial orientation among the Northeastern bean farmers. However, national data (SECPLAN, 1994) indicate the Mideastern bean farmers market 63% of their total bean production, while Northeastern farmers market only 53%. This paradox may be explained by several factors. First, on average bean fields are small, regardless of farm size, but larger in the Mideastern Region (0.98 ha) than in the Northeastern Region (0.84 ha). Second, the Northeastern Region is less densely populated, and because many farmers live further away from the main urban-trading centers, they have less access to markets. In addition, because inputs are more readily available in the Mid-Eastern region, these farmers may be more able to produce marketed surpluses.

3.2.3.1 Mideastern Region Farming System

The Mid-Eastern region, which accounts for 30% of the bean area, encompasses the Departments of Francisco Morazan and El Paraiso. The largest urban centers in this region are Tegucigalpa (580,000 population), the capital of Honduras, and Danli (30,000 population), where the National Bean Program is headquartered. Additionally, Zamorano, the leading agricultural teaching and research center in Honduras, is located in the middle of this region.

Topographically, the Mid-Eastern region has a number of small deep valleys, where tobacco, cotton, and horticultural production are important farming enterprises. Beans are grown both in the deep valleys and the hillsides, and 94% of the beans produced in this region are harvested in the drier *postrera* (SECPLAN, 1994).

In this region most farmers only grow small-seeded red beans, and the majority of the improved seed adopters are in this region. The most commonly planted local bean varieties are Paraisito and Chile, two flat-shaped small-seeded light-red beans. Improved varieties commonly planted include Catrachita in the hill-sides, and Dorado, an improved BGMV-tolerant variety, in the lower altitudes where bean golden mosaic virus (BGMV) is an important production constraint.

Secondary data indicate that most beans are grown as a mono-crop, especially during the *postrera*. However, as is shown in Chapter Four, this practice varies from one season to another. Additionally, while most Honduran bean farmers apply few modern inputs (MRN, 1988), bean farmers in the Mid-Eastern Region are more likely to apply chemical inputs than farmers in other regions of the country.

3.2.3.2 North-Eastern Region

This region, which accounts for 34% of total national production, encompasses the department of Olancho and is less urbanized (75% rural) than the Mid-Eastern region. The two largest urban centers are Juticalpa (20,000 population) and Catacamas (18,000 population), which are approximately 28 miles apart and connected by a two-lane paved highway.

Agriculture in this region is more extensive than in the Mideastern Region. Data from the National Agricultural Census (1993) show that there are over 200,000 head of cattle in Olancho, and most of the flat land in the region is used for pasture, corn, and sorghum production.

In contrast, beans are mostly planted in the less fertile hillsides. Compared to the Mideastern Region, bean production is more evenly distributed, between seasons, with the *primera* accounting for 40% of the region's total bean production and the *postrera* for the remaining 60%.

As in the Mid-Eastern region, most of the beans produced in this area are small red types. But in contrast to Mid-Eastern farmers, few Olancho farmers plant improved bean varieties. Among farmers planting improved varieties, Catrachita is the most widely grown cultivar --in fact, very few farmers have planted or even heard of Dorado or Don Silvio. Among local bean varieties, Cuarenteño, Vaina Blanca, and Chile are most commonly grown.

As in the Mid-Eastern region, farmers in Olancho prefer early- maturing small-seeded light red bean varieties. Farmers prefer these types because they both command a price premium and their earliness helps to reduce production risk due to drought.

In Olancho, the most common crop association in bean fields is a corn-bean relay. During the *primera*, bean farmers plant a larger proportion of corn in association with beans, and during the *postrera* only beans are planted between the rows of dried corn stalks.

3.2.3.3 Western Region Farming System

The Western Region, which accounts for 10% of total bean output, encompasses the departments of Copan, Lempira, and Ocotepeque. The region's largest urban center is Santa Rosa de Copan (20,000 people). This region borders Guatemala (west) and El Salvador (south), with the border town of El Poy approximately 60 miles from San Salvador (over 500,000 population), the capital of El Salvador.

This region is divided into three eco-zones. The northern part, which includes one of Honduras' most fertile valleys, has abundant rainfall (1,600 mm per year) and is dominated by tobacco, cattle, and corn production. In contrast, in the southern part of the region, which includes a much drier valley, horticultural crops predominate. Finally, bean production is concentrated in the more mountainous part of the region.

In general, bean farmers in this region are more traditional than bean farmers of the Northeastern and Mideastern Regions. Most farmers visited do not use any modern inputs and only sell 46% of their total production.

Unlike the other regions, farmers in the Western Region produce almost equal proportions of red- and black-seeded beans. Most of the black-seeded bean cultivars are climbing varieties, whereas most of the red-seeded beans are short erect bush types. According to most farmers, black-seeded beans are more resistant to the most common diseases in the region--web blight, common bacterial blight, and anthracnose.

Although bean farms in this region are relatively small (0.64 ha), these producers appear responsive to both domestic and export markets. While Hondurans consume both black and red beans, Guatemalan consumers prefer black beans, and El Salvadorian consumers prefer light-colored red beans. Because the strength of the demand (and market price) in these markets varies from year-to-year, farmers grow both red and black beans as a price risk management strategy.

The most common crop-association in this region is corn-beans, with corn as the main *primera* season crop and beans as the most important *postrera* season crop. Also, climbing beans--which climb on the dried corn stalks planted in the *primera*--are more prevalent here than in the other two regions.

Most farmers in this region use few modern inputs, as they do not perceive added benefits from using them. For example, small traditional bean farmers reported that they use fertilizer for corn production, but not for bean production because beans are not responsive to fertilizer.

3.2.4 Honduran Bean Yields

Historical data show that bean yields in Honduras vary considerably from year-to-year (Figure 5). Although, this suggests that yields are driven by weather conditions which are beyond the control of bean producers, in recent years BGMV may have contributed to yield variability.

Analysis of harvested area, yield, and production data indicates that over the past decade, increases in harvested area accounted for 60.7% of the production increase, while higher yields accounted for 39.3% of the total. However, during 1988-91 higher yields accounted for a larger share (56.1%) of the production increase. Nonetheless, during these three years the bean area increased by 17,000 ha (25%). This suggests that recent yield increases may be driven by a combination of factors--good weather conditions and an increase in new (or fallowed) higher fertility land brought into bean production in response to attractive market prices[12]. Therefore, these recent yield increases may not be sustainable, as suggested by the decrease in yields from 1990-91 to 1991-92.

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[12] GOH statistics report area harvested. In poor rainfall years, if land initially planted is later abandoned, it is excluded from the area estimate. Thus, in good rainfall years both harvested area and yields will show increases.

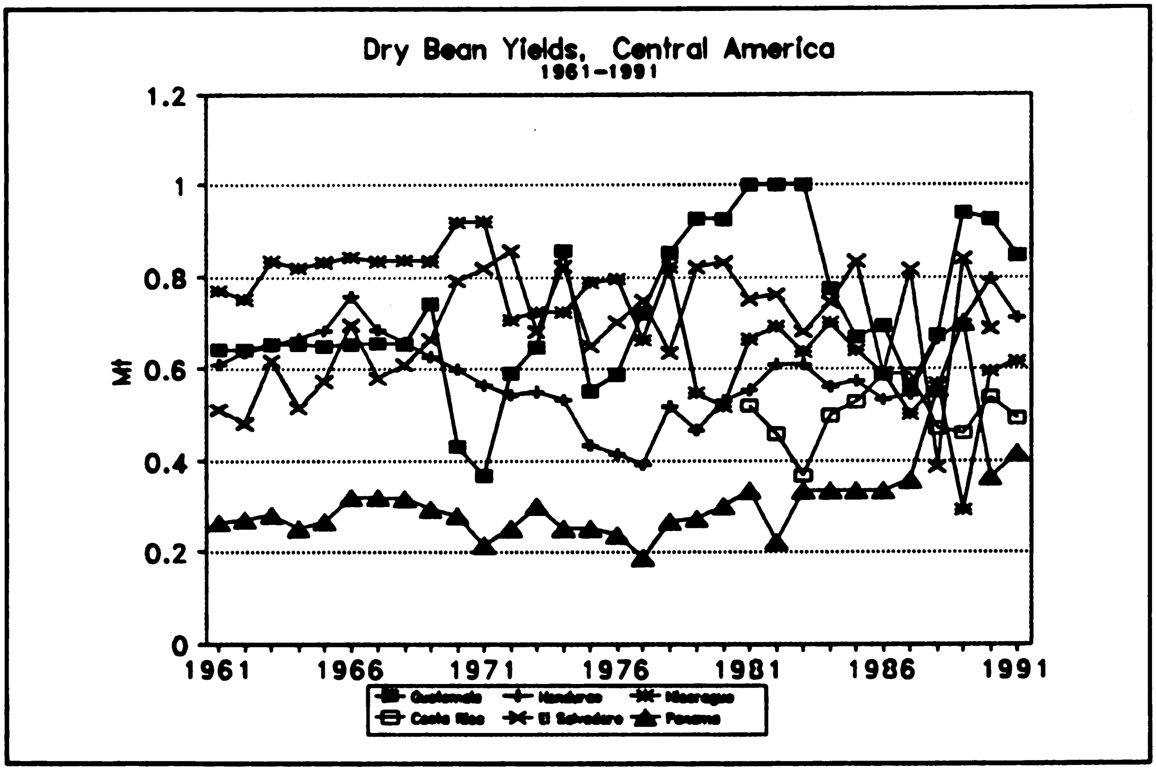

Figure 5. Average Dry Bean Yields (mt/ha), Central America Countries, 1961-1991, Source: FAO.

Official data show that among the major bean-growing regions, yields are highest in the Northern (0.95 mt/ha) and Northeastern (0.88 mt/ha) Regions. Paradoxically, in the Mideastern Region where improved-varieties and inputs are more widely used, yields only average 0.68 mt/ha. This may partially be due to a higher incidence of BGMV in the more intensely cultivated Mideastern Region, where beans and crops that serve as alternate hosts for the white fly (BGMV vector) are widely grown in the low elevation fertile valleys[13]. Although, fungal diseases are less of a constraint in the dryer *postrera*, drought

[13] As these regional yields are based on one year of data, yield differences may only reflect differences in weather conditions.

limits this season's yield potential. Thus, as expected, seasonal data show little difference in yields between the *primera* (0.74 mt/ha) and the *postrera* (0.72 mt/ha). Finally, farm size does not appear to have much influence on bean yields. For example, yields on farms smaller than 3.5 ha averaged 0.72 mt/ha, whereas farms larger than 14 ha averaged 0.77 mt/ha.

3.2.5 Central American Production

Guatemala and Honduras are the most important bean producers in Central America, in most years, accounting for over 50% of the region's total output (Figure 6). In 1991 the Central American governments (excluding Panama) signed a free trade treaty which established a price-band mechanism for most extra-regionally traded agricultural products. In the case of white corn and beans (red and black) which were not subjected to the price-band mechanism; the treaty eliminated all intra-regional tariffs and quantitative trade barriers which applied to these products. In addition, the signatories agreed to minimize the role of marketing parastatals in inter-country trade. The expected goal of the free trade treaty is to increase the incomes of farmers and reduce the variability of agricultural prices by insuring a more stable supply of goods in the region.

Reducing variability in the bean supply represents an important challenge for the governments of the region. Historical data show that bean production in Nicaragua, Honduras, and El Salvador is extremely variable, and varies together (Figures 5& 6).

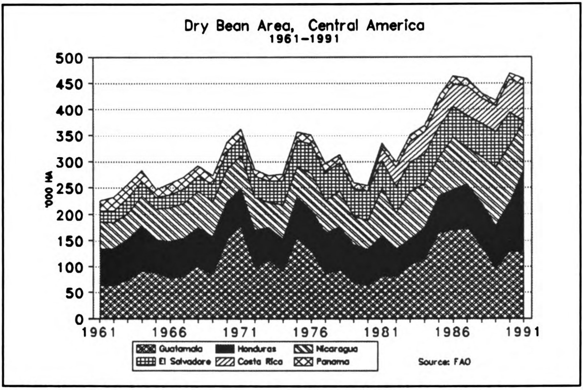

Figure 6. Dry Bean Area ('000 has), Central America, 1961-91, Source: FAO.

3.3 Bean Price Analysis

In 1992, the GOH passed the Honduran *Law of Agricultural Development and Modernization*, designed to promote agricultural productivity. Most of the anticipated impacts of this law are based on the assumption that agricultural producers and traders will respond to price signals. As a result of market liberalization, it is assumed that welfare among producers and consumers will be distributed on an efficiency basis. This section explores past behavior of bean prices in Honduras and attempts to analyze how it relates to the subsector's performance.

3.3.1 Trends in Real and Relative Prices in Honduras

Real producer prices for beans fell steadily from 1970 to 1987, then rose through 1991, and fell to their lowest in 1992. In contrast, while consumer prices for beans have been far more volatile that producer prices, over the period they have increased in real terms. For example, from 1970-72 to 1990-92 real producer prices fell by 3% while real consumer prices rose by 2.8%[14]. Thus, real gross marketing margins of beans were higher in 1990-92 than in 1970-72, which suggests that either more marketing services are provided and demanded off-the farm, or real transportation costs have increased.

3.3.1.1 Relative Bean Prices

Historically, although the relative producer prices of beans, *vis-a-vis* other grains, has varied considerably from year-to-year, producer prices have been higher for beans than for sorghum and white corn. During 1970-87, producer prices of beans ranged from 177% (1978) to 98% (1987) higher than for white corn, and from 152% (1985) to 95% (1981) higher than for sorghum. On the other hand, producer prices of beans varied from 15% (1975) to 31% (1981) lower than for rice over the same period.

However, since 1988 beans appear to have become an increasingly attractive crop for farmers. Available data show that for 1988-92 the relative producer prices of beans rose to their highest levels--equal to 226%, 195%, and 43% above the producer prices of sorghum, corn, and rice, respectively (Figure 7). During the same period, bean production

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[14] Compared to a 5%, 29%, and 54% decreased in real producer prices of corn, sorghum, and rice, respectively (APAH, 1992).

grew more rapidly than the other basic grains[15], suggesting that farmers are price responsive. Additionally, McCandless (1991) suggests that relative bean prices may have increased in the latter part of the 1980's because the government of Honduras received more cereal donations than in the first half of the 1980s. This would have tended to decrease the price of corn and rice during the period.

[15] From 1988 to 1992, the average annual growth rate in bean production averaged 28%, compared to 3.98% for corn, 14% for rice, and 24% for sorghum.

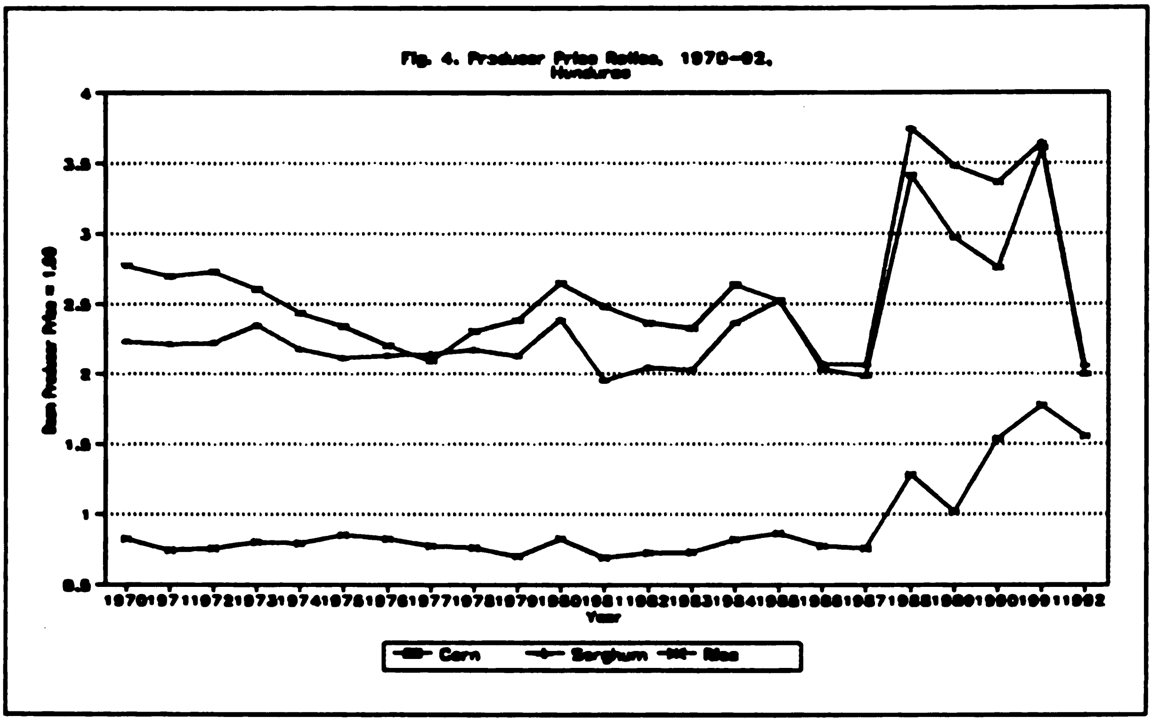

Figure 7. Producer Price Ratios, 1970-92, Honduras.

3.3.2 Bean Price Seasonality

Bean prices in Honduras follow a seasonal pattern that reflects the two bean production seasons, the *primera* and the *postrera* (Figure 8). As farmers sell their *postrera* harvest, wholesale prices fall to their lowest levels during January and February. As bean inventories decrease, prices rise to a peak during July and then fall again during August and September after the *primera* harvest. Numerically, the average seasonal price index for beans ranges from 86% in January to 116% in July[16] indicating a maximum spread of 30% between the seasonal maximum and minimum price. The sharp decline in

[16] Average price index was calculated using six years (1986 to 1991) of monthly data (UPSA).

prices after the two harvests suggest that farmers sell surpluses immediately after harvest or store for only a short period of time before liquidating their inventories.

Due to the nature of available data, this brief analysis of price seasonality has at least two limitations. First, in Honduras wholesale price data are only collected at markets in the major cities. Thus, it is unclear if the large proportion of Honduran bean consumers who live in rural areas face similar or greater price variations in seasonal prices. Second, available monthly data only dates back to 1986. Therefore, it is hard to draw firm conclusions about the price variability that traders face in any given month. High year-to-year variability in seasonal price patterns make storage decisions more difficult for traders due to high price risk.

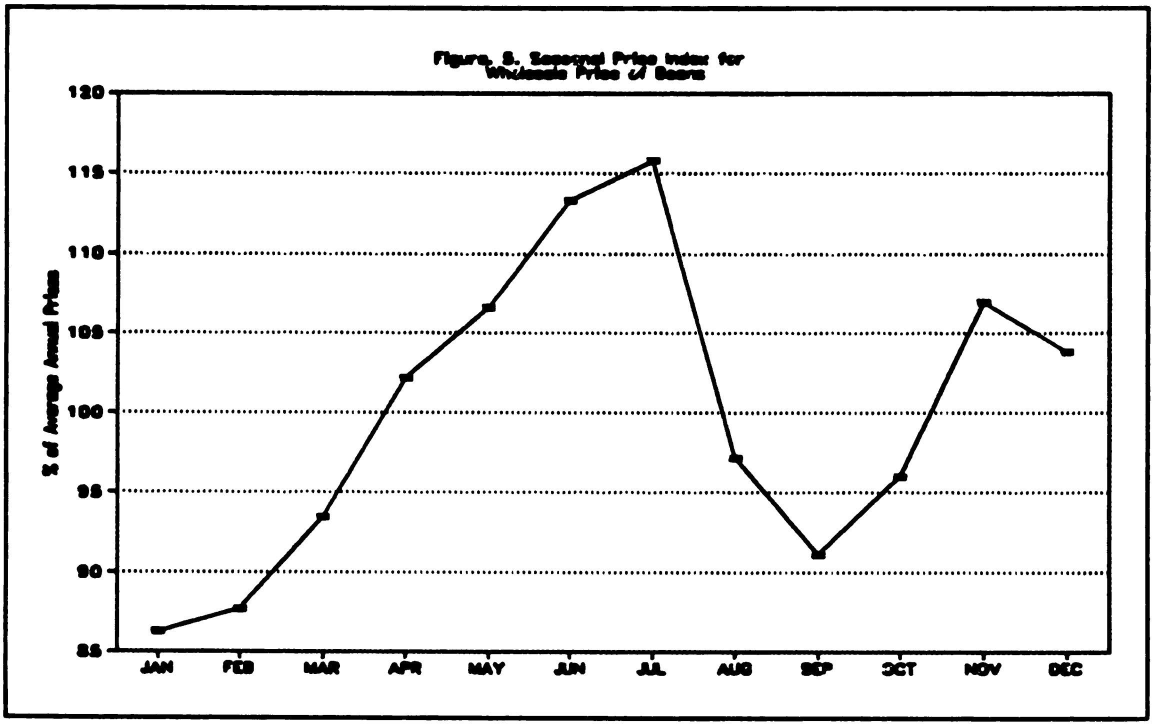

Figure 8. Seasonal Wholesale Price Index for Beans, Honduras.

3.3.3 Central American Prices

As previously mentioned, Salvador is an important export market for Honduran beans. During 1993, Honduran bean traders reported that the El Salvadorian market offers the highest bean prices in the region. This may be due to the fact that El Salvador is a more urbanized country with a higher per capita GNP than Honduras; and the fact that El Salvador, one fifth the size of Honduras, has more limited access to arable land.

Similarly, secondary data show that during the past two years El Salvadorian bean prices have exceeded prices in Honduras, Nicaragua, and Guatemala. As a result of the recently signed free trade treaty which reduces transaction costs, regional bean trade--especially exports to El Salvador--is likely to expand over the coming years.

3.4 The Bean Marketing System

The bean marketing system consists of both the infrastructure that facilitates marketing of beans and the channel through which beans are bought and sold. While Martel and Bernsten (1994) discussed the bean marketing infrastructure, this section briefly discusses the Honduran bean marketing channel and his agents. Chapter 4 and Chapter 6 of this thesis present a fuller discussion of farmers' and traders' market behavior as they relate to the Mideastern and Northeastern Regions of the country.

3.4.1 Bean Marketing Channels

The principal marketing channel agents are farmers, local traders (rural *pulperias*), regional traders (intermediaries from the cities), wholesalers, El Salvadorian traders, Honduran Institue for Agricultural Marketing (IHMA), BANASUPRO, bean packers, bean processors, and urban retail markets (Figure 9).

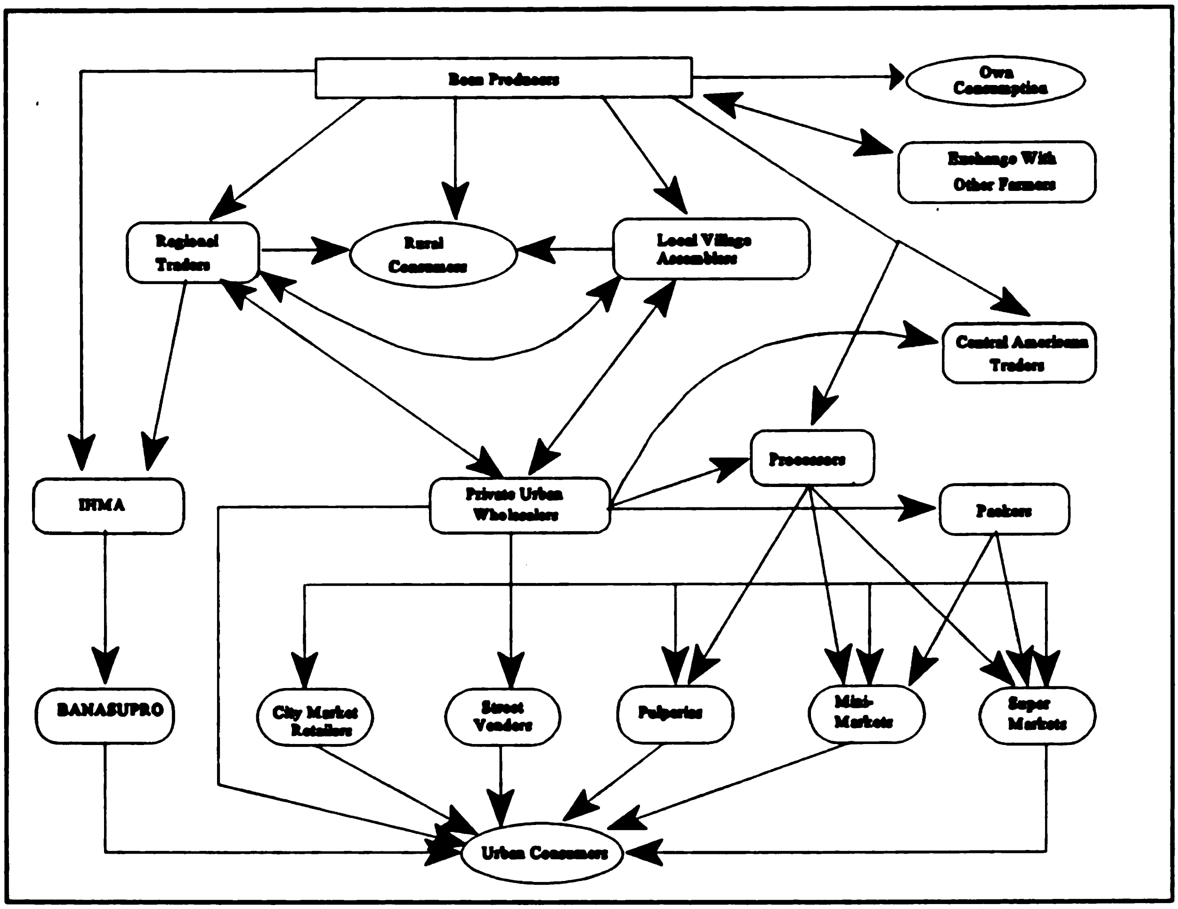

Figure 9. Bean Marketing Channels, Honduras.

3.4.1.1 <u>Farmers</u>

As previously mentioned, bean producers market approximately 57% of their total production. Most farmers sell to city intermediaries (or assemblers) who visit their farms, local traders (or assemblers), and to a lesser extent local consumers. In addition, some farmers pay the cost of transport and take their beans to the nearest urban wholesale market. Finally, some producers sell beans directly to traders from El Salvador.

Although, official statistics report low volume of farmer sales to rural consumers, several farmers reported that during the hungry season some farmers lend and/or borrow beans to/from other farmers. These are normally small volume transactions (5-20 lbs), which do not involve written (formal) contracts or monetary exchanges. Normally, when the borrower's food crops are harvested he/she repays the lender in kind.

3.4.1.2 Local Traders

Most local traders/assemblers are *pulperia* owners, or larger farmers in the region, who are familiar with the production characteristics in the region and know the farmers. These middlemen typically sell most of their bean purchases to wholesalers in the nearest urban center, although some transport their inventories to Tegucigalpa or San Pedro Sula for sale in the wholesale market.

Some local traders who own a *pulperia* buy beans from farmers and later resell them to local consumers. However, several *pulperia* owners reported buying beans from the nearest urban wholesale markets to resell in the villages. This suggests that *pulperia* owners do not store beans for long periods--possibly because the return to storage is low or that, like farmers, they hold minimal inventories because of cash flow constraints.

3.4.1.3 Regional Traders

Regional bean traders operate over a larger geographical area than do local bean traders. Generally, these traders either work directly for urban wholesalers, or work independently--selling their purchases to the highest bidder in the market. Although the relative importance of traders in rural financial markets is not clear, several bean producers reported receiving loans from local and regional traders. Clearly, the low transaction costs and timeliness of these loans are two attractive incentives that encourage small farmers to borrow from traders[17].

In addition, these traders perform the important role of redistributing beans throughout the country. For example, some wholesalers reported selling beans to regional traders for redistribution to the major production zones, as local supplies became depleted, and for sale in non-bean producing regions where beans are typically in short supply.

Although most farmers interviewed reported that they do not sell to only a single trader in a given year, at the time of this rapid reconnaissance it was difficult to determine the level of trader competition at the regional level. Some key informants contended that one of the major marketing problems in the bean subsector is collusion by traders, who set buying prices at unfairly low levels.

3.4.1.4 Wholesalers

Wholesalers buy beans from farmers, some local (rural) traders, and regional traders; and sell beans to El Salvadorian traders, bean packers, bean processors, urban retailers, and back to regional and local traders. Available evidence suggests that wholesalers store most of the beans sold between the harvesting seasons. While traders reported that they only stored beans for a maximum of 2-4 months because bean quality deteriorates with time, longer-term storage would likely be unprofitable since beans are harvested in Honduras twice a year--during the *primera* and *postera* seasons.

[17] A farmer in Olancho reported paying 5% simple interest rate per month (not compounded).

Some wholesalers play a major role as bean exporters. For instance, one wholesaler in San Pedro Sula reported exporting four truckloads (22 mt/truckload) to El Salvador in a single transaction, and another wholesaler in Tegucigalpa kept in constant phone communication with bean traders in El Salvador and Nicaragua to negotiate bean sales.

As previously stated, the GOH requires that bean exporters obtain a phytosanitary certificate from the Ministry of Natural Resources, and a certificate of origin from the Central Bank. While these documents could be readily obtained (prior to September 1993) from the Government, traders reported that they often exported beans without these official documents because obtaining them requires traveling to Tegucigalpa. Although the Honduran Government recently (September 1993 to January 1994) prohibited all bean exports to neighboring countries due to a drought-induced bean shortage, traders reported that they continued to export beans because the ban was not enforced at the borders. Thus, it is very likely that Honduras' official bean export trade statistics greatly under-record these flows. While the actual magnitude of the bean exports trade is difficult to estimate, the fact that all wholesalers interviewed reported selling beans to El Salvadorian traders within the last year indicates that it is substantial.

3.4.1.5 <u>El Salvadorian Traders</u>[18]

Although some El Salvadorian traders buy beans directly from farmers, most purchase their supplies from wholesalers. These traders mainly buy (and pay a premium

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[18] Information about El Salvadorian traders was obtained from Honduran wholesalers and farmers.

for) light shiny red beans, the market class preferred by urban El Salvadorian consumers. Three categories of El Salvadorian traders operate in Honduras. The first type, small-volume traders, travel to Honduras in a rented vehicle or a bus, with manufactured goods that they sell to Honduran stores. On their return trip to El Salvador, they buy 2-4 mt of pre-contracted beans from wholesalers in La Entrada and Santa Rosa de Copan (Western region)--which they transport (by bus or in a rented vehicle) back to El Salvador for resale. The second, intermediate-volume traders, travel mainly to buy beans directly from farmers in the Mideastern and the Northeastern Regions, or from wholesalers in the urban centers--typically assembling truckloads of 2-6.8 mt before returning to El Salvador. The third type, large-volume traders, enter Honduras with manufactured merchandise for sale to wholesalers and retailers in San Pedro Sula and Tegucigalpa. Before returning, they purchase full truckloads of beans (up to 20 mt) from wholesalers for resale in El Salvador.

3.4.1.6 Honduran Agricultural Marketing Institute (IHMA)

The IHMA was established (1978) with a mandate to improve the production and marketing efficiency of basic grains (i.e., beans, corn, rice, and sorghum). Its specific responsibilities were to: 1) provide a direct marketing channel between producers and final consumers, 2) establish minimum producer price guarantees, 3) build storage facilities in urban and rural areas of Honduras, and 4) manage all imports and exports of basic grains.

Given this mandate, IHMA's ultimate clients were to be both the producers and consumers of basic grains. Price guarantees were designed to minimize variability in farmers' inter-year revenue, with the expectation that this would stimulate investment in agriculture, which in turn would lead to a higher level of basic grain production. As basic grain production increased and a more "efficient" marketing system was established, consumers were expected to benefit from lower consumer grain prices.

However, since its creation IHMA's impact on the production and marketing of beans has been minimal. First, nominal producer prices in the parallel market have always been lower than IHMA's guaranteed producer price (Curry, 1993). Second, key informants at IHMA reported that most bean purchases were made through special arrangements with local and regional traders, rather than purchased from farmers[19]. Finally, Garcia *et al.* (1991) argues that one of IHMA's main problems was its inability to support the announced guaranteed price, due to insufficient budgetary resources. Under the new Law of Agricultural Development and Modernization (LAM), the role of IHMA as a handler of grains has been significantly reduced (3.6).

3.4.1.7 BANASUPRO

Although the internal administrative organization of BANASUPRO was redefined under the 1990 structural adjustment program to permit the franchising of some of its retail stores to private managers, BANASUPRO's main objectives remain unchanged. As a market agent, BANASUPRO is still authorized to contract beans with producer groups or import beans if necessary.

Procured beans are distributed among all BANASUPRO stores and/or sold to BANASUPRO franchisers. Additionally, in cases of national scarcity, BANASUPRO is authorized to sell beans to other retail stores. For instance, during the recent bean

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[19] SECPLAN 1991-92 reports that for this agricultural year 8% of marketed beans were sold to IHMA.

shortage (third quarter of 1993), BANASUPRO imported 2,270 mt of beans from the People's Republic of China, which it sold to BANASUPRO franchisers and privately operated retail/wholesale stores.

3.4.1.8 Bean Packers and Bean Processors

Bean packers buy beans mainly from wholesalers in the larger cities. After packaging in 5 lb bags (or lb bags), these beans are sold to mini-markets and super-markets in the main cities. One bean packer reported that he does not enter into long term contracts with the retail stores. Instead, he visits the stores regularly and fulfills orders from the retail managers on a case-by-case basis. During periods of abundant supply, bean packers reported offering special price discounts to the retail stores in order to keep shelf space and maintain a market share[20].

Several small bean-processing firms sell frozen refried beans, and one large bean-processing firm (Alimentos del Valle S.A.) sells refried beans in flexible foil packages. Alimentos del Valle S.A. buys beans from wholesalers, contract farmers, and from the conglomerate's production unit. Its processed beans (flexible packages) are sold to the main supermarkets in urban centers of Honduras, and since September 1993 are being exported[21] to the rest of Central America and the United States.

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[20] This information was obtained from only one bean packer in Tegucigalpa.

[21] During the period when bean exports were banned, this firm continued to export their products because the ban only covered dry unprocessed beans.

3.4.1.9 Retailers

Most consumers purchase beans from retailers, located in both urban and rural areas. While supermarkets and mini-markets typically procure their beans from several sources (i.e., wholesalers, bean-packers, and bean-processors), some supermarkets and mini-markets in Tegucigalpa and San Pedro Sula only buy beans from packers and processors.

Pulperias (small privately-owned stores) in major cities purchase beans from both processors and wholesalers. On the other hand, some *pulperias* in smaller towns buy directly from farmers who transport their beans to the nearest urban centers. In Tegucigalpa and San Pedro Sula, street and city-market vendors purchase beans from wholesalers; whereas in smaller towns in the bean-producing regions, city-market vendors reported buying beans from both producers and wholesalers[22].

3.5 Bean Improvement Research

The Ministry of Natural Resources and the Escuela Agricola Panamericana (El Zamorano), a private agricultural school founded in 1942, are responsible for bean improvement research and extension activities in Honduras. The Ministry of Natural Resources' Agricultural Research Division is administratively responsible for coordinating all bean research and extension activities under its National Bean Program (NBP). But in recent years, due to a reduction in Government funding[23], the NBP has been downsized.

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[22] City vendors in Comayagua, Santa Rosa de Copan, Danli, Juticalpa, Gracias, and Siguatepeque.

[23] In recent years the Regional Cooperative Bean Program for Central America, Mexico, and the Caribbean (PROFRIJOL) has provided most of the funding to support

Currently, the NBP collaborates with Zamorano in the evaluation and release of improved bean varieties, conducts agronomic trials, supports an artisan seed multiplication program, and since 1992 has conducted socio-economic studies to better understand farmers' acceptability of recently released improved varieties[24].

In contrast, Zamorano's Agronomy Department has primary responsibility for the bean breeding program, which has been carried out in collaboration with the University of Puerto Rico and the University of Nebraska since 1986, in collaboration with the Bean/Cowpea CRSP. In addition, Zamorano produces foundation seed, which it makes available to the NBP.

3.5.1 Bean Improvement Research Objectives and Priorities

The main objective of the breeding program has been to increase bean productivity through the development and release of high-yielding, multiple disease-resistant, small red, bush-type varieties. Highest priority has been placed on incorporating resistance to bean golden mosaic virus (BGMV) which is transmitted by the white fly, and is considered to be the most important (and an increasingly widespread) yield constraint for Honduran bean farmers. But because farmers typically save their own seed, the program has given secondary priority to incorporating resistance to the most common seed borne diseases--web blight (WB), common bacterial blight (CBB), and anthracnose.

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the NBP research agenda.

[24]At the time of this study, the NBP had only one full-time Ph.D. researcher and one full-time B.S. level research associate. The NBP receives partial cooperation from other programs which are part of the National Agricultural Research Program.

Although the breeding program has focused on disease resistance, it has also sought to develop heat-tolerant varieties appropriate for the southern and northern region of Honduras. Heat-tolerant varieties are expected to make it possible to expand the production frontier of beans into the more fertile lowlands of the southern and northern regions.

3.5.2 Bean Breeding and Foundation Seed Production

Zamorano's plant breeding program can be roughly separated into six stages or activities. *Stage One* (germplasm collection) involves the collection and characterization of local land races and the acquisition of exotic germplasm for use as parents in the crossing program. Presently, Zamorano's germplasm collection includes over 2,000 small red-bean acquisitions from Honduras and numerous entries obtained from the CRSP and CIAT's gene bank.

In *Stage Two* (early generation), material from Zamorano's germplasm collection with the desired agronomic and disease resistance traits are selected, hybridized, grown out, and then evaluated for yield and disease resistance[25]. All early-generation breeding carried out to generate these pure lines (F6) is conducted on-station at Zamorano. In 1992-93, the program evaluated 5,000 entries.

In *Stage Three* (advanced generation), 10-15 advanced lines that performed well in *Stage Two* are selected for testing at three different sites located in the main bean-producing areas of Honduras, namely Comayagua, Olancho, and El Barro (El Paraiso).

[25] While these material are also evaluated for agronomic traits including days to maturity, the breeding program does not screen for cooking time, taste, or any consumer preference except color and seed size/shape.

In *Stage Four*, the best 2-3 lines from *Stage Three* are further evaluated in Bean Advanced Lines Network (RELAF) field trials, in collaboration with farmers and the NBP. Currently, in each of the 20 multi-locational RELAF trials, 8 advanced lines and 2 check cultivars are being tested and scored for all major diseases.

In *Stage Five*, Honduras' most promising lines from *Stage Four* are further evaluated each year under the different agro-ecological conditions found in the region. Zamorano and the NBP implement this stage by sending their best 2-4 lines from the RELAF trials for evaluation in the PROFRIJOL-sponsored Central American National Bean Nurseries (NBN). Likewise, each member country sends 2-4 entries yearly for evaluation in Honduras' NBN.

Stage Six involves the production, release/certification, and distribution of foundation seed. After evaluating the performance of multi-location trial data, the NBP approves the release of lines with superior characteristics. Subsequently, Zamorano produces foundation seed, which it makes available to the NBP for distribution among farmers participating in the NBP's artisan seed production program.

3.5.3 Agronomic Research

Both the NBP and Zamorano carry out a limited number of agronomic trials. However, due to limited documentation available, it is difficult to assess the implications or relevance of this research. Compared to the varietal improvement research, it appears that the NBP's and Zamorano's agronomic research is quite limited in scope, particularly its outreach component.

3.5.4 Socio-Economic Research

To date, minimal socioeconomic research is being carried out in support of the bean research program. While the NBP employs no full time social scientist assigned to carry out bean research, it does support a limited socioeconomic research program which is coordinated by PROFRIJOL's regional economist based in Guatemala. The objective of these activities is to gain a better understanding on farmers' constraints to adopting improved bean varieties. In Honduras, the required farm-level data is collected by extension agents from the Ministry of Natural Resources. In addition, an agronomist from the NBP is currently being trained in primary data collection and analysis techniques. Because the extension agents were instructed to survey the most accessible bean farmers in each of their regions[26], the resulting sampling biases may limit the validity of any conclusion based on analysis of these data.

Zamorano has the potential to develop a strong socioeconomic research program to support its bean breeding efforts. Zamorano's Agricultural Economics and Rural Development Departments have several social scientists in their staff. However, to date there has been limited collaboration between the bean breeding program and these departments. Historically, the Agricultural Economics Department has focused its effort on agri-business development in specific, targeted rural areas. While the Rural Development Department has provided some support to the bean breeding efforts, this has been limited to providing technical assistance to farmers participating in the RELAF trials.

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[26] Extension agents are expected to visit small, medium, and large size farmers.

Thus, Zamorano has yet to establish strong linkages between its social science programs and the Agronomy Department.

3.6 Government Policies Affecting The Bean Subsector

As previously mentioned, in Honduras, beans are an important crop for small farmers, and the second most important source of proteins in the diet of a large proportion of rural and urban consumers. During the past two decades, the performance of the bean subsector, as well as that of the overall agricultural sector, has been mixed. Recognizing the need to address structural constraints, in 1992, the Government (with assistance from international donors) introduced a comprehensive set of macro-economic and sectoral policy reforms that are expected to increase agricultural productivity and have a positive influence on the bean subsector. Under its structural adjustment program, the Government eliminated price controls, decreased regulation of international trade, dismantled the marketing parastatal, decreased support to the Ministry of Natural Resources for technology generation and diffusion, and introduced policies designed to develop a more comprehensive land market.

Despite recent increases in the production of beans (1989-1991), Honduras faces the challenge of sustaining this achievement--as indicated by the severe bean shortages that occurred during 1993. The future performance of the bean subsector will be greatly affected by the impact of these reforms on the structure of incentives facing producers, traders, processors, and consumers.

3.6.1 Macro-Policies

Since 1990, the Honduran Government has introduced several macro-economic policy changes that can be expected to have a major impact on the agricultural economy and the bean subsector.

3.6.1.1 Price Control Policies

During the second half of the 1970s and through the 1980s the Government, through IHMA, established guaranteed producer prices to stimulate the production of beans and other basic grains. However, large bean farmers and traders, rather than small bean farmers, benefited the most from these guaranteed prices. Thus, by the end of 1989 the GOH started to gradually liberalize price controls; and in 1992 passed the LAM which specifically eliminated price guarantees for bean and other basic grains.

Some economists and policy makers argue that price liberalization will result in higher producer prices, which will encourage more "efficient" farmers (i.e., farmers who will adopt more modern technologies) to enter the bean subsector. And as a result, a higher level of productivity will be achieved in the bean subsector. However, this scenario assumes that bean farmers face few constraints (other than low prices) to expanding their production. Thus, it is important to determine what are the main production and off-farm bottlenecks which need to be relaxed in order to increase bean productivity.

3.6.1.2 International Trade

Two recent trade-related developments are expected to have a significant impact on the bean sector. First, after 73 years (1917-1990) of maintaining a fixed exchange rate, in 1990 the GOH introduced a flexible exchange rate, and by 1993 a visible and legal parallel foreign exchange market functioned throughout the country. Second, in 1991 the GOH and the other Central American countries signed a free trade treaty, which eliminated tariffs for beans and other agricultural products traded in the region.

Both of these measures are expected to enhance the competitiveness of Honduran beans in the Central American regional market --a development which highlights the need to analyze the Honduran bean subsector within the broader context the Central American region[27].

3.6.2 Sectoral Policies

In addition to macro-policy reforms, the Honduran Government has implemented several new sectorial policies which will have far reaching impacts. The Council for Agricultural Development (CODA), responsible for designing the GOH's sectoral agricultural policies, is a key actor in the agricultural policy process. Chaired by the Minister of Natural Resources, the Council includes the heads of the Ministry of Economics and Commerce, the Ministry of Finance, the Supreme Council of Economic Planning (CONSUPLANE), and the National Agrarian Institute. Several of the major sectoral policy reforms introduced since 1990 are discussed below.

3.6.2.1 Dismantling of the IHMA

As previously stated, under the 1990 structural adjustment program, the GOH gave priority to redefining the role of IHMA. By 1993, IHMA's functions were reduced to purchasing strategic grain stocks from regional and international markets and providing

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[27] A more complete discussion of the history of Honduras' exchange rate policy found in Schreiner and Garcia (1993).

ancillary services (i.e., market information, technical assistance, and storage of strategic reserves). Therefore, under a regime of budgetary austerity and as Honduras integrates into the regional and global markets, it is important to strengthen IHMA's efficiency.

3.6.2.2 Agricultural Technology Policy

One of the major changes introduced by the LAM was the redefinition of the role of the Ministry of Natural Resources in the development and transfer of new agricultural technology. Most important, the LAM created the Division of Agricultural Science and Technology (DICTA), and placed it in charge of the design, direction, and execution of all research and extension programs. While previously agricultural research and extension had been the responsibility of the Ministry of Natural Resources, DICTA's mandate is to promote agricultural research in the private sector, with the objective of minimizing public sector participation in agricultural research.

Under these new institutional arrangements, Escuela Agricola Panamericana del Zamorano, in collaboration with Bean/Cowpea CRSP and PROFRIJOL, are increasingly responsible for conducting most of the technical research on beans. In addition, the GOH has delegated the distribution of improved seeds to private agents.

These major institutional changes have important implications for the subsector's future performance and raise important questions about the future sources of bean technology development and transfer capacity. Are available resources sufficient to develop new bean technologies? Do sufficient incentives exist for private agents to multiply and distribute an adequate supply of improved seeds? How do these subsector participants view and how will they respond to the new set of institutional arrangements?

These issues highlight the need to better understand how new coordinating mechanisms will be implemented to link public and private sector efforts to develop and extend new technology for the subsector, and what incentives are required to insure successful performance.

3.6.2.3 Land Market Policy

Finally, the LAM prescribes a new set of rules concerning land reform. The core of these reforms legalizes agricultural land leases, and promote the development of land markets by establishing a more widespread and inclusive land titling program. More secure land tenure arrangements are expected to promote more efficient resource use--including the rapid adoption of new bean technology.

However, given an already existing skewed land distribution structure, these reforms raise several problematic productivity and equity issues. Will these new incentives promote productivity increases on both small and large farm holdings? Will the net effects of these changes lead to an inter-sectoral shift in production that reduces the income of small bean farmers? Insights regarding these potential impact are needed to not only better understand how the new land reform regulations will contribute to improving the productivity and welfare of small bean producers, but also to identify additional policy reforms needed to further increase productivity and equity in the bean subsector. Bonnard (1995) presents a comprehensive assestment of the current situation, and potential impacts of the new policies affecting Honduran agricultural land markets.

3.7 Summary

In Honduras, beans are an important crop for small farmers, and the second most important source of proteins in the diet of a large proportion of rural and urban consumers. During the past two decades, the performance of the bean subsector, as well as that of the overall agricultural sector, has been mixed. This chapter reviews the recent history of the Honduran bean subsector, using official aggregated production and price data in addition to a series of informal interviews with subsector participants conducted from November 1993 through January 1994.

In recent years, per capita bean consumption in Honduras has averaged 10 kg/year. Although small red beans are the dominant market class, consumer preferences for red versus black beans varies across the country. Because Government data collection agencies only report data for red beans, available statistics implicitly reflect the incorrect assumption that only red beans are produced and consumed. Although consumers express strong preferences for quality characteristics such as color, cooking time, and cooked texture, to date little research has been undertaken to determine the most important factors affecting consumer preferences. Finally, while most beans are marketed as dried beans, several entrepreneurs have recently emerged to meet the demand of more sophisticated urban consumers for processed beans, producing refried bean in frozen and flexi-pak presentations.

To better understand the role of beans among different farm size strata, official data were stratified by farm size. Moreover, the Central American region represents a major market outlet for Honduran beans, with Honduras accounting for approximately 44% of the region's officially recorded bean exports (1982-91).

During 1982-92, the bean area averaged 74,900 has, equal to 15% of the total staple food crop area. Although bean production appears to have increased in the past four years (112,000 has in 1992), it is difficult to determine what has prompted this production response. Available evidence suggests that part of the response is likely due to a redefinition of the "farm" to include the smallest holdings (e.g., farms < 0.7 has, which account for 12% of the bean farmers)--prior to 1987-88, these small units were not counted by Government data collection agencies. In addition, the expansion of the land frontier may account for part of the reported production increases. About two-thirds of the country's beans are grown in the *postrera*. The most important regions are the Northeastern and Mideastern, which account for 70% of total national production. While small farmers (<3.5 has) produce most (57%) of the output, the small share of farms >14 has (15%) account for 34% of total production. Generally, farmers intercrop beans with corn in the *primera*, and plant beans as a sole crop in the *postera*.

Over the last two decades, annual producer prices have been more stable than consumer prices which have varied considerably from year-to-year. However, wholesale domestic bean prices are highly seasonal--ranging from 86% of the average annual price in January to 116% of the annual average price in July. Over the past four years, beans have become an increasing attractive cash crop for farmers--bean prices, compared to the price of maize, sorghum and rice, have increased significantly over the period. While this development has made bean production more profitable for farmers, it has made beans more expensive for consumers. Among the Northern Central American countries, the El Salvadorian bean price seems to be the best indicator of regional price trends.

Although with market liberalization, the role of government grain marketing agencies has decreased, this has not resulted in any major problems. Prior to market liberalization, the Honduran bean marketing system--composed of many private market agents--was relatively strong and has continued to develop into a very progressive marketing system. However, a lack of transparency in the intra-regional trading rules remains a key marketing constraint that negatively affects export trade.

Bean research has made a major contribution to the subsector, primarily through the development of improved bean varieties resistant to key diseases. As a result of the restructuring of the GOH's budget, funding for the Ministry of Natural Resources research program has decreased significantly. As a result, Zamorano's Agronomy Department is now primarily responsible for breeding improved bean varieties. In contrast, agronomic research and socio-economic research has been very limited.

As an additional consequence of budgetary cuts, the Ministry Natural Resources has reduced its extension services to farmers. The main bean-related extension effort is the promotion of the artisan seed production programs. In addition to limited access of extension services, small bean farmers have very limited access to the government-sponsored credit programs.

Since 1990 the Government has introduced major changes in macro and sectoral policies, designed to revitalize the agricultural sector. At this point, the effect of the new Law of Agricultural Development Modernization on the bean subsector is unclear. In contrast, the new international trade policies are likely to affect the performance of the bean subsector, specially under a regime of potential competitive advantage with respect to the other Central American countries. On the other hand, the potential for Honduran bean producers to compete in a regional market may be affected by the inability of these policies to promote an increase bean farmer's production without significantly raising the per unit costs.

CHAPTER FOUR

THE BEAN FARMING SYSTEM IN MIDEASTERN AND NORTHEASTERN HONDURAS

4.1 Introduction

The general characteristics of the bean production systems were described in chapter 3. This Chapter studies the micro components of the different farming systems and analyzes how each element of the system is expressed across different macro-environments and farm sizes; including farmers' land use (4.2), use of chemical inputs (4.3), use of improved bean varieties (4.4), farmers' market orientation (4.5), and characteristics of the household members and the decision makers (4.6).

As an introduction to the data analysis presented in this Chapter, recall from Table 2.1 that in total 215 bean farmers were interviewed. These farmers were distributed as follows: a) 12.1% small hill-side farmers, b) 11.6% small flat-land farmers, c) 22.8% medium hill-side farmers, d) 20% medium flat-land farmers, e) 13.5% large hill-side farmers, and f) 20% large flat-land farmers. Thus a larger proportion of large farmers in the sample are flat-land farmers. Additionally, as is shown in this Chapter, a larger proportion of bean farmers plants beans in the *postrera* (dry season) than in the *primera* (rainy season). In the *postrera* 89% of the farmers planted beans, whereas in the *primera* only 64% of the sampled farmers planted beans.

Moreover, although the sample design did not stratify by Administrative Region it is shown that there are several production differences associated with the Administrative Region. Therefore it is important to understand the distribution of sampled farmers by

Administrative Region. There were 145 bean farmers interviewed in the Mideastern Region, and 70 farmers in the Northeastern Region. Table 4.1 shows the distribution of sampled bean farmers across two different topographical regions by Administrative region in each cropping season. While the total number of interviewed farmers is larger in the Mideastern region, it is clear that a larger proportion of interviewed farmers in the Northeastern region were in the hill-sides.

Table 4.1 Sample Distribution Across Topography by Administrative Region, Honduras 1994.

Count Row Pct. Column Pct.	Hill-Side	Flat-Land	Row Total
Region in *Primera*			
Mideast	53 55.8 65.4	42 44.2 72.4	95 68.3
Northeast	28 63.6 34.6	16 36.4 27.6	44 31.7
Column Total	81 58.3	58 41.7	139 100.0
Region in *Postrera*			
Mideast	55 41.7 61.8	77 58.3 74.8	132 68.8
Northeast	34 56.7 38.2	26 43.3 25.2	60 31.2
Column Total	89 46.4	103 53.6	192 100.0

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

4.2 Bean Cropping Patterns and Land Use

Honduran bean farmers can be grouped into three categories: a) farmers who only plant beans as a mono-crop, b) those who plant beans both as a mono-crop and an inter-crop, or c) those who only inter-crop beans, typically with corn. Moreover, farmers use their land resource differently during the two distinct cropping periods, rainy and dry seasons. Therefore, data in this section are reported independently for each season, and across the three different bean cropping systems; mono-crop, mono-crop/inter-crop, and inter-crop.

Rainfall is one of the most important elements determining the intensity of land use. In the Mideastern and Northeastern Regions of Honduras where irrigation systems are scarce, during the *primera* (rainy season) farmers use land more intensely than during the *postrera* (dry season). In the *primera* the surveyed bean farmers allocated 54% of their available land to crops, whereas during the *postrera* they cropped only 40% of their land. Weather also influences the intensity of farmers' cropping patterns. For example, in the *primera* 22% of the farmers planted inter-cropped beans, whereas in postrera only 3% of the farmers intercropped beans. Moreover, farmers plant corn --with larger water requirements than beans-- more widely in the *primera*.

Although Honduran agricultural policies have traditionally been biased in favor of larger farmers, data show that small farmers crop their available land more intensely. ANOVA analyses confirmed that during both the *primera* and *postrera*, there is a strong negative association between farm size and the percentage of farm land which farmers cropped[1]. In addition, during the primera flat-land farmers tend to use their land more

[1]Although pasture for cattle is not reported as a crop, it is important to mention that only among some larger farmers in the sample, cattle production is an important agricultural activity .

intensely than hill-side farmers[2] (Table 4.2); mainly because corn, an important flat-land crop, is more widely grown in the rainy season.

While exploring how intensely farmers crop available land is important to determine the potential to increase cropped area, an analysis of the different crops farmers produce helps understand what these farmers perceive as their agricultural alternatives. In terms of planted area, the most important crops grown by bean farmers are corn, beans, and coffee (Tables 4.3, 4.4, and 4.5). While corn is the dominant crop in the *primera*, in the *postrera* beans are planted in a larger proportion than any other crop. However, although the share of cropped land planted to corn is not associated with farm size, there is a strong evidence that smaller farmers allocate a larger percentage of their cropped land to beans[3] than do larger farmers. This suggests that under existing technologies and market environment corn can be successfully planted in larger areas, whereas bean production appears to be constrained to relatively small enterprises (i.e., < 2 has). Finally, while coffee is the third most widely grown crop --within the sample--, among bean growers who also plant coffee --mainly hill-side farmers-- coffee is the most widely grown

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[2]During primera, mono-crop farmers in the flat-lands farm about 8% more of available land than hill-side farmers (significantly different at 16% level), and inter-crop flat-land farmers farm about 44% more than their hill-side counterparts (significantly different at the 1% level).

[3]ANOVA analyses , indicate that the percentage of all crop land in beans decreases as the farm size increases, for both the primera and postrera (at a 1% level of significance). In contrast, for corn the evidence for relationship between farm size and area planted is not so strong (38% level of significance in the primera).

crop --accounting for 48% and 45% of the of total land cultivated by hill-side bean farmers in the *postrera* and *primera*, respectively[4].

This overview of the bean farmers' land use sheds some light on the prospects for increasing bean production. It is clear that medium and large bean farmers have sufficient land resources to increase their bean production by increasing their area in beans. However, given the riskiness of bean production during the postrera; it is unlikely that these farmers will increase their area under bean cultivation without significant changes in policies/technologies which will enable producers to cope with the unpredictable nature of rainfall. Moreover, it is important to recognize that for hill-side farmers --with a potential to grow coffee-- there is less incentive to expand their bean area than for flat-land farmers who are mainly staple grain producers.

[4]Among coffee/bean farmers, in the postrera the 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 4.2 Proportion (%) of Available Land Planted in Different Cropping Systems[5], Mideastern and Northeastern Regions of Honduras, 1993-1994.

Sampling Strata	**Rainy Season**						**Dry Season**			
	Mono		**Mono/Inter**		**Inter**		**Mono**		**Inter**	
	n	Mean Median	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										
Flat	49	56% 52%	2	58% 58%	7	96% 60%	97	40% 32%	0	
Hill	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.

[5]Mono-cropping, farmers who only plant beans as a Mono-crop; Single/Inter-cropping, farmers who plant beans as a single and inter/crop; and inter-cropping, farmers who only plant beans as an inter-crop.

Table 4.3 Proportion (%) of Cropped Land in Different Crops, Mono-Crop Bean Farmers, Mideastern and Northeastern Honduras, *Primera* 1993.

Bean Farm Categories	Crops for Mono-Crop Bean Farmers in *Primera*			
	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				
Flat (n=49)	26%	64%	6%	4%
Hill (n=59)	26%	51%	22%	2%
Region				
Mid-Eastern (n=69)	29%	59%	8%	4%
North-Eastern (n=39)	21%	53%	26%	1%

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

Table 4.4 Proportion (%) of Cropped Land in Different Crops, Inter-Crop Bean Farmers, Mideastern and Northeastern Honduras, *Primera* 1993.

Bean Farm Categories	**Crops for inter-crop bean farmers in *Primera***			
	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				
Flat (n=7)	40%	8%	45%	6%
Hill (n=19)	22%	16%	56%	6%
Region				
Mid-Eastern (n=22)	26%	10%	57%	7%
North-Eastern (n=4)	32%	37%	31%	n.a.

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

Table 4.5 Proportion (%) of Cropped Land in Different Crops, Mono-Crop Bean Farmers, Mideastern and Northeastern Honduras, *Postrera* 1993-1994.

Bean Farm Categories	**Crops for Mono-Crop Bean Farmers in *Postrera***			
	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				
Flat (n=97)	82%	9%	4%	4%
Hill (n=89)	71%	2%	22%	4%
Region				
Mid-Eastern (n=126)	84%	5%	6%	4%
North-Eastern (n=60)	62%	7%	27%	5%

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

4.3 Use of Chemical Inputs[6]

As is the case of the intensity of land use, in the Mideastern and Northeastern Regions of Honduras, farmers' input use varies considerably across cropping seasons, farming systems, farm sizes, and topographical regions. In general, farmers apply chemical inputs either to increase yields (i.e., fertilizers), reduce labor requirements (i.e., herbicides), or to reduce the risk of losses from disease and insect attacks (i.e., fungicides and insecticides). While the intensity of input use, and the type of input use are important technical questions, in this section input use is a broader concept. This analysis focuses on understanding different farmers' propensity to make cash investments in bean fields.

4.3.1 Chemical Input Use and Cropping Seasons

Disaggregating input use across cropping seasons indicates farmers' willingness to make cash investments in one season versus another, providing researchers and policy-makers with insights as to the relative importance of the two different seasons. Differences in use across cropping seasons may arise from two different sources. First, from farmers who plant beans in both seasons (dual-season farmers) and tend to use inputs more frequently in one season; and secondly, from farmers who plant beans only in one season (single-season farmers) and tend to use inputs more frequently in a specific season. In the study area, farmers demonstrated a stronger preference to apply inputs in bean fields during the *postrera*. For example, in 1993, during the *postrera* 46% of the farmers

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[6] In this section chemical inputs refer to purchased inputs such as fertilizers, insecticides, herbicides, and fungicides (chemical inputs and inputs are used interchangeably). In this section the use of inputs is measured as a dichotomous variable (i.e., use, and not use), as opposed to intensity of use. Input users strictly refers to farmers who use inputs in bean fields.

used inputs, whereas in the *primera* only 35% of the farmers used inputs (Table 4.6). While dual-season/mono-crop bean farmers used inputs as frequently in both seasons, single-season/mono-crop and dual-season/mono- & inter-crop bean farmers showed a stronger preference for applying cash inputs in the postrera.

Overall the evidence suggests that 44% of the single-season/mono-crop *postrera* farmers apply inputs whereas only 27% of their *primera* counterparts use inputs. Moreover, among dual-season farmers who plant inter-crop beans in the *primera* and mono-crop beans in the *postrera*, a larger proportion of the *postrera* farmers (83%) use inputs than in primera (44%)[7]. These results suggest that farmers in the *postrera* are more likely to perceive the use of inputs as an economically justifiable expenditure.

[7]In the *primera* the average amount of money spent on all inputs was Lps. 250 per hectare (median Lps. 100), and in the *postrera* the average was Lps. 490 (median Lps. 100).

Table 4.6 Bean Farmers Applying Chemical Inputs (%) by Cropping Season, Mideastern and Northeastern Honduras, 1993-1994.

Cropping Systems	**Season in Which Farmers Plant Beans**			
	Primera		***Postrera***	
	(n)	%	(n)	%
All Farmers	(139)	35%	(192)	46%
Single-Season/Mono-Crop	(15)	27%**	(72)	44%**
Dual-Season/Mono-Crop	(92)	34%	(92)	37%
Dual-Season Inter-Crop and Mono-Crop	(18)	44%*	(18)	83%*

** Significantly different across seasons with a p-value of 0.07.
* Significantly different across seasons with a p-value of 0.21.
Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP, and Food Security II.

4.3.2 Chemical Input Use and Farm Size

Further analysis of the data by farm size, within the same cropping season, helps to further clarify the basic characteristics of input users (Table 4.7). Traditionally, the National Bean Research Program (NBP) and policy makers have considered larger farmers to be more progressive. However, data from this study show no significant association between total farm size and farmers' use of purchased chemical inputs. This evidence supports the proposition that, in general, chemical input use is similar for small or large farmers. While this analysis does not present evidence about the level of input use by farm size[8], it has been found that differences in levels of input use across farm size are normally explained by institutional variables such as access to credit and extension services, and proximity to input markets (Mekurai, 1994). Nonetheless, greater access to these ancillary services by larger farmers emphasizes the already existing institutional bias towards larger farmers, and sheds little light about differential behavior of small versus large farmers.

4.3.3 Chemical Input Use and Topography

While beans are more widely grown in the flat-land than in the hill-sides there is no evidence among the sampled farmers that a larger proportion of flat-land farmers use chemical inputs. Among sampled farmers, similar proportions of flat-land and hill-side farmers used inputs. Over 40% of the mono-crop bean farmers in the *postrera* used inputs both in the flat-land and hill-sides, and just over 30% of their *primera* counterpart did so. This evidence suggests a need to reconsider the conventional belief that larger and flat-land farmers are more progressive than smaller and hill-side farmers.

4.3.4 Chemical Input Use by Administrative Region and Types of Inputs

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 than Mideastern farmers. Farmers in the Northeastern Region use chemical inputs less frequently than farmers in the Mideastern Region. For instance, about 15% more of the Mideastern farmers used inputs than did their

[8]Data on the level of input use was very hard to obtain specially in the case of insecticides which are frequently purchased as fluid products. Making it hard to standardize measuring units and concentrations.

Northeastern counterparts (in all different production systems). 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.

Additionally, these data indicate that the two inputs bean farmers use most frequently are fertilizers and insecticides (Table 4.8). While a majority of the input-users only apply one input in beans (i.e., 86% and 65% of input-users in *primera* and *postrera*, respectively) the strategy to use insecticides seems to differ from that of using fertilizer. During *postrera*, 59% of the farmers who used insecticides applied it in combination with another type of chemical input, whereas only 43% of those who used fertilizer combined it with another chemical input.

Table 4.7 Bean Farmers (%) Using Chemical Inputs by Farm Size, Topography, and Administrative Region, Honduras, 1993-1994.

Farm Strata	**Rainy Season**				**Dry Season**	
	Mono-Crop		**Inter-Crop**		**Mono-Crop**	
	(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						
Flat	(49)	35%	(7)	43%	(97)	47%
Hill	(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.

Table 4.8 Bean Farmers (%) Applying Different Types of Chemical Inputs, Mideastern and Northeastern Honduras, 1993-1994.

Type of Input	Rainy Season		Dry Season
	Mono-Crop (n=108)	Intercrop (n=26)	Mono-Crop (n=186)
Fertilizer	19%	27%	25%
Insecticide	15%	31%	27%
Herbicide	2%	0%	10%
Fungicide	1%	0%	3%

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

Finally, it is clear that average bean yields of input users are higher than for non-users of inputs. During the *primera* input users average a bean yield of 610 Kg/ha whereas non-users average 490 kg/ha. During the *postrera* the difference is larger, input users average 690 kg/ha and non-users only 440 kg/ha[9]. This suggests that further analysis of what limits chemical input use among farmers could help improve bean productivity in the Mideastern and Northeastern Regions of Honduras.

4.4 Use of Improved Bean Varieties

As described in Chapter 3, the most important bean related research and extension activity of the NBP during the last decade has involved the release of improved bean varieties. The release of Catrachita in 1987, and Dorado in 1990 were the most important

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

achievements of the NBP[10]. While Catrachita was released for its yield potential, it was not tolerant to the most virulent bean disease in the inland valleys, Bean Golden Mosaic Virus (BGMV). Further research and trials led to the release of Dorado, a bean variety tolerant to BGMV[11]. 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 the adoption of these varieties in other regions of the country. This section presents data on the adoption of these improved varieties[12] during 1993-1994 across different farm sizes, administrative regions, and topographies. This section also analyzes how bean yields vary among adopters[13] versus non-adopters of improved varieties.

4.4.1 Distribution Channels of Bean Seeds and Genetic Diversity

In Honduras, farmers can acquire seeds through, at least, four different channels. First, through the official government distribution channel (sponsored by the NBP) which includes the artisan seed production/distribution system; second, through farmers' own production; third, through relatives or friends -- usually neighboring farmers; and finally through the market from traders selling and recommending the use of a specific variety.

[10]In addition, Don Silvio, a variety from the same genetic source as Dorado, was released in 1993.

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

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

[13]In this section adopters (non-adopters) of improved varieties refer to those farmers who planted (did not plant) either (neither) Dorado or (nor) Catrachita during the agricultural year 1993-1994.

In the Mideastern and Northeastern Regions, neighbors and traders are the two most important sources of bean seeds for farmers using new varieties for the first time. In particular, 55% of the farmers who planted Catrachita during 1993 obtained this improved seed for the first time from neighboring farmers; this compared to 48% for farmers who planted Dorado. Traders are the second most frequent source of new seed for Catrachita (23%) and Dorado users (15%). On the other hand, once farmers adopt a bean variety a large proportion of farmers save seed for the next season. For example, in 1993 a large proportion of veteran[14] Catrachita (69%) and Dorado (41%) adopters planted self-grown seed. This evidence supports the strategy followed by the artisan bean seed production/distribution program, which promotes the production and distribution of improved seeds through neighbors and farmers' own production.

Historically the introduction of improved varieties has reduced genetic diversity by encouraging farmers to substitute a high-yielding modern variety for several traditional varieties. However, in the case of Honduran bean farmers the evidence shows that a large proportion of farmers who grow improved varieties also plant other bean varieties (traditional or improved). For instance, in 1993, 82% of the farmers growing traditional varieties planted only one variety, whereas only 52% of those producers who planted improved bean varieties grew a single variety. When asked why they grew more than one variety, farmers' two most frequent reasons were: a) to reduce the risk of production losses and thus ensure production (35%), and b) to conduct their own farm trials and

[14]Veteran users refers to farmers who in 1993 had used the improved variety for at least two years.

determine which variety has the highest potential for yields (29%). On the other hand, 27% of the farmers who planted only one variety did so because their chosen variety was easier to sell when not mixed with several varieties, and 17% of the farmers said that they planted only one variety because it was the best yielding variety they knew.

4.4.2 Use of Improved Bean Varieties and Topography

The interaction of a variety with weather and topography --variables which the farmers cannot control-- influences the performance of improved technologies. In Honduras, farmers prefer to grow traditional varieties in the drier season due to their shorter physiological maturity time (60-65 days); whereas resistance to fungal diseases may induce farmers to plant disease tolerant improved varieties in the rainy season. While both Catrachita and Dorado have longer physiological maturity periods (75-80 days) than traditional varieties; only Catrachita has shown tolerance to some fungal diseases. Nonetheless, both varieties' yield potential makes them equally attractive to farmers for both rainy and dry seasons. Thus, in 1993, over 30% of the farmers planted improved varieties in both seasons[15]. Despite this evidence of widespread adoption of improved varieties with long maturity periods and low tolerance to fungal diseases, these characteristics may represent a constraint to long term sustained adoption of these varieties and more widespread diffusion.

On the other hand, topography has had a stronger influence on the adoption of improved varieties in Honduras. While Catrachita is markedly planted more often by

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[15] In *primera* 34% of the farmers used improved varieties; in *postrera* 32% of the farmers used improved varieties --Catrachita and Dorado.

hillside farmers than flat-land farmers, Dorado is widely grown in the hillsides as well as in the flat-lands. The data show that while 37% of hillside farmers used Catrachita, only 11% of flat-land farmers planted this variety (Table 4.9). The difference in the adoption of Catrachita across topographies reflects Catrachita's low tolerance to BGMV, which is more virulent in the low valleys. On the other hand, Dorado has shown tolerance to this disease. Thus, this evidence suggests that as farmers acquire knowledge about the different characteristics of specific improved varieties, they make selective decisions about their use.

4.4.3 Use of Improved Varieties and Administrative Regions

However, in order to acquire personal knowledge about the new technologies farmers must be exposed to them. Therefore, it is logical to expect that farmers in regions where there is more access to modern technology are more likely to adopt the technology. In the case of 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 4.9).

4.4.4 Use of Improved Bean Varieties and Farm Size

On the other hand, as in the case of chemical inputs there is little evidence that the use of Dorado is associated with farm size. However, the evidence suggests that adoption of Catrachita is positively associated with farm size. While 19% of the farmers with 10 hectares or less use Catrachita, 32% of farmers with farms larger than 10 hectares use Catrachita (Table 4.9). This result may suggest that Catrachita may have certain characteristics which favor larger farmers, as opposed to smaller farmers. For instance, both traders and producers have stated that while Catrachita has undesirable culinary characteristics[16] it has an acceptable tradeable appearance in some Honduran markets. Thus making Catrachita more acceptable among farmers who tend to sell a larger proportion of their bean production. On the other hand, the association between farm size and use of Catrachita may reflect that larger farmers have had more access to the improved variety than smaller farmers.

Although it is clear that the interaction between variety and the environment is an important factor in farmers' adoption decision, farmers' varietal choices are influenced by additional factors. At first glance, the initial farmers' varietal selection criterion appears to be similar to the objectives guiding a standard plant breeding program. In the Mideastern and Northeastern Regions of Honduras, a large proportion of farmers said that their first reason for planting a variety was its potential for good yields. Among farmers who planted Dorado or Catrachita, 40% listed their potential for good yields as a the first reason for planting the varieties. Similarly, among farmers who used all other varieties, 35% listed their yield potential as the first reason for using the variety. The second most frequently cited criterion for selection is closely related to yield potential. In the case of Dorado, 19% of adopters reported its resistance for BGMV as their first selection

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[16]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 and round bean preferred in some markets.

criterion, while 21% of Catrachita growers listed some kind of resistance as their selection criterion (i.e., no specific reference to a single disease). Among all other varieties, 21% of farmers reported they had selected their variety for its ability to escape droughts (i.e., a short physiological maturity period). These results show that farmers introduce risk parameters into their decision-making process when selecting a specific variety, suggesting that advanced improved lines should continue to be evaluated under risky environments as a means of simulating farmers conditions.

Table 4.9 Farmers Using Improved Bean Varieties (%), Mideastern and Northeastern Regions, Honduras, 1993.

Strata	Improved Varieties	
	Catrachita (n=50)	Dorado (n=44)
Administrative Region		
Mid-Eastern (n=144)	27%[a]	27%[b]
North-Eastern (n=70)	16%[a]	7%[b]
Topographical Region		
Hilly (n=104)	37%[c]	18%
Flat (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%

[a] Significantly different across administrative regions with a p-value of 0.04
[b] Significantly different across administrative regions with a p-value of 0.00
[c] Significantly different across topographical regions with a p-value of 0.00
[d] Positive association use of Catrachita and farm size with a p-value of 0.08
Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP, and Food Security II.

4.4.5 Improved Bean Varieties and Yields

The data show that yield performance of improved bean varieties is influenced by environmental conditions. While bean yields for Dorado adopters were significantly higher than for non-adopters only in the *postrera*, bean yields were significantly higher for Catrachita adopters in the *primera* only. These results suggest that Catrachita is a higher yielding variety in the *primera* and Dorado in the *postrera*[17] (Table 4.10). This may be partly due to a season-pathogen interaction. While the *postrera* environmental conditions are more appropriate for the development of the BGMV vector (white fly), in the *primera* fungal diseases are more prevalent. This suggests that while in the absence of BGMV Dorado is not a higher yielding variety than other bean varieties, Dorado performs better than other varieties under the virus' pressure. In addition, bean yields among Dorado adopters in postrera may be influenced by the use of chemical inputs. While there is no significant association between input users and Catrachita users in *primera*, the data show that there is significant association between Dorado users and input users in the *postrera* (70% of Dorado users also use other chemical inputs). This suggests that average bean yields among Dorado users in the postrera are also influenced by the use of chemical inputs.

[17]While the results reported in Table 4.10 control for the interaction between Dorado and Catrachita growers (i.e., Dorado yields cannot be attributed to interaction with Catrachita, and vice-versa), these results, however, may underestimate the yields of the improved varieties because they represent an average bean yield including all other traditional varieties.

Table 4.10 Bean Yields Among Adopters of Improved Bean Varieties, Mideastern and Northeastern Regions, Honduras, 1993-1994.

Season	Catrachita Adopters	Dorado Adopters	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

[a] Significantly different adopters vs. non-adopters with p-value of 0.09, (t-test).
[b] Significantly different adopters vs. non-adopters with p-value of 0.03, (t-test).
Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP, and Food Security II.

4.5 Farm Sales

In Honduras there has been little research on the sales behavior of basic grain farmers. Much of the conventional wisdom about basic grain farmers' sales behavior evolves around the notion that small farmers are self sufficient, and that beans are not an important commercial crop. This section describes bean farmers' sales behavior disaggregated across farm sizes, and analyzes the relative importance of bean sales with respect to total farm sales. In addition, this section presents evidence to assess the relationship between farmers' commercial orientation and the use of improved varieties.

The sampled farmers can be grouped into three different groups according to their commercial orientation: first, the 18% of farmers who did not report any farm sales (non-sellers), second, the 32% of farmers who reported selling farm products other than beans (non-bean sellers), and third, the 50% of bean farmers who sold beans (bean-sellers). The rest of this section describes the basic characteristics of the farmers within each group, and their bean sales and purchases behavior.

While 18% of the sample households reported no farm sales, among these households 71% reported having received wages as laborers or income from non-agricultural enterprises[18]. Their median reported income level from wages and non-agricultural sales is Lps. 1,000[19] per year with an average of Lps. 1,600 (Table 4.11). However, these data under-estimate sales from non-agricultural activities because some farmers could not recall the value of their sales during the 1993-1994 agricultural year. On the other hand, eleven farmers did not report any source of income from wages or non-agricultural sales. These farmers, who did not report any monetary income, on average harvested a per adult consumption equivalent[20] of 0.45 kg of corn and 0.21 kg of beans per day. This figure is much higher than the national average bean consumption in rural areas, estimated at 0.03 kg per person per day (ADAI, 1994), suggesting that these farmers depend to a much larger extent on beans than the average rural household.

On the other hand, of the 82% of bean farmers who reported selling farm products 39% (n=69) reported no bean sales. For these non-bean seller households, the median

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[18] Non-agricultural enterprises include trade, carpentry, bread making, and other activities. All of these farmers have 13 hectares or less of land.

[19]Lps. is the abbreviation for Lempiras, the official Honduran currency, with an exchange rate between Lps. 5.80 = US$ 1.00 and Lps. 7.50 = US$ 1.00 for the reference dates in the survey.

[20]Adult equivalent factors used are 1.0 for males 18-60 years, 0.83 for males over 60 years, 0.81 for females 18-60 years, 0.72 for females over 60 years, 0.85 for boys 10-18 years, 0.70 for girls 10-18 years, 0.66 for boys 5-10 years, 0.60 for girls 5-10 years, and 0.45 for all below 5 years (FAO/WHO/UNU, 1985).

income from all farm[21] sales was Lps. 2,600 with an average of Lps. 9,400. If income from wages and non-agricultural sales is added to these farmers' farm sales, the median income level is Lps. 4,000 with an average total income of Lps. 10,900. Among those farmers who did not sell beans, but sold other farm products, coffee and corn were the most important source of farm income each contributing 40%[22] to total farm income.

While non-sellers and non-bean sellers account for 50% of all sampled farmers, 37% of these two groups of farmers were net buyers of beans. Similar proportions of non-sellers (40%) --farmers who sold no farm products-- and non-bean sellers (35%) --farmers who sold farm products other than beans-- were net buyers of beans. This shows that a significant number (19%) of bean farmers in the sample bought beans to meet their household consumption demand, contradicting the notion that all bean farmers are self sufficient. This finding suggests the need to better understand the effects of seasonal price fluctuations among rural net-buyers, who typically purchase beans late after harvest, when prices are highest.

As implied above, 50% of the sampled bean farmers sells beans. For these farmers, the median income from farm sales was Lps. 3,800 with an average of Lps. 10,400. If non-farm income is added to their farm sales income, these farmers' median income is Lps. 5,400, with an average of Lps. 15,000. The remainder of this section concentrates on analyzing the characteristics of these bean sellers; emphasizing the

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[21]Farm sales/farm income refers to sales/income from agricultural or livestock products sold by the household. Non-farm/non-agricultural income/sales refer to wage and/or non-farm income/sales.

[22]This figure is an average for all 69 farmers.

distribution of these farmers across farm size, topographical region, and across users and non-users of improved bean varieties.

Table 4.11 Median Bean Farmers Income Records by Commercial Orientation Group, Mideastern and Northeastern Honduras, 1993-1994.

Sources of Income	**Commercial Orientation Grouping**					
	Non-Sellers		**Non-Bean Sellers**		**Bean-Sellers**	
	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
Net Bean Sales	12	-280	23	-280	108	1,200

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

In order to determine farmers' market orientation, it is important to distinguish between bean sellers and net buyers of beans. While 15% of bean sellers reported purchasing beans from May 1993 through April 1994, none of these farmers bought more beans than the quantity they sold during the agricultural year[23]. Therefore, all bean sellers were net-sellers of beans. Nonetheless, not all bean sellers can be considered equally market oriented. While some bean sellers only sold their surplus beans (i.e., those beans produced in excess of the household's demand), other bean sellers grew beans with a clear intent of selling them. This suggests that a portion of the net-sellers of beans are residual sellers who are not strongly market oriented. In order to better understand this

[23]The recall periods for purchases and sales for farmers was subdivided into two distinct time periods, 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.

situation, three variables are studied through the rest of this section: first, total amount of bean sales in kilograms and lempiras; second, the proportion of beans sold as a percent of total production; and third, the percent of total farm sales from beans. Careful analysis of these three variables helps better understand the market orientation of these bean sellers.

Among all bean sellers, the median net quantity of beans sold was 360 kg with an average of 830 kg; equivalent to a median income from beans of Lps. 1,200 with an average of Lps. 3,400. To better understand the relationship of these variables to farmers basic characteristics, net sales are analyzed across farm size, and topography. As expected, there is a significant positive association between farm size and total bean sales[24]. On average, small farmers (<= 2 has) sold 260 kg equivalent to an average bean sales income of Lps. 950. In contrast, the averages for medium and large size farmers were 800 kg and 1,200 kg, respectively, with average bean sales of Lps. 3,000 and Lps. 5,300. Moreover, bean sales are also associated with topography. Hillside bean sellers sold an average of 530 kg with average bean sales income amounting to Lps. 2,050. On the other hand, flat-land farmers sold almost twice this amount, an average of 1060 kg. with average bean sales of Lps. 4,400. These data support the hypothesis that small farmers and hill-side farmers are more likely to be incidental or residual bean sellers[25].

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[24]ANOVA-tests of net kg. and net Lps. sold by farm size groups had p-value=0.05 and p-value=0.05 for net kg and net Lps., respectively.

[25]Comparison of average bean sales by small hill-side and flat-land, and large hill-side and flat-land farmers support 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).

Categorizing net sellers into two distinct groups, market-oriented and incidental sellers, also supports the hypothesis presented above. To distinguish market-oriented from incidental bean sellers, the median amount (kilograms) 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 bean sellers. Using this classification, only 32% of small farmers would be considered market-oriented farmers, in contrast to 50% and 65% medium and large farmers. Similarly, a larger proportion (65%) of flat land bean sellers would be considered market-oriented than hillside farmers (34%) (Table 4.12).

Table 4.12 Market Oriented Bean Sellers and Incidental Bean Sellers by Farm Size and Topography, Honduras, 1993-1994.

Bean Farmers Strata	Market Oriented Sellers		Incidental Bean Sellers	
	%	(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]				
Flat-Land	65	(40)	36	(22)
Hill-Side	34	(15)	66	(29)

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

In addition to analyzing the relationship of total sales with farmers characteristics, it is important to determine the relative importance of these bean sales. On average, bean sellers sell 50% of the beans they produce, and bean sales amount to 64% of total income from farm sales. Comparing percent of beans sold across farm size indicates that medium size farmers sold a larger percentage of beans produced (55%) than small (44%) and large farmers (48%). Additionally, flat-land bean sellers sold a larger percentage of beans produced than hill-side bean sellers (Table 4.13), supporting the evidence that larger and flat-land farmers sell larger amounts of beans.

On the other hand, the proportional contributions of bean sales to total farm income is larger among smaller farmers and among hill-side farmers (Table 4.13). This suggests that although larger sized farmers and flat-land farmers appear to be considered more market oriented (in absolute terms), bean sales are a relatively more important source of farm income for those incidental sellers --more likely to cultivate smaller farms and be located in the hillsides. Therefore, efforts to increase bean yields, which are positively correlated to net sales, among smaller and hillside farmers would help improve both these farmers financial conditions through expanding their sales opportunities, and their ability to achieve food self-sufficiency as they become more market oriented.

The analysis presented in the previous section (4.3) showed that there is a positive association between farmers use of improved varieties and bean yields. Although it is important to understand what factors explain farmers decision to adopt improved bean varieties, it is clear that improved varieties represent a feasible technological alternative for improving farmers well being, especially if varieties are available to perform well under different environmental conditions. Moreover, among farmers who plant improved varieties bean sales are larger than among those bean sellers who do not plant improved varieties. On average, bean sellers who adopt improved varieties sell 1,080 kg of beans, whereas those who plant traditional varieties only sell 660 Kg[26]. While the next chapter studies the market disadvantages commonly associated with the improved bean varieties, these results suggest that their greater yield potential may expand the economic opportunities of improved variety adopters.

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

Table 4.13 Beans Sold (%), and Proportional Contribution of Bean Sales to Farm Income by Farm Size and Topography, Honduras, 1993-1994.

Bean Farmers Strata	Percent of Beans Sold		Percent of Sales From Beans	
	%	(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				
Flat-Land	53[c]	(61)	57[d]	(60)
Hill-Side	46[c]	(43)	74[d]	(43)

[a] Using One-Way ANOVA test significant association with farm size (p-value=0.14)
[b] Using One-Way ANOVA test significant 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)
Source: Survey of Honduran Bean Farmers, 1994, Bean/Cowpea CRSP, and Food Security II.

4.6 Characteristics of the Households

The household is the ultimate unit of analysis. In this section four household characteristics which are commonly found to influence the household's decision making process are studied. These variables are: family size, availability of labor, age of the household head, and educational level of the household head. These characteristics are analyzed across farm size, and topography. In addition a brief analysis of these characteristics is made in relation to bean yields and the use of improved varieties.

Among all bean farmers, the average number of household members was 6.3 members with a median of six members. Moreover, about 75% of the household in the study have families with 8 members or less and 25% have 4 members or less (Table 4.14). The number of members in the household is not significantly different across farm size or topography. Among rural Honduran families[27], larger families are commonly associated with more labor availability, which is an important constraining factor in agronomic activities such as weeding and harvesting. While the data in the sample show that there is a significant positive correlation between family size and the number of family members who work in the agricultural fields, the evidence does not support the hypothesis that larger families obtain higher bean yields[28].

Contrary to conventional wisdom, it was found that a significant number of female members worked on 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. Moreover, although the data collected do not specify which field activity the household members work on, female labor is most important during harvest and post-harvest activities.

Two other important household characteristics are the age of the household head and education level. Among the bean farms in the sample, the average age of the household head was 50.8 with a median of 50 years old. While no significant difference

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[27]In this study family is defined as all members who permanently lived in the household during the 1993-1994 agricultural year.

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

was found across age of the household head and topographical region, as expected a larger farm size was found to be associated with an older age. In contrast, younger farmers tend to have less land. For example, the average age for farmers farming 2 has or less of land was 44.6 years, while this figure was 50.7 and 55.5 years for medium and large farmers[29]. While this is only a partial analysis of these two variables, these results suggest that asset accumulation tends to increase over time, thus suggesting that availability of land may not be the most important constraint over time[30].

Although education programs have been an important component of the GOH's development policies, literacy rate is still very low in the rural areas. According the World Bank 27% of Hondurans are illiterate with a larger proportion of illiteracy in the rural areas (World Bank, 1994). In the sample, the average level of formal education received by household heads is 1.97 with a median of 1 year of formal education, and only 25% with 3 years of formal education or more. While there is no difference across topographical region and the level of formal education, a positive relationship between farm size and education level of the household head was found, but at a low level of statistical significance[31].

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

[30]However, it is important to consider that as population density increases, land availability becomes a more limiting production factor.

[31]One-Way ANOVA test show a positive association with a p-value=0.21 between farm size and education level.

While higher formal education is commonly associated with higher agricultural knowledge, this issue is further explored in the next Chapter where the relationship between education and both bean yields and adoption of new varieties is explored. In addition, lower age of the household head is commonly associated with higher education and more progressiveness among agricultural households. Although a significant negative association was found between age of the household head and level of formal education[32], the data did no show a significant correlation between these two variables and bean yields.

Table 4.14 Cumulative Distribution of Household Characteristics, 1993-1994

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

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

4.7 Summary

This chapter was divided into six sections. Section 4.1 introduced the contents of the Chapter and presented how the sampled bean farmers were distributed across the different stratifying criteria (i.e., topography, farm size, and administrative region). Section 4.2 showed that bean production systems are different across cropping seasons.

[32]The correlation coefficient is -0.43 with a p-value=0.00.

First, among bean farmers bean production is most important agricultural activity in the *postrera* (dry season). Second, during the *primera* (rainy season) inter-cropping is a more common practice than during the *postrera*. Third, the data showed that while corn is the most important crop in the *primera*, coffee is an important crop for hill-side farmers in both seasons.

Section 4.3 presented results on the use of purchased chemical inputs (i.e., fertilizers, insecticides, fungicides). The data showed that bean farmers are more willing to purchase chemical inputs in the postrera. The difference in input use across season is more pronounced among those farmers who only planted beans in one season, postrera farmers were more likely to apply chemical inputs than primera farmers. In addition, it was found that Mideastern farmers tend to use chemical inputs more frequently than do Northeastern farmers (in all production systems). Finally, it was shown that bean farmers who used chemical inputs also reported higher bean yields than those farmers who did not use chemical inputs.

Section 4.4 presented data on the use of improved bean varieties. The findings in this section suggest that the use and yield performance of improved varieties is influence by environmental, and institutional variables. First, the variety Catrachita is more frequently used among the hill-side farmers, and among Mideastern farmers. On the other hand, the variety Dorado, tends to be used in equal proportion by flat-land and hill-side farmers; but more frequently used among Mideastern farmers. The yield performance of these varieties is also influenced by environmental conditions. While Catrachita is a better yielding variety in *primera*, Dorado is a better yielding variety in the *postrera*. This suggests decision makers need to understand the diffusion constraint of improved varieties in different administrative regions, and the performance of different improved varieties under different production environments.

Section 4.5 presented data on the sales behavior of different bean farmers. The findings in this section show that there are some bean producers (19%) who are also net-buyers of beans. These farmers tend to be smaller farmers who mainly produce corn and beans. This suggests that there are small farmers who may be negatively affected by extreme price increases, specially late after harvest. There is also a large proportion of bean farmers who do not sell beans, but sell other agricultural products. The sales of corn and coffee represent these farmers' main source of agricultural income. Thus only 50% of the sampled bean farmers sold beans during the 1993-1994 agricultural year. However, some farmers who sold beans could be considered incidental sellers. Further analysis of the data suggests that large farmers are more market oriented than small farmers. In addition, it showed that flat-land farmers tend to produce more beans for sales than do hill-side farmers.

Finally, Section 4.6 showed some of the basic household characteristics. The median family size in the sample is six. While most household heads are male, at least one fifth of the women in the household reported working in the fields. While the median age of the household- head is 50 years, the age of the household-head and farm size are positively related. It was also found that formal schooling is low among the sampled farmers. The median number of years the household-head has attended formal schooling is 1 years.

CHAPTER FIVE

EMPIRICAL MODELS ON THE ADOPTION OF IMPROVED VARIETIES AND DETERMINANTS OF BEAN YIELDS

5.1 Introduction

Chapter four presented a descriptive analysis of bean farmers' production systems, emphasizing the contribution of improved varieties as a yield increasing technology. In addition, average bean yields were presented across different factors which influence bean yields. This Chapter, on the other hand, focuses on analyzing the interaction of different factors affecting the adoption of improved bean varieties, and the interaction of different factors affecting bean yields in Mideastern and Northeastern Honduras. Logistic models are used to analyze the adoption of improved varieties and ordinary least squares (OLS) models are used to analyze the determinants of bean yields.

Chapter Five is organized in four different sections which include: a) the theoretical basis for using a logistic model to predict adoption of improved varieties (5.2); b) an analysis of the results of the logistic models (5.3); c) a description of the variables used in the OLS regression models to analyze bean yields (5.4); and d) results of the bean yield response models (5.5).

5.2 The Logistic Model and the Adoption of Improved Bean Varieties

The adoption of improved varieties is assumed to be an economic decision based on farmers' expected profitability (or expected utility) of using the new variety, given a set of constraints (i.e., availability of credit, land, labor, type of environment). A farmers' profit function depends on a the mix of crops, technologies (i.e., varieties), and non-farm activities the farmer chooses in any specific time period.

Given this setting, a farmer will choose to plant an improved bean variety (i.e., Dorado) instead of a traditional variety if he/she perceives that he/she will attain larger profits (or will be at a higher utility level) by planting the improved bean variety[1]. The conventional procedure for analyzing farmers' adoption decision making utilizes qualitative response (QR) models or binary choice models. These models are appropriate for analyzing the relationship of a discrete dependent variable to a set of continuous or discrete explanatory variables. These models assume that farmers' will adopt an improved variety if the utility derived from adopting the improved variety is larger than the utility derived from planting the traditional variety.

Following Amemiya (1981), the adoption decision can be measured by using a dichotomous random variable which takes the value of 1 if the farmer plants the improved bean variety and 0 if he/she does not plant the improved bean variety . The general form of the dichotomous model is written as:

$$P_i = P(Y_i = 1) = G(X_i, \theta),$$
$$i = 1, 2, \ldots, n.$$

This general model states that the probability of an event occurring (i.e., adoption of an improved variety) depends on a vector of explanatory variables X_i and a vector of

[1]A fuller discussion of the assumptions behind several agricultural technology adoption models can be found in Feder et al. (1985).

unknown parameters, theta. However, the functional form of G is too general for the specific application at hand.

In this study the logit model is used to analyze farmer's adoption of improved varieties[2]. The general form of this model defines the functional form of G to be:

$$P(Y = 1) = \frac{1}{1 + \exp^{-(\beta' X)}}$$

and

$$P(Y = 0) = 1 - P(Y = 1)$$

$$= \frac{1}{1 + \exp^{\beta' X}}$$

Where

P(Y=1) is the probability that the event has occurred (i.e., adoption of improved variety);

P(Y= 0) is the probability that the event has not occurred;

X is a (n x k) matrix of independent variables which capture the farmers' and farms' characteristics;

and Beta is a (n x 1) vector of parameters.

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[2]Amemiya (1981), and Greene (1990) present a different set of qualitative response models and their applications.

As opposed to a linear probability model, this functional form restricts the probability estimates to lie between 0 and 1. Additionally, the computational ease of this functional form makes it attractive over alternatives such as the normal distribution function or probit model (Kennedy, 1992; Greene, 1990; Amemiya, 1981). Moreover, the logit maximum likelihood estimation procedure produces consistent, efficient, and asymptotically normal estimators.

In contrast to an ordinary least squares regression, where a coefficient can be interpreted directly as the change in the value of the dependent variable by a unit change in the independent variable associated with the coefficient; in the logit regression model, the probability of an event occurring given the change in an explanatory variable depends both on the change in the variable and the level of the other explanatory variables. Therefore, a change of one independent variable does not affect the probability of adoption in a linear fashion.

In order to specify the adoption model presented in this Chapter it is important to clearly define what is meant by adoption, the dependent variable in the general model outlined above. The most common studies of the adoption of agricultural technology are: a) time-series adoption studies where an aggregate measure of adoption is measured, such as the percent of farmers using an improved variety; or b) cross sectional studies, which measure the number of farmers who have adopted the technology at point in time (Besley, T. and A. Case, 1993).

Specifically, this study uses cross sectional data to determine the factors that influence the adoption of two different improved bean varieties, Dorado and Catrachita.

An adopter of either of these varieties is defined as a farmer who during the 1993-1994 bean farming season, planted either variety. Therefore, the specific form of the general model presented above tries to determine the effect of different variables on the probability of adopting Dorado and/or Catrachita. Insights gained from analyzing these models will help researchers prioritize their strategies for achieving wider adoption of the improved varieties, or alternatively, help to determine how farmers' characteristics affect the adoption of the two improved bean varieties.

5.3 Results of the Adoption Models

To study the adoption of improved bean varieties, this study presents two different adoption models. Namely, an adoption model for the improved variety Dorado, and one for the improved variety Catrachita. In the first case, the dependent variable (Y_i) is one, if the farmer planted Dorado during the 1993-1994 agricultural year[3], and zero otherwise. Similarly in the second case, the dependent variable (Y_i) is one, if the farmer planted Catrachita, and zero otherwise.

Table 5.1 presents the distribution of sampled bean farmers who planted each improved variety during the 1993-1994 agricultural year. The data show that 41 sample farmers planted Dorado, and 46 planted Catrachita. In addition, 7 farmers planted both varieties in the *primera* and 7 farmers planted both varieties in the *postrera*.

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[3]The 1993-1994 agricultural year includes both the *primera* and the *postrera* seasons.

Table 5.1 Adopters of Improved Bean Varieties by Season, Honduras, 1993-1994.

Adopters of Improved Bean Varieties	**Number of Adopters of Improved Bean Varieties by Season**			
	Primera Only	**Postrera Only**	**Both Seasons**	**Total**
Dorado Adopters	8	19	14	41
Catrachita Adopters	10	14	22	46

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

Farmers decision to adopt improved varieties is affected by several socio-economic and environmental factors. These factors can be broadly grouped into demographic or social factors (i.e., characteristics of the household members), economic factors, farmers' field management practices, institutional factors, and environmental factors. Table 5.2 lists some of the specific variables measured in this study which were expected to influence the farmers' adoption decision, and proposes the hypothesized relationship between the variables and the farmers' adoption decision.

Because the two improved varieties have different attributes, it is expected that some of these explanatory variables are variety specific. For instance, Catrachita is more likely to be planted by farmers in the hill-sides than Dorado. On the other hand, some of these explanatory variables are not variety specific. For instance, the location of farmers within a specific geopolitical region affects the adoption of both improved varieties in a similar fashion. Improved varieties are more likely to be used in the Mideastern Region where the NBP has emphasized the release and diffusion of the variety, and where the

BGMV disease is more prevalent. A more detailed discussion of the regressions' results is presented in Section 5.3.1.

Table 5.2 Lists of Factors affecting Farmers Decision to Adopt Improved Varieties

Category	Factors	Variable Name	Measurement in this study	Expected Relationship
Demographic/ Social Factors	Age of HH	AGEHH	Years	-
	Education of HH	EDUHH	Years of formal education	+
	Sex of HH	SEX	F/M (0/1)	+/-
	Technical Knowledge		Not measured	+
Economic Factors	Farm Size, Bean Area	ATOTHA, BEAHAS	Hectares	+/-
	Relative Importance of beans	BEALL	% of total farm area in beans, relative income from beans	+/- +/-
Management Practices	Cropping System	INTER	Mono/Inter (0/1)	-
	Use of Chemical Inputs	INUSE, FERT, INSECT	No/Yes (0/1)	+
	Desired Characteristics of Bean varieties (i.e., yield, drought resistance)	PREYLEI, PREDROEI	No/Yes (0/1)	+/-
Institutional Factors	Access to credit in five years, received credit in 1993-1994.	CREDIT, CRED93	No/Yes (0/1)	+
	Visit from extensionists to region?	H127	No/Yes (0/1)	+
	Geopolitical Region	REGCODE	Northeast/ Mideast (0/1)	+
Environment Factors	Topography	TOPCOD	Hill/Flat (0/1)	+/-
	Farming Season	CICLO1	Postrera/Primera (0/1)	+/-

5.3.1 Results of the Adoption Models

As stated above farmers' adoption decisions for different varieties are influenced by different socio-economic, institutional, and environmental factors. The results of the Logit models confirm this general hypothesis, and confirms that there is a strong relationship between adoption and agro-ecological conditions (Table 5.3). For instance, the coefficients for topographical region (TOPCOD) are significant for the adoption of both varieties, but the signs are opposite. In the Catrachita model, the negative coefficient implies that farmers in hill-sides are more likely to adopt Catrachita than farmers in the flat-lands, while the opposite relationship is found for Dorado. As explained in Chapter 4, the pressure of BGMV in the flat-lands limits the performance of Catrachita in flat-land environments.

The coefficient for the socio/demographic factors have the expected signs. However, formal education level (EDUHH) is not a statistically significant variable in determining the adoption of either of the two improved varieties. This may be due to the fact that the formal education level among sampled heads of household is truncated towards zero --median education level equals to one year (Section 4.6). Farmers' technical knowledge (i.e., farmers' indigenous knowledge of diseases, farmers' knowledge of new technologies) could have been used as an alternative explanatory variable for education, however this variable was not appropriately measured in this study. On the other hand, the age of the household head (AGEHH) is only an important[4] variable in the adoption of Dorado. As expected, this variable has a negative coefficient, which implies that older farmers are less likely to plant the variety Dorado. In addition, the number of family members who work in the fields (WORK#) is an important variable affecting the adoption of Dorado --families with more family labor available are more likely to adopt Dorado.

The yield of improved varieties is highly dependent on the use of complementary inputs. The coefficient of the use of fertilizers (FERT) (dummy variable) confirm this observation, suggesting that farmers who use fertilizers are more likely to plant the improved varieties. On the other hand, there is a negative relationship between the use of insecticides (dummy variable) and farmers' adoption of Catrachita. Although, this relationship is not intuitively expected, it suggests that farmers in the hill-sides may tend to use less insecticides due to less pressure, in this environment, from the white fly, the BGMV's vector.

Farm size also appears to be a variety-specific variable. Larger farmers tend to adopt Catrachita, whereas there does not exist a significant relationship between farm size and the adoption of Dorado. This may be due to the fact that larger farmers in the hill-side have more access to improved technologies than smaller farmers in the hill-sides. Additionally, access to credit is only a significant variable among Dorado adopters. However, it is difficult to interpret this relationship without more information about

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[4]In this context "important variable" means statistically significant at p-values <= 0.10 in the logit models.

farmers' specific source and use of credit. For example, it may be that farmers who have a history of having access to credit are more likely to have contacts with extension services, but this hypothesis needs to be further studied.

Finally, it is clear that administrative region (REGCODE) is an important variable in the adoption of both improved varieties. Farmers residing in the Mideastern region are more likely to have planted the improved varieties. This confirms the findings in Chapter 4, which documented the existence of marked differences in the services provided by extension agents across the two administrative regions. Generally, researchers and extensionists have concentrated their work in the Mideastern Region.

As shown in Table 5.3 the models correctly predicted 80% and 87% of the cases in the Catrachita and Dorado adoption models, respectively. While, these models are better predictors of non-adopters than adopters[5] of the improved varieties, these results still provide useful insights on farmers' adoption/non-adoption decision. For instance, flat land farmers tend to be non-adopters of Catrachita because of certain production traits of the variety. Therefore, it is unlikely that simply promoting the use of this variety in the flat lands will increase farmers' adoption. On the other hand, it is clear that most farmers in the Northeastern Region are non-adopters of the improved varieties mainly because farmers in the region have less access to these varieties. In addition, as is shown in the yield models, farmers in the Northeastern Region have a potential to obtain higher yields.

[5]As shown in Table 5.3, the model correctly predicts 93% and 98% of non-adopters of Catrachita and Dorado, respectively, and 29% of Catrachita and Dorado adopters.

Therefore, a greater effort should be made to distribute improved varieties in this politically marginalized region.

Table 5.3 Logit Models for the Adoption of Improved Varieties

List of Explanatory Variables Used	**Estimates and Significance Level For Different Dependent Variables**	
	Adoption of Catrachita (Significance level)	**Adoption of Dorado (Significance Levels)**
EDUHH (Years formal education HH)	0.08 (0.22)	0.05 (0.50)
AGEHH (Age of Household Head)	n.i.	-0.04 (0.01)
ATOTHA (Total Farm Area has)	0.01 (0.03)	-0.01 (0.36)
CREDIT (Access Credit Last 5 years)	0.31 (0.33)	0.72 (0.05)
FERT (Used Fertilizer)	0.84 (0.02)	1.40 (0.00)
INSECT (Used Insecticides)	-1.66 (0.00)	n.i.
REGCODE (Administrative Region)	1.12 (0.01)	1.43 (0.01)
TOPCOD (Topographical Region)	-1.94 (0.00)	0.93 (0.02)
WORK# (# Family Labor)	n.i.	0.30 (0.00)
CONSTANT	-1.89 (0.00)	-3.27 (0.00)
CORRECT PREDICTIONS	80%	87%
ADOPTERS	29%	29%
NON-ADOPTERS	93%	98%

n.i. Not included in the models.

5.4 Econometric Models of Bean Yields Determinants

Having determined what are the most important factors that influence the adoption of improved varieties, the following analysis focuses on identifying the most important variables that affect bean yields in Honduras, including the effect of the improved bean varieties. Two ordinary least squares (OLS) models were specified to show what variables affect bean yields in both the *primera* and the *postrera*. A list of variables that are expected to influence bean yields are listed in Table 5.4, and their expected relationships to bean yields are specified. Although variables included this list are expected to explain a considerable proportion of bean yield variations, there are several factors that limit the explanatory power of these variables as used in these models, including measurement errors and excluded variables. First, the data used for the dependent and some explanatory variables are based on recall data for an entire agricultural year. Second, farmers in different regions used different measurement units, which were sometimes hard to correctly standardize to an equivalent unit. Moreover, some respondents tended to under-record/overestimate production data because of personal reasons (i.e., tax considerations). Third, some important variables which are expected to explain farmers' yields were not measured or are hard to measure using the survey methodology. For instance, although soil quality is very likely to affect bean yields, time and financial constraints made it impossible to accurately measure soil characteristics in this study.

Although the yield models specified in this study have low explanatory power, these models do confirm some of the findings in the previous chapter. For instance, the

OLS results clearly show that improved varieties have a differential impact on yield across season, and that the topographical region in which beans are planted tends to influence bean yields in the same direction across seasons.

Table 5.4 Factors Expected to Affect Farmers' Bean Yields

Category	**Factors**	**Variable Name**	**Measurement in this study**	**Expected Relationship**
Demographic/ Social	Age of HH	AGEHH	Years	+/-
	Eudcation of HH	EDUHH	Years of formal education	+
	Sex of HH	SEX	F/M (0,1)	+
	Technical Knowledge		Not measured	
Economic Factors	Farm Size	ATOTHA	Hectares	+/-
	Relative Importance of beans	BEALL	% of total farm area in beans, relative income from beans	+ +
Management Practices	Cropping System	INTER	Mono/Inter (0/1)	-
	Use of Chemical Inputs	INUSE, FERT, INSECT	No/Yes (0/1)	+
	Amount of Input Use (i.e., all inputs, fertilizer, insecticides)	BEINPHA, BEFERHA, BEINSHA,	LPs. of Inputs spent on beans/hectare	+
	Use of Improved Varieties	DORUNI, CATUNI, IMPVAREI	No/Yes (0/1)	+
Institutional Factors	Access to credit in five years, received credit in 1993-1994.	CREDIT, CRED93	No/Yes (0/1)	+
	Visit from extensionists to region?	H127	No/Yes (0/1)	+
	Geopolitical Region	REGCODE	Northeast/ Mideast (0/1)	+
Environmental Factors	Topography	TOPCOD	Hill/Flat (0/1)	+
	Farming Season	CICLO1	*Postrera/Primera* (0/1)	+
	Main Production Problem (i.e., weather, insects, Bean Golden Mosaic Virus)	WHEA, INSEPRO, BGMV	No/Yes (/01)	-
	Complete loss of Production due to environmental catastrophe	CATASDUM	No/Yes (0/1)	-

5.5 Results of the Yield Response Models

Because analysis in Chapter 4 demonstrated significant production characteristics across the two different farming seasons, separate yield models are estimated for the *primera* and the *postrera*. The OLS coefficients and significant levels for these two models are presented in Table 5.5.

As previously stated, the variables in these models include economic factors (i.e., BEAHAS, ATOTHA), farm management factors (i.e., BEINPHA, BEFERHA, CATUNI, DORUNI, INTER), environmental factors (i.e., BGMSEV, CATASDUM, INSEPRO, TOPCOD), and institutional factors (i.e., REGCODE). Because the socio-demographic factors measured in this study did not help explain bean yield variability, these variables were not included in the models.

Before discussing the regression results, three variables need to be further explained. First farmers were asked to determine if their bean fields had been attacked by the Bean Golden Mosaic Virus, and to rank how severe these attacks had been. Farmers were asked to choose from a 4 degree scale (i.e., not severe, little severe, somewhat severe, and very severe) to determine the severity of the attack. The variable BGMSEV, included in the models, is equals to one if farmers ranked the disease attack somewhat severe or very severe and zero otherwise[6].

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[6]Only farmers who reported severe/very severe BGMV attacks were considered to have been significantly affected by the disease attack.

Second, several farmers reported zero production[7] due to excess rains (*primera*) or severe droughts (*postrera*), or a combination of weather/disease/insect attacks. The variable CATASDUM, catastrophe dummy, is equals to one for farmers who reported zero yields and zero otherwise. Finally, farmers were asked to list their most important production problem in either season. The variable INSEPRO is equals to one if farmers considered that insect attacks were the most important production problems and zero otherwise.

In addition, not all the same variables were included in both models because there were certain variables that were not statistically significant or applicable in both seasons. For instance, since intercropping is not a common practice in the *postrera*, it is excluded from the *postrera* model. Moreover, the use of fertilizer is more important in the *primera* than in the postrera because farmers think that fertilizers are better absorbed by the plants in the rainy season. However, in the postrera a sum of all inputs (BEINPHA) used is more appropriate because it includes both insecticides and fertilizer expenses. In addition, since insects are more constraining during the *postrera* than the *primera*, INSEPRO is only included in the *postrera*. Finally, while bean area is a significant explanatory variable in *primera*, neither bean area nor total farm area have a statistically significant influence upon bean yields in the *postrera*. Therefore, in order to include a variable which measures the influence of farm size, ATOTHA was included instead of the variable for bean area, BEAHAS.

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[7]Some farmers may have reported zero production, when they actually obtained very low yields.

Comparing the results of the models across farming seasons shows the importance of seasonal differences in the farming systems. First, in the *postrera* the use of Dorado has a larger effect on bean yields than Catrachita. In contrast, in the *primera* Catrachita has a larger yield impact than Dorado. The results also show that flat-land farmers have higher yields in both seasons, compared to hill-side farmers[8]. On the other hand, while significantly different from zero, cash invested in chemical inputs does not seem to have a very large impact on bean yields in either season. This supports the finding that the majority of farmers do not apply chemical inputs on their bean fields. Finally, contrary to expectations, the BGMSEV dummy variable showed little of impact of BGMV on bean yields. Yet, this result is consistent with technical assessments made by the NBP which reported that BGMV was not a very limiting production constraint during the 1993-1994 agricultural year.

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[8]In Primera, flat-land farmers obtained bean yields of 525 kg/ha and hill-side farmers 490 kg/ha. In Postrera, flat-land farmers obtained yields of 600 kg/ha and hill-side farmers 500 kg/ha.

Table 5.5 OLS Estimates for Two Yield Response Models

Independent Variables	Estimates for Yield Response Models in *Primera* and *Postrera*	
	Coefficients in *Primera* (significance level)	Coefficients in *Postrera* (significance level)
ATOTHA (Total Farm Area has)	n.i.	-0.49 (0.40)
BEAHAS (Bean Area has)	75.90 (0.00)	n.i.
BGMSEV (Severe BGMV attack)	25.48 (0.76)	-83.38 (0.35)
BEINPHA (LPs. Input per ha)	n.i.	0.04 (0.05)
BEFERHA (LPs. Fertilizer per ha)	0.18 (0.20)	n.i.
CATUNI (Used Catrachita)	220.03 (0.01)	59.47 (0.51)
DORUNI (Used Dorado)	-99.46 (0.30)	156.76 (0.09)
CATASDUM (Catastrophe Dummy)	-524.03 (0.00)	-634.62 (0.01)
INSEPRO (Insects Main Problem)	n.i.	-214.44 (0.01)
INTER (Intercropping)	-238.31 (0.00)	n.i.
REGCODE (Administrative Region)	-65.50 (0.38)	-117.60 (0.12)
TOPCOD flat (Topographical Region)	140.04 (0.05)	194.20 (0.01)
CONSTANT	454.07 (0.00)	553.38 (0.00)
R^2	0.26	0.08
F-statistic	6.55	2.72

n.i. not included in the model

5.6 Summary

This Chapter presented the basis for using logistic models for explaining farmers' varietal adoption decisions. The interpretation of the coefficients from a logistic model is not as straight forward as the interpretation of coefficients from a linear multi variate regression model. In the logistic function, the level of the dependent variable (i.e., the probability of Yi = 1) is affected by the coefficient of the variable in question and the level of the other coefficients. In contrast, in an ordinary least squares model, the level of a the dependent variable is directly affected by the value of the coefficient of the independent variable.

The results of the logistic models showed that several explanatory variables that are variety specific. For example, topography has a differential influence on the probability of adoption of the improved varieties. Flat-land farmers are less likely to adopt Catrachita than Dorado. On the other hand, it is clear that the geopolitical region affected farmer adoption of both varieties. Farmers in the Northeastern Region are less likely to have adopted the improved bean varieties.

Given that environmental variables such as topographical regions are not easily influenced, it is hard to expect that flat land farmers will widely adopt Catrachita. On the other hand, because there has been less emphasis on spreading the improved varieties in the Northeaster Region, a greater extension effort could increase the level of adoption in this area.

Finally, it was shown that farmers' bean yields are influenced by economic, management, and environmental factors. The results from the yield response models showed that bean yields are higher in the flat lands than in the hill-sides. Moreover, Dorado and Catrachita perform different across farming seasons. The use of Catrachita has a positive impact on yields only during the primera, and Dorado has a positive impact on bean yields only in the postrera. This shows the importance of understanding the interaction of improved varieties and different agro-ecological conditions.

CHAPTER SIX

THE HONDURAN BEAN MARKETING SYSTEM AND THE IMPROVED BEAN VARIETIES

6.1 Introduction

Chapter Three identified the bean marketing system participants and described the general characteristics of the system. However, little empirical data about the market structure and the market participants' behavior characteristics were presented. In contrast, this chapter uses empirical data to a) analyze the existing trading links between farmers and traders (6.2), b) identify the main market preferences (i.e., farmers', and traders' preferences) for beans (6.3), c) discuss the implications of market preferences for farmers welfare by comparing farmers' revenues from improved bean varieties and traditional varieties (6.4), and d) evaluate the links between the Honduran and El Salvadorian bean trade (6.5).

6.2 Bean Market Structure

6.2.1 The marketing System at the Farmer Level

Chapter Four identified three types of bean farmers: farmers who do not sell any farm products (18%), farmers who do not sell any beans (32%), and bean farmers who sell beans (50%). This section analyzes the marketing links between the sampled bean sellers and other market participants, focusing on three aspects of farm level trading activities: the type of traders with whom farmers transact, the geographical distribution of farmers' sales, and the seasonality of farmers' sales.

Since the implementation of the Law of Agricultural Development and Modernization (LAM), which proposed reducing the role of the Honduran Institute of Agricultural Marketing (IHMA), the popular media has portrayed private grain traders as market participants who take advantage of uninformed and 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 consumers' 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 at different levels in the marketing system, in order to help farmers and consumers make a better decision about food sales and purchases. While strongly held, there exists little empirical evidence to substantiate these opinions. Since the implementation of the LAM, neither the opinions of farmers nor the behavior of traders have been analyzed. This section presents an analysis that helps to inform these issues.

As stated in Chapter 3, 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 farmers' bean sales were made to regional traders; while wholesalers bought 11% of farmers' sales; neighbors and *pulperos* accounted for the remaining 12% of farmers' bean sales[1]. As expected, these sales take place at the farm-gate or in a nearby village (93%). This sales pattern suggests

[1]In this section sales or transactions, used interchangeably, refer to a single transaction whereby a farmer sells beans, unless specified otherwise.

that if farmers do not have widespread access to market information, traders would be able to set buying prices at lower levels than in a competitive market.

However, survey data only partly support this assumption. When asked why they sold their beans to a given trader, 27% of the farmers reported that that particular trader was the only one in the region at the time of the transaction; 12% said they had sold to that trader because the trader had lent them money before harvest; 27% said that that trader paid the highest price; and 8% said they sold to that trader because the trader was a friend or relative. These results suggest that at least in 39% of the cases, farmers had very limited market options, since there was only one trader in the region, or the farmers had to honor a loan. Nonetheless, although farmers selling beans to potential colluding traders received on average a lower price (Lps. 3.81/kg) than farmers selling beans to other traders (Lps. 4.06/kg), the difference is not significantly different[2]. In addition, given that most farmers who sold beans to potential colluders were in remote segments (68%), this average difference may actually reflect the higher transportation cost to remote areas[3]. Moreover, in general, hill-side farmers, who lived in the more remote areas, received lower average bean prices (Lps. 3.78/kg) than flat-land farmers (Lps. 4.12/kg)[4]. Thus, these data suggest that while there may be a potential for traders to collusively buy beans at lower price levels in remote areas, a better understanding of the

[2]t-test for comparison of means had a p-value of 0.28.

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

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

cost structure among different traders in the marketing system is needed before concluding that the price difference is due to collusion.

Finally, as was shown in Chapter 3, bean prices in Honduras are highly seasonal. In both seasons, most sampled farmers sold their beans within two months after the bulk of the harvest, when prices were lower. Therefore, farmers revenues are lower than they would be if they sell their beans several months later after harvest. While this suggests that farmers could increase their bean revenues by storing beans for later sales in the higher priced months, the opportunity cost of capital must be taken into account to evaluate the profitability of storage for later sale.

As reported in Chapter 3, over a six month period the difference between lowest and the highest average seasonal price is about 30%. Considering that the opportunity cost of capital in the informal financial markets ranges from a low of 60% to as much as 120% annually, it is clear that in an average year farmers would not be necessarily receive higher economic revenues by storing beans for 6 months and selling their stocks at the seasonal highest price[5].

6.2.2 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. These traders were located in three cities nearby the major production areas of the Mideastern and Northeastern Regions (n= 21), in the two

[5]Assuming a bean price of Lps. 10/kg at harvest time, on average a farmer would receive Lps. 13/kg at the seasonal highest price. However, using as discount rate of 60% annually, the present value of these Lps. 13/kg at harvest time is Lps. 9.70/kg (discount rate compounded monthly).

largest cities of Honduras, Tegucigalpa and San Pedro Sula (n= 18); in two mid-size cities, Comayagua and El Progreso (n= 10); and in Santa Rosa de Copan (n= 8) the largest city in the Western Region. Wholesalers[6] in these cities were interviewed because they were considered to be the best source of information to determine how beans are transferred from farm-gate to consumers[7].

As expected, the number of wholesalers is positively related to number of people in each of the cities visited. Discussions with key informants in Tegucigalpa indicate that the number of bean wholesalers may range from 50 to 75. In San Pedro Sula, there may be from 25 to 40 bean wholesalers; in Danli, Juticalpa, Catacamas, Comayagua, and El Progreso, there are from 15 to 30 wholesalers in each city; and in Santa Rosa de Copan there are approximately 10 wholesalers. Data collected from farmers and wholesalers indicate that intermediaries (i.e., independent truckers, and wholesalers in the production cities) are an important link to transfer beans from the farm-gate to consumers in the largest cities (i.e., Tegucigalpa and San Pedro Sula), as all of the wholesalers in the largest cities reported that they mainly buy beans from intermediaries. In addition, 72% of the interviewed traders from the largest cities also reported that they occasionally buy beans from producers who travel to the main market.

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[6]In this text, 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., but may also sell smaller quantities to end consumers.

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

On the other hand, while 95% of the traders located in the production zones reported purchasing beans from farmers who arrive at the main market; only 62% of the interviewed traders reported purchasing beans from independent truckers. In addition, at the time these wholesaler interviews were carried out, the *primera* harvest had recently taken place in the Mideastern Region. In Danli, 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 visit the market towns less frequently. In Juticalpa and Catacamas, cities located in the less densely populated area of Olancho, a wholesaler normally goes out to the farms --using their own trucks--, or mainly buy beans from independent small truckers.

This suggests that in the main production areas, at least farmers who live closer to the major trading towns, receive a fairly competitive price. In addition, it is logical to expect that farmers who visit the markets to determine price levels communicate this information back to relatives and/or neighbors in the production villages. These results further support the evidence that farmers in more accessible areas receive higher prices than farmers living in the more remote regions.

Additional results highlight the relative importance of intermediaries in the Honduran bean marketing system. Most traders interviewed in the largest cities (84%) (i.e., Tegucigalpa and San Pedro Sula), and in the mid-sized cities (90%) (i.e., Comayagua and El Progreso) buy beans at their place of business. These traders cited market competitors, and the cost of buying beans in the farming areas as the two reasons for buying most beans at their place of business in the city. First, wholesalers argued that if they decided to go out to the farming areas to buy beans, other competitors would be able to buy beans from the incoming intermediaries, reducing their market share. In addition, city wholesalers argued that due to the intermediaries' 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 between farm-gate and consumers can be capture by determining the market participants to whom wholesalers sell beans. A large majority of the interviewed traders (79%) said they sold beans directly to consumers. As expected, since wholesalers in the largest cities are more specialized, only 67% of the interviewed wholesalers reported selling beans directly to consumers. However, virtually all wholesalers in the largest cities (94%) sell beans to retailers. Therefore, the primary role of the wholesaler in the largest city is to provide retailers with enough beans throughout the year[8]; whereas, in the mid-sized cities and the production cities wholesalers also sell directly to consumers in addition to supplying retailers with beans throughout the year.

In addition, while less frequently mentioned, traders who purchase beans for subsequent sales in El Salvador represent an alternative market for wholesalers. Over 50% of all interviewed traders reported selling beans to traders from El Salvador. For

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[8]In Tegucigalpa and San Pedro Sula market informants reported that there are some large traders whose sole purpose is to store beans to supply smaller wholesalers throughout the year. These traders finance their purchases through the formal banking system at lower interest rates than the informal financial market available to farmers, thus making it profitable to store beans.

instance, among traders in the largest cities, 61% said they had sold beans to traders who sell beans to El Salvador. In addition, 61% and 45% of traders residing in the production regions and mid-sized cities, respectively, sold beans to El Salvadorian traders. However, these figures may under-represent the relevance of bean transactions with El Salvador. At the time of these interviews, traders in San Pedro Sula were more reluctant to talk about any transactions with El Salvador than were traders in Tegucigalpa; mainly because the Ministry of Economics in San Pedro Sula was more strict on penalizing traders who violated a bean export ban to any Central American country decreed in January of 1994. Nonetheless, later interviews in El Salvador confirmed the hypothesis that bean trade with El Salvador was more prevalent than was 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. A fuller discussion of the El Salvadorian trading links are presented in Section 5 of this Chapter.

6.3 Bean Preferences in The Market

While the National Bean Research Program (NBP) has focused on the production of improved varieties designed to relax key production constraints (i.e., multiple disease tolerance), the lead researchers at the NBP and Zamorano have maintained a broader perspective and sought to take into account the preferred attributes of beans by end-users (i.e., processors, traders, consumers). For instance, in selecting varieties for the Mideastern and Northeastern Regions, the breeding program screens out genetic material which is not within the acceptable small-red beans market classes. Moreover the NBP has released small black-bean varieties for the Western and Central Regions, where black beans have higher demand than in the rest of the country. Nonetheless, there is little documentation as to the preferred market attributes of beans among farmers or traders, and how these preferences are reflected on the market prices of different bean varieties.

This section presents bean quality preferences, as expressed by farmers and traders, and provides the background for an analysis of bean quality-price trade-off. While the preferred market characteristics of beans include both physical and chemical properties of the commodity, the analysis of chemical characteristics is beyond the scope of this study. However, as information about a particular bean variety is spread in the market, both traders and farmers are able to associate bean varieties with specific non-physical properties.

Data presented in this section were elicited both from farmers and traders in a similar format. First, bean farmers were asked to list what they considered to be the three most important attributes of beans that traders desire. Second, traders were asked to list the three most important characteristics they desired. This information was used to determine how well farmers can identify bean market preferences, and obtain better information about the preferred market attributes for beans.

In addition, using a different set of questions, both traders and farmers were shown samples of eight different bean varieties. These samples included the three most 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 felt they could sell easier at a higher price. Similarly, traders were asked which of these varieties they would buy and what price they would pay for each variety. 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, it can be used by bean researchers to further determine what non-physical characteristics of these varieties may influence market preferences.

As in the previous section, this section only reports information elicited from those farmers who are net sellers of beans. This decision was based on the assumption that those farmers who sell beans are most likely to accurately reflect market preferences, from a seller's view point. Information bean sellers provided about the three bean characteristics most preferred by traders can be grouped into four 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 (e.g., beans with no impurities (i.e., dirt, twigs), low humidity content, only containing one variety of beans, and not physically damaged from weevils or harvesting). Third, according to farmers, traders consider culinary characteristics such as softness and flavor. Finally, according to farmers, traders consider the shape, preferring small somewhat elongated beans. Thus, the opinion among bean sellers was that traders mainly look for a good quality red bean. Because the opinions of farmers who sold more than the median were very similar to those of farmers who sold less than the median, the results in this section are presented for all net bean sellers (Table 6.1).

The data collected from bean traders reflects that bean farmers are well informed about the market preferences, as expressed by traders. Nonetheless, among traders general good-quality characteristics were considerably more important than color characteristics[9]. Traders desire beans with no impurities, free of weevils, and sun dried (Table 6.2). According to bean traders, cleaner beans command a higher price because it reduces the cost of processing --needed to prepare beans for sales to their customers. In addition, the desire for drier beans and free of weevils reflect traders' propensity to store beans.

[9]This suggests that although some farmers buy black beans, they assumed that most beans in the market belong to the small-reds market class.

Table 6.1 Farmers' List of Traders' Most Preferred Bean Characteristics, Honduras, 1994.

Traders' Most Preferred Characteristic[10]	**Farmers Ranking of Traders Preferences (%)**		
	Most Preferred	**Second Most Preferred**	**Third Most Preferred**
Red Beans (i.e., light reds)	44%	20%	11%
Good Quality (i.e., clean, dry, not damaged)	46%	56%	52%
Culinary Characteristics (i.e., softness)	1%	2%	5%
Shape of Grain (i.e., small elongated)	5%	13%	6%
Other	3%	4%	3%
Did not List	0%	4%	22%
All[a]	99%	99%	99%

[a] 1% of the bean sellers did not respond this question.
Source: Survey of Honduran Bean Farmers , 1994, Bean/Cowpea CRSP and Food Security II.

[10]A respondent was categorized as choosing good quality as the most preferred, the second and third most preferred characteristic if, for instance, he/she answered clean, dry, and not damaged beans as preferred characteristics.

Table 6.2 Traders' Most Preferred Bean Characteristics, Honduras, 1994.

Traders' Most Preferred Characteristic[11]	**Traders Ranking of their Bean Preferences (%)**		
	Most Preferred	**Second Most Preferred**	**Third Most Preferred**
Red Beans (i.e., light reds)	9%	19%	9%
Good Quality (i.e., clean, dry, not damaged)	74%	62%	52%
Culinary Characteristics (i.e., softness)	3%	5%	2%
Shape of Grain (i.e., small elongated)	9%	5%	3%
Other	5%	3%	3%
Did not List	0%	5%	31%
All	100%	99%	100%

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

Farmers assessment of bean varieties also confirmed that bean sellers can accurately identify traders preferences. In general the bean varieties included in the sample may be grouped into five different categories. First the small black bean was used to represent black beans, second Dorado and Don Silvio --both improved varieties-- were

[11]A respondent was categorized as choosing good quality as the most preferred, the second and third most preferred characteristic if, for instance, he/she answered clean, dry, and not damaged beans as preferred characteristics.

used to represent small dark-red beans, Catrachita --an improved variety-- was used to represent small-round red beans; Chile and Cuarenteño were used to represent small red beans; and finally Zamorano and Seda were used to represent small light-red beans. Both farmers and traders agreed that the most marketable varieties in the sample were the small light-red beans. While a majority of the bean sellers (56%) said that the small light-red beans were the most marketable bean types, about 20% of the bean sellers said the small reds were the most marketable varieties, and 18% said Catrachita was the most marketable variety. Similarly, among traders the small light-red beans were considered the most marketable varieties (62%), although about 20% said the small reds were the most marketable beans, and about 14% listed Catrachita as the most marketable variety.

The expected market price for these varieties was obtained by asking traders the price they were paying for each bean type/variety at the time of the interview. As expected, traders priced Seda and Zamorano the highest; while the small black bean, Dorado and Don Silvio were given the lowest market price (Table 6.3). 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 paired comparison of prices for two different varieties to assess the statistical significance of the price spread.

Table 6.3 Average Buying Price for Different Bean Varieties in Major Markets, Honduras, August 1994.

Bean Variety	Average Bean Price	
	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.

The average prices for Dorado and Catrachita --the most widely grown and traded improved varieties-- were compared with the average price of Seda, the most preferred traditional variety. Seda was consistently priced higher than the improved varieties, averaging 19% higher than the price of Dorado, and 12% higher than Catrachita[12]. While this analysis is based on data provided by traders who reported a price for both Seda and the improved varieties , it is clear that Seda commands a higher market price than the improved varieties.

[12]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.

Most traders priced Dorado lower, compared to the other varieties, because it is a small dark-red bean, which traders reported costumers are less willing to purchase when small light-red beans are available in the market, even when priced at a higher level. Traders argue that early after harvest, the markets are flooded with high quality small light-red beans. Thus, the bulk of small dark-red beans will not be sold until the stocks of light-red beans are low, causing the prices of small light-red beans to rise sufficiently high so that costumers feel better-off buying *lower quality* small dark-red beans. Traders argue that the need to carry-over small dark-red beans for later sale represent a storage cost which they have to cover by paying suppliers a lower price at harvest time.

On the other hand, bean traders argued that Catrachita, a small round-red bean; is priced lower than Seda because its demand is limited to Honduran consumers. Traders argued that while Honduran costumers purchase Catrachita, El Salvadorian costumers do not buy Catrachita. According to the interviewed traders, El Salvadorian traders are willing to buy any kind of small-red beans, except Catrachita --mainly because its unacceptable cooking characteristics[13]. This opinion, coincides with what farmers reported as the least desirable characteristic of Catrachita.

In addition to providing an explanation for the price difference between Catrachita and Seda, this information suggests that the El Salvadorian market represents an important source of demand for Honduran beans. While official data recording the transfer of beans from Honduras to El Salvador is unreliable and the volume of trade is hard to

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

estimate from visits to the markets; a majority of the traders (58%) interviewed said they had sold beans to El Salvadorian traders at least once during the last year. These traders also agreed that Seda or similar varieties were the most preferred bean types among El Salvadorian traders. A comparison of the wholesale price of Seda destined for Honduran markets, vis-a-vis those destined for El Salvadorian markets, suggested that traders expected to sell Seda at a 16% price premium to El Salvadorian costumers[14].

This section presented evidence that bean sellers and traders are able to accurately identify the same market preferences and suggested that the existing informal market information system effectively transfers information back and forth from traders to producers. In addition, the evidence has shown that there exists a strong market preference for small-red beans, especially for bean varieties which are lighter in color. While the two most widely grown improved varieties are priced lower than traditional varieties, consumers penalize each variety because of different reasons. In addition, small dark-reds are less marketable early after harvest, which requires traders to incur in storage costs that they partially cover by paying a lower purchasing price to intermediaries or farmers. On the other hand, the lower price of Catrachita arises from the limited market potential, suggesting that the El Salvadorian market is an important market outlet for Honduran beans.

[14]A paired sample t-test for comparison of means show that the price difference was significantly different at a p-value of 0.00.

6.4 The Market Performance of Improved Varieties

Chapter four, which presented the characteristics of farmers who plant improved bean varieties, highlighted " yield potential" as the most desired characteristic of these improved varieties. However, most farmers also reported that the most important disadvantage of these improved varieties was their market performance. In addition, the data in the previous section showed that improved varieties command a lower market price than do traditional varieties.

As has been studied in the case of modern rice varieties in South-East Asia (Unnenvehr, L.J. et al., 1992) and corn in Africa (Rubey, L. et al., 1995); undesirable market attributes of improved varieties may limit widespread adoption of higher yielding cultivars, specially if the greater yield potential of the improved genetic materials can only be observed under certain conditions.

This section presents two different scenarios to analyze the market performance of the improved bean varieties by first comparing the gross revenues of improved and traditional bean varieties grown in *primera* , and then by comparing gross revenues of improved versus traditional bean varieties grown in *postrera*. The yield data presented in Chapter four and the price data presented in the previous section are used to calculate the estimated revenues.

This comparative analysis incorporates several assumptions. First, it is assumed that the farm-level survey data, as well as the trader-level survey data, are acceptable measures of yield and price differences between traditional varieties and improved varieties. Second, while the price data presented in the previous section were collected after the *primera* harvest, it is assumed that the price differences (relative prices) remain at the same level for the *postrera* harvest. Third, it is assumed that the costs of production for traditional varieties are the same as for improved varieties. Fourth, it is assumed that the yield of traditional varieties is similar for all varieties including Seda; likewise Seda is assumed to represent the market price for traditional varieties. Finally, for ease of computation the unit of analysis is a one hectare field of beans planted to traditional varieties, and improved varieties (Table 6.4).

The analysis presented in Table 6.4 suggests that Catrachita generated more gross revenues than the traditional variety both in *primera* and *postrera*. On the other hand, Dorado generated higher gross revenues than the traditional variety only in the *postrera*. Catrachita generated 28% higher gross revenues than the traditional variety in the *primera*, but only 3% more revenues in the *postrera*. On the other, Dorado generated only 83% of the gross revenues generated by traditional varieties in the *primera* of 1993, and 16% more revenues than the traditional varieties in the *postrera*.

This analysis suggests that while the improved varieties have a higher yield potential than traditional varieties, the advantage of the yield potential may be discounted by the lower market price. Overall, the gross revenue differences between the improved and the traditional varieties are not very high, especially since the variable costs associated with the use of improved varieties may be higher than for traditional varieties. This implies that in a situation where production constraints such as BGMV are absent, the returns to planting improved varieties may be considerably lower, compared to the lower yielding but more marketable traditional varieties. For instance, if Dorado users perceive that the Bean Golden Mosaic Virus is not, or has ceased to be a production constraint, these farmers may shift back to the use of traditional varieties. Subsequently, in the absence of the tolerant variety, Dorado, the virus could potentially resurge and result in unexpected production losses for previous users of Dorado.

Table 6.4. Comparison of Bean Revenues for Traditional Versus Improved Bean Varieties, Honduras, 1994.

Variety	Unit of Area (ha)	Average Yield kg/ha	Bean Price Lps/kg[15]	Gross Revenues Lps.
Primera				
Traditional	1	430	5.06	2,175.80
Catrachita	1	620	4.51	2,796.20
Dorado	1	430	4.25	1,827.50
Postrera				
Traditional	1	520	5.06	2,631.20
Catrachita	1	600	4.51	2,706.00
Dorado	1	720	4.25	3,060.00

This brief and simple analysis using farm-level data and trader-level data, highlights the importance of understanding the relationships between a farmers' production system, the market with which that farmer transacts, and the National Bean Research Program. In order to improve the performance of the bean subsector, researchers and decision makers need to pay close attention to these interrelationships.

[15]Prices for Traditional variety is 12% and 19% higher than for Catrachita and Dorado, as presented in the previous section.

6.5 The Honduran-El Salvadorian Bean Marketing System

A Central American Free Trade Treaty, signed in 1991 by the presidents of the region[16], was enacted to improve the economic welfare of consumers and producers among the trading partners. For instance, when fully enacted bean producers in countries with a comparative advantage will receive higher prices, and consumers in net bean importing countries will pay lower prices than under a highly restricted trade regime[17]. In addition, during the last five years all Central American countries have started to privatize their respective grain marketing parastatals, and have eliminated price controls on staple food grains. Moreover, since 1990 the wars which disrupted the region during the 1980s have subsided. In Nicaragua, in 1990 the Sandinista government allowed democratic elections after 10 years of continuous fighting. In El Salvador, in 1992 the guerilla and the Government signed a peace accord.

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 keep accurate official data of the trading flows between the two countries. However, all governments have agreed to report prices of different basic staple grains in the different countries. Nonetheless, despite this commitment, there are a few inconsistencies in the price collection methods used across countries which makes formal analysis difficult. First, prices are reported on a Central American dollar equivalent.

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

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

However, the conversion from national currency prices to the standard Central American price is made using the official exchange, which in Honduras (before 1993) was much lower than the parallel exchange rate. Second, since not all countries have committed to reporting price data consistently, in the case of Honduras and El Salvador there are several missing data points. Third, between and within each of the countries there are inconsistencies as to the precise date of data collection. Finally, in the case of beans there are several market classes which command different market prices. However, in the case of Honduras and El Salvador the official records only report a single price for red beans, despite the fact that the market recognizes different market classes of beans.

As an alternative to using inter-country price data to assess the integration of the Honduran and the El Salvadorian bean markets, this section presents evidence collected from informal interviews conducted during a rapid appraisal of the El Salvadorian marketing system during September 1994. 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 visited were: a) the city market in San Salvador, the capital; b) farmers market in San Vicente; and c) wholesalers in San Miguel, the largest city in the eastern section of El Salvador.

As mentioned in the previous section, a large proportion of interviewed bean traders identified El Salvadorian traders as important costumers. Likewise, in El Salvador bean traders identified Honduras as one of the most important suppliers of beans for the national market. All traders interviewed[18] reported buying beans from three different

[18]In total 15 traders were interviewed.

sources: first, from the national intermediaries; second, from the Honduran market; and third, from the Nicaraguan market. In fact, some traders in San Salvador and San Miguel reported buying most of their beans from Honduras and Nicaragua. Finally, in San Salvador wholesalers and retailers differentiated their different beans into three broad market classes: a) the El Salvadorian pink-bean, b) the Honduran bean, and c) the Nicaragua bean.

Traders interviewed in the three different cities reported buying Honduran beans through different channels. While in San Salvador, traders identified large bean traders who buy large amounts of beans from Honduras and sell them to smaller traders, some traders also reported arranging transactions with Honduran traders over the phone. These El Salvadorian traders place an order to a Honduran supplier, who then buys beans from the Honduran market and delivers or waits for the beans to be picked-up. According to traders, these pre-arranged transactions considerably reduce the transaction costs, benefiting both the supplier and the purchaser.

Some traders in San Miguel tend to operate differently. Since San Miguel is about 80 kilometers from the Honduran Border on the eastern side of El Salvador, traders in this market normally travel to towns on the El Salvadorian side of the border. At these locations, they purchase beans from intermediaries who have bought the beans in a Honduran bordering town, or somewhere along the border. Traders argued that this type of transaction was very common because, at the time of the interview, Honduran customs authorities did not allow the outflows of beans into El Salvador. Additionally, in San Miguel there are also traders who make pre-arrange purchases from Honduran traders.

Finally, in San Vicente a third type of traders was interviewed --intermediaries (truckers), who travel around the country selling beans in different city markets on specific market days for each city. Similarly to traders in San Miguel, these truckers purchase Honduran beans from traders in the bordering towns. As did traders in San Miguel, these intermediaries claimed that due to transaction costs of crossing the border, it was less expensive to purchase the Honduran beans in El Salvador, than to purchase them in Honduras.

The recurring theme among the interviewed El Salvadorian traders was the high transaction costs[19] incurred at the Honduran border. In fact, given the trading practices used in the Honduran borders, some El Salvadorian traders argued that it was less expensive to purchase beans from Nicaraguan traders --with whom El Salvador has no borders-- than it was to purchase beans from Honduras. While it is not clear what the nature of the official trade restrictions[20] --which created an incentive for bribes and other parallel market trading activities-- were at the Honduran border, policy advisors in Honduras contended that according to the free trade treaty these trade restrictions should not be occurring[21]. This is a clear example of how newly drafted trading rules need to be

[19]The most important transaction cost, were the bribes traders had to pay to Honduran officials and/or the cost of crossing the border through non-official crossing points.

[20]Customs official reported the that the new president had enacted a executive decree restricting the trade of beans, among other goods, with Central American countries.

[21]As of March 1995 the government of Honduras had posted signs at the Honduran borders which announced the enforcement of the free trade treaty between Honduras and the Central American countries, including the trade of beans.

monitored to ensure their fulfillment, especially when these rules encompass a complete turn-around from the previous trading rules previously in force.

In addition to determining the structure of the Honduran-El Salvadorian marketing system, El Salvadorian traders were asked to express their bean preferences. As with Honduran traders, El Salvadorian traders were ask to estimate the price of the eight samples of beans mentioned in Section 6.3. In El Salvador, traders from San Salvador expressed a marked preference for small light-red beans; whereas in San Miguel traders were indifferent between small light-reds and small dark-red beans. Moreover, traders in San Miguel said that in this region of the country small dark-reds are often preferred over small light-red beans.

On the other hand, El Salvadorian traders reported that Honduran beans are commonly priced lower than El Salvadorian and/or Nicaraguan beans because beans from Honduras are usually sold at a lower quality standard (i.e., more dirt and foreign matter). This suggests that either Honduran traders do not believe that the returns to processing justify its cost, or that in a competitive market Nicaraguan traders and El Salvadorian producers are adjusting faster to the demand requirements.

6.6 Summary

This chapter was divided into five sections. Section 6.1 was the introduction of the Chapter. Section 6.2 presented evidence of the existing bean marketing links from the farm-gate all the way to the consumers in the major Honduran cities. The third section discussed the market preferences for beans, and the price differences between improved varieties and traditional varieties. The fourth section, presented a comparative analysis of the market performance of improved varieties against traditional varieties. The last section (6.5) presented some evidence of the existing links between the Honduran bean marketing system and El Salvador.

Section 6.2 showed that most farmers sell beans at the farm-gate, mainly to intermediaries who operate on a regional basis. While wholesalers in the larger cities buy beans mainly from intermediaries, wholesalers in the production regions also serve as intermediaries between the production zone and the largest cities. While traders in the more remote areas have a potential to take advantage of a regional monopsonistic power, it is important to determine if existing price differences between remote areas and more accessible areas reflect a lack of competition or mainly reflect transportation costs. In contrast, in more accessible areas farmers travel to the main market towns to negotiate prices, suggesting that in these farming areas farmers have access to an accurate although informal market information.

Section 6.3 emphasized the need of the NBP to maintain market perspectives in their plant breeding program. Both farmers and traders identified the traditional varieties as more marketable than the improved varieties. Besides a desire for red color, traders identified some post harvest handling characteristics as desired attributes of the commodity. In response to costumer demand, traders reported that cleaner and less damaged beans are more desired. Finally, this section showed that during the primera of 1993 there was a marked price difference between improved varieties and the traditional varieties. Seda --the traditional variety-- was priced 19% and 12% higher than Dorado and Catrachita, respectively.

Section 6.4 presented a comparative analysis of the potential revenues farmers may earn growing improved varieties versus traditional varieties. The results showed that while on average improved varieties gave higher farm yields, they commanded lower market prices. Therefore, the gross revenues from improved varieties are only slightly higher than the gross revenue for traditional varieties. Furthermore, The revenue differentials are not very attractive, if risky conditions and input costs are incorporated into the analysis of these estimated revenues.

Finally, Section 6.5 presents the evidence of strong links between the Honduran and the El Salvadorian bean marketing system. Traders in El Salvador, the smallest and most densely populated Central American country, corroborated the findings in the Honduran marketing system. El Salvadorian traders buy a substantial quantity of Honduran and Nicaraguan beans. Additionally, bean preferences in El Salvador vary regionally. In the eastern section of the country, small-dark red beans are often preferred, whereas in the central region the beans found in the market are almost exclusively small light-red beans. Moreover, according to traders, the most important marketing constraint between El Salvador and Honduras were the high transaction costs incurred at the Honduran border.

CHAPTER SEVEN

CONCLUSION AND IMPLICATIONS

7.1 The bean subsector

Beans are one of the most important crops among small farmers in Honduras. At least one-third of all Honduran farmers plant beans, and about 75% of these farmers have farms smaller than 7 hectares. As shown in Chapter 3, beans are an important cash crop both for small and large farmers. Honduran farmers sell approximately 55% of their total bean production. Beans are also an important part of the diet for most urban and rural consumers, with national apparent consumption averaging 10 kg per capita per year. In addition, Honduran bean exports to the Central American market have increased in recent years and could become an increasingly important source of foreign exchange earnings.

However, the performance of the bean subsector has been mixed. Average bean yields (697 kg/MT for 1989-1994) are much lower than expected by researchers and extensionists, and extremely variable from year-to-year. Moreover, as the Central American countries embark towards a more integrated regional market, Honduran bean producers will increasingly be competing with their Nicaraguan counterparts for a larger share of the El Salvadorian bean market.

In recent years, several institutional reforms have been introduced to revitalize the Honduran agricultural sector. In 1992, the Government of Honduras (GOH) approved the Law of Agricultural Development and Modernization (LAM), which policy makers expect will improve the performance of the agricultural sector through incentives which minimize government's participation in several critical areas of agricultural production and marketing. But driven by the politics of market liberalization, these reforms were introduced with only minimal empirical understanding of the agricultural sector and constraints facing small farmers.

As an integral part of modernizing the agricultural sector, the Honduran government has established a new set of market norms which redefines the role of the Agricultural Marketing Institute (IHMA). Under these new market rules, IHMA's role is limited to providing market information (i.e., market prices). Additionally, in case of national emergencies, such as natural disasters which critically reduce food availability, IHMA may use its basic grains strategic reserves (i.e., corn and red beans) to redistribute them into the national market. However, although private traders participated widely in the marketing system even before the LAM was adopted, little empirical analysis has been carried out to document how the bean marketing system operates. Moreover, there is little awareness of neither the historical impact of the regional Central American market on Honduras' bean subsector, nor what will be required to further exploit this potential market.

Additionally, as the National Bean Program (NBP) has sought to improve the performance of the bean subsector by releasing improved bean varieties, the research program has tried to introduce genetic materials with some acceptable market attributes. However, only minimal research efforts have been carried out to better understand how market preferences can limit the widespread acceptability of the improved bean varieties.

Unfortunately, the GOH's plans to modernize the agricultural sector have overlooked the potential contribution of public investments. In recent years, public funds for agricultural research and extension activities have been severely reduced, thereby threatening the viability of the NBP. Currently, Most of the bean research and extension activities are funded by international collaborative research projects such as the Bean/Cowpea CRSP, and the Central American PROFRIJOL research program. Given the scarcity of research funds, in order to help improve the performance the bean subsector, both the NBP research/extension staff and policy makers require a better understanding of the production characteristics of bean farmers, the constraints they face, and the performance of existing technologies.

7.2 The Modified Subsector Approach

Originally the subsector approach was conceptualized as an in-depth study of the different vertically linked economic activities which generate value added to a narrowly defined commodity, using the industrial organization paradigm of structure-conduct-performance. The present study followed a modified subsector approach, focusing on the farm-level bean production/marketing and on the intermediary/wholesaler level.

To inform the issues outlined in the previous section, surveys of farmers and traders were conducted. Having identified the Mideastern (30%) and the Northeastern (32%) as the largest bean production regions in the country, 215 bean farmers were interviewed from these Regions. In an effort to represent the national distribution of bean farmers, these farmers were stratified into small, medium, and large farmers. In addition, to take into account agro-ecological factors both hill-side and flat-land bean farmers were interviewed. Farm-level data collection focused on understanding the bean production system, with an emphasis on farmers' use of improved bean varieties, and their marketing behavior.

At the intermediary/wholesaler level, 57 traders were interviewed in different city markets throughout Honduras. These interviews focused on gaining a better understanding of the market links between the farm-gate, urban consumers, and other potential Central American consumers. Additionally, this survey focused on trying to better understand the market acceptability of the improved bean varieties, compared to the traditional bean varieties.

This modified subsector study generated information that enables bean researchers to better evaluate the performance of the newly released bean varieties, in the context of a dynamic market. Moreover, policy makers can use insights from this study to consider policy options to improve the productivity of the bean subsector at both the farm and market levels, a dual perspective that is especially useful given the increasingly competitive Central American market.

7.3 The Bean Farming System

While most of the data presented in Chapter 3 (7.1, 7.2) were obtained from secondary data sources, primary data were used in Chapter 4 to highlight five aspects of the bean farming system: the bean farmers' cropping patterns (4.2), their of chemical inputs (4.3), their adoption of improved bean varieties (4.4), bean farmers' sales behavior (4.5), and key demographic characteristics of the bean farmers' households (4.6). These different components of the bean farming system were compared across two broadly defined topographical environments (i.e., flat-lands and hill-sides), and across different farm sizes.

Data presented in Chapter 4 were analyzed by comparing the characteristics and behavior of farmers in the hill-sides and flat-lands because it was hypothesized that the agro-ecological conditions in these two settings influence farmers' production decisions differently. Additionally, it was considered important to understand differences across farm size because there may exist policy prescriptions and technologies which are more amenable to the conditions of farmers within a particular farm size group. As a way of better understanding the bean production system, data in Chapter 4 were also analyzed within the context of either the *primera* (the rainy season) or the *postrera* (the dry season). When applicable, comparisons of the farming system characteristics were made across the two seasons.

In the *postrera*, beans are the most important crop grown by basic grain producers. During the *postrera*, which extends from October through May, beans alone account for most of the land cultivated in the Mideastern and Northeastern Regions (73% of farmed land in the sample). In contrast, during the *primera*, corn is the most important crop for basic grain producers. Therefore, research and policies directed at relaxing bean production constraints in the *postrera* are likely to have a larger production impact, than those directed at relaxing production constraints in the *primera*.

Consequently, it is especially important to understand what farmers consider to be their most important production constraints in the *postrera*. While researchers consider BGMV to be the primary factor limiting yields and a large proportion of farmers identified the presence of Bean Golden Mosaic Virus (BGMV) in their bean fields (45%) during the 1993-1994 agricultural year, farmers did not perceive BGMV as their primary production problem. Instead, almost one-half of the farmers (45%) identified low rainfall in the *postrera* season as their primary production constraint. This suggests that bean researchers need to prioritize their research objectives to relax this production constraints (i.e., droughts); and that policy makers need to direct resources in support of initiatives designed to help farmers minimize the adverse effects of weather uncertainties. For example, in a complementary study, Bonnard (1995) highlighted the importance of promoting soil conservation practices which help improve soil quality, and improve the water carrying capacity of soils in the Northeastern and Mideastern Regions of Honduras.

Bean farmers' more frequent use of chemical inputs in the *postrera* further highlights the relative importance of the *postrera* season for bean producers. In addition, these data showed that Mideastern farmers are more likely to use chemical inputs than farmers in the Northeastern Region. While this study did not analyze what factors determine the use of chemical input, information provided by key informants suggests that in the Northeastern Region farmers have less access to chemical inputs.

Catrachita (1987) and Dorado (1990), the two most important improved varieties released by the NBP since 1987, were planted by 21% and 19% , respectively, of the sampled bean farmers during the 1993-1994 agricultural year. These represent high adoption rates, if one considers that these sampled farmers reported planting a total of at least 50 different land races. However, Mideastern farmers planted both improved varieties more frequently than did farmers in the Northeastern Region. This implies that, as was the case for chemical inputs, extension and research efforts to diffuse improved varieties has been limited to certain geopolitical areas (i.e., Mideastern Region).

Moreover, the data demonstrated that these two varieties perform differently across different regions and climatological conditions. While a larger proportion of Catrachita adopters are hill-side farmers, Dorado is used in similar proportions by both hill-side and flat-land farmers. Moreover, the yield performance of these improved bean varieties varies across farming seasons. For instance, only in the *postrera* did Dorado adopters obtain higher yields (730 kg/ha) than farmers who planted traditional varieties (520 kg/ha). In contrast, in the *primera* Catrachita adopters obtained higher yields (620 kg/ha) than farmer who planted traditional varieties (430 kg/ha). Nonetheless, on average the bean yields among adopters of these improved varieties are much lower than the 1.7 mt/ha and 1.4 mt/ha yield potential of Dorado and Catrachita, respectively, as reported in the NBP extension bulletins. This suggests the need to initiate research on constraints to higher yields of improved varieties in farmer-managed fields under different environmental conditions. This research will help to better identify varietal attributes required to relax constraints in various agro-ecological settings and guide the distribution of different improved varieties among bean farmers in different environments.

Analysis of farmers' sales behavior (4.5) showed that a considerable proportion (19%) of sampled bean farmers are net buyers of beans -- most of whom farmed less than 10 hectares. This suggests, that contrary to conventional wisdom, many poor farmers are not self-sufficient in beans. Thus to achieve its goal to alleviate poverty and ensure food self-sufficiency among farmers, the GOH must pay particular attention to addressing the needs of this group of farmers. In addition, bean researchers must develop and make available production increasing-technologies (i.e., improved varieties and crop management practices) appropriate for different environments (i.e., flat-lands vs. hill-sides) and farmers' varying circumstances (i.e., small vs. large).

The level of formal education among household heads throughout the farming regions is surprisingly low (Section 4.6), averaging 1.97 years with a median of only 1 year. This suggests that if farmers are to benefit from extension services, the information they provide must be designed to be accessible to farmers with minimal literacy. For instance, it is naive to expect farmers to know how or when to use chemical inputs, as complements of improved bean varieties, if recommendations are only made available to farmers through written extension bulletins. In an effort to produce appropriate technologies, it is also important to better understand the role of women in the production system. In contrast to conventional wisdom, an important proportion of women in the household (20%) take part in some bean related activity (20%) --primarily in harvest and post harvest handling of grains. This suggests that it is especially important to incorporate women's view-points in designing post-harvest technologies (i.e., improved threshing technologies).

7.4 Adoption and Yield Determinants Models

Chapter 5 presented an econometric analysis of factors that affect farmers' adoption of improved varieties and bean yields in the Mideastern and Northeastern Regions of Honduras. Two logistic models were estimated to predict the adoption of Dorado and Catrachita, and two OLS models were estimated to identify the factors that affect bean yields in the *primera* and *postrera*. The results of the multivariate regression models confirm and strengthen the findings presented in Chapter 4.

First, the adoption models showed that farmers' decision to adopt improved varieties is greatly influenced by agro-ecological conditions. Catrachita is more likely to be planted by hill-side farmers and Dorado is more likely to be planted by flat-land farmers. In addition, farmers in the Northeastern region are less likely to have adopted the improved varieties. These findings suggests that to achieve a higher level of impact, technical recommendations for the use of improved varieties must take into consideration the farmers' own environmental conditions and the interaction between varieties and major environments. In addition, providing greater access to improved varieties in marginally served administrative regions will be required to increase the adoption of improved varieties over a wider geographical area.

The yield models further stressed the importance of the environment-improved variety interaction. While adoption of Catrachita had an impact on bean yields in the *primera*, adoption of Dorado was associated with higher yields in the *postrera*. Moreover, the yield models showed that holding everything else constant, bean yields are higher among flat-land farmers than among hill-side farmers.

7.5 Understanding the Bean Marketing System

Chapter 6 analyzed the basic characteristics of the different marketing channel participants. Most farmers' sale transactions (93 %) take place as farm-gate sales to truckers. While farmers in more remote areas receive up to 15% lower bean prices than do farmers in the areas closer to the most important market towns, additional analysis is needed to establish if these price differences arise from the existing marketing cost structure (i.e., high transportation costs) or from traders' rent-seeking behavior (i.e., monopsonistic behavior).

The analysis of bean market preferences (Chapter 6) suggests that plant breeders and policy makers need to pay closer attention to the market. For instance, since most bean traders prefer small light-red beans with minimal post-harvest damage, dark-red beans and black beans command lower market price than do light-red beans (up to 20% lower). Thus, given current yields of traditional and improved varieties, farmers who plant improved bean varieties do not earn significantly higher revenues than do farmers who plant traditional bean varieties. This suggests that market attributes of improved varieties may limit the widespread adoption of improved varieties.

Widely available price data which reflect consumers' tastes and preferences help improve the efficiency of a marketing system. However, bean prices as currently reported by the government do not differentiate beans by market classes or physical quality characteristics. Given that the role of the Agricultural Marketing Institute has been redefined to provide market information (i.e., market prices), in the future, decision makers at IHMA must provide price information to farmers and consumers that takes into consideration different market qualities, especially bean color and cooking quality.

With the resurgence of the Central American Common Market and the cessation of the wars which disrupted the region during the 1980s, trading links to El Salvador have strengthen in recent years. Section 6.5 documented the close linkages of the El Salvadorian market *vis-a-vis* the Honduran bean market. Therefore, in developing improved varieties bean researchers need to explicitly take into account the quality characteristics that are important in the El Salvadorian market. Otherwise, bean quality requirements in El Salvador may limit the acceptability of certain bean varieties among commercially-oriented Honduran bean farmers. Similarly, as the wider Central American market expands, researchers must consider the quality requirements of each country in the region when allocating scarce research resources to develop improved varieties targeted for these regional consumption/production niches.

Finally, policy makers must understand that since Honduran producers and traders are competing in a regional market, the competitiveness of Honduran beans is strongly influenced by government regulations. For instance, this study showed that the 1994 export ban to neighboring countries did not eliminate trade. Instead, it generated added costs to exporters, thus decreasing the attractiveness of Honduran beans *vis-a-vis* other regional competitors. As a result, Honduran bean farmers and traders received lower prices than would have prevailed under a more transparent set of intercountry trading practices.

7.6 Limitations of the Study and Recommendations for Further Research

The main objective of this study was to identify the most salient characteristics of the Honduran bean subsector and opportunities for increasing its productivity, emphasizing the impact of new technologies; within the context of different environmental settings and recent institutional changes. To achieve this goal three sources of data were used; namely official government data, key informant data, and primary survey data.

While these sources of data were appropriate for this study, some weaknesses are associated with these data. First, government data are normally highly aggregated (i.e. reported at regional levels), which makes it difficult to identify and understand existing micro-economic relationships. Second, while key informant data are valuable in gaining a good understanding of regional differences/patterns in farming and marketing practices, it is difficult to use these data for cross-sectional analysis of microeconomic relationships.

Third, while primary survey data are most appropriate for cross-sectional analysis of micro-economic relationships affecting the performance of the bean subsector, the primary data collected for this study had some unavoidable limitations. First, due to time/financial constraints, the farmer's and trader's surveys were carried out during single visit interviews. Therefore, the results presented in the study were based on analysis of data obtained on a recall basis for an entire agricultural year. While these data are good indicators of existing differences across different environments and regions, it is important to recognized that there exist some measurement errors which may bias the specific size of the estimates (coefficients) reported in this study. Nonetheless, since these biases are expected to be consistent (upward/downward), the relationships identified through the analysis of these data are still consistent. To reduce these measurement errors, future researchers could utilize multiple visit surveys. However, since this data collection approach is more demanding time/financially, it is more appropriate for studies which give high priority to estimating production costs and/or consumption patterns.

7.6.1 Recommendations for Further Research

1. While this study demonstrated that beans are an important crop for small farmers, both as an important source of food and cash income, further economic analysis of the role of beans in the farmers' portfolio is needed to more precisely assess the economic opportunities available to bean farmers. For instance, whole-farm budgets would help to better understand the relative profitability of beans (compared to other agricultural and non-agricultural activities), and thereby generate information required to assess farmers' likelihood to invest in their bean enterprise vis-a-vis other alternative economic opportunities.

2. This study documented an important interaction between specific agro-ecological conditions, and farmers' adoption of improved bean varieties. In addition the data showed an interaction between agro-ecological conditions and bean yields. This suggests the need to further evaluate the yield performance of recommended technologies (i.e., improved varieties) within specific environmental conditions, and give greater priority to developing improved varieties for specific ecological niches.

3. Given the considerable gap between yields in farmers' fields and those reported as possible through extension bulletins, it is important to further analyze what explains this bean yield gap. Yield constraints studies can be carried out by multidisciplinary teams to determine key factors that explain experimental station and farm-level yield gaps. Such studies will both help to better evaluate the performance of improved varieties across different farmers-managed conditions, and serve to prioritize production constraints that require further research focus.

4. The data presented in this study showed that traditional bean varieties command a higher market price compared to improved bean varieties. This suggests that the market acceptability of improved varieties may limit the adoption of improved varieties. Therefore, it is important to continue to evaluate market preferences and incorporate this information into the breeding program.

5. Given the influence of the Central American market on the Honduran bean subsector, further research directed at understanding the long-run competitiveness of Honduran beans in Central America will help policy makers determine how to best use public funds to improve the performance of the subsector. Central American bean price data are needed to further evaluate the regional market integration process, and help determine the competitiveness of Honduran beans *vis-a-vis* its competitors. In addition, a more efficient record-keeping system of exports and imports is needed to generate data to better document the Central American trade flows, which in turn help demonstrate the relative importance of the regional markets for the Honduran bean subsector.

7.7 Concluding Comments

In spite the limitations of this research, there are several conclusions and implications supported by the total evidence. These implications can be categorized in terms of results that primarily impact policy makers, plant scientists, and agricultural extensionists.

7.7.1 Implications for Policy Makers

As the agricultural modernization program is implemented, it is important to understand what economic opportunities are currently available to small and medium size farmers, who conform the majority of Honduran farmers. Official government data, as well as primary data, show that beans and corn represent an important livelihood for a large proportion of Honduran farmers. Beans, particularly, are an important source of proteins for farmers and urban consumers. Additionally, beans are an important source of cash income for farmers, as well as an increasingly important tradeable good in the Central American region. However, as with the rest of the agricultural sector, in order for beans to make a positive contribution to Honduras' economic development and maintain a competitive position in the Central American region the productivity of the bean subsector must be increased both at the production and marketing levels. The need to increase the bean subsector's productivity calls for appropriate government incentives, especially more transparent market rules and norms, and adequate research policies which take into account subsector participants' (i.e., traders, farmers, food processors) conditions. This Section presents specific policy implications highlighted by the results of this study.

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 works in close cooperation with the internationally funded research programs (i.e., Bean/Cowpea CRSP, and PROFRIJOL) to relax production and marketing constraints with a potential for high impact, such as the development of more market acceptable varieties 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 (i.e., daily radio broadcast of producer and consumer prices) which collects and publishes bean prices for different market classes and for different regions. This information will help farmers, consumers, and traders to make better informed decisions -- specially among farmers and consumers with less access to large markets.

Third, it is clear that the Central American market represents an important economic opportunity for Honduran bean producers and traders. However, policy makers must understand that the regional competitiveness of Honduran beans are directly affected by regional trading policies. Restrictive regional export/import policies may create production disincentives which, in the long run, may affect the regional competitive position of Honduran beans and as a consequence lead to more volatile prices within the national bean market. Additionally, restrictive trading rules may create disincentives for further investments in value added activities such as food processing which could further exploit regional market opportunities.

7.7.2 <u>Implications for Plant Scientists</u>

Both the national 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 conduct research with the largest potential for impact. The results from this study highlight 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 socio-economists to better comprehend the evolving competitive position of the bean subsector within a larger food system. In addition, it serves as an example for the study of other agricultural commodities within the economy.

Second, as shown by official government data bean production takes place primarily in the Northeastern, Mideastern, and Northern Regions. To date, the research program has given highest priority to relaxing the BGMV production constraint. While this research focus has greatly benefitted producers in the Mideastern Region, less emphasis has been given to the production constraints of Northeastern farmers, who produce the largest proportion of Honduran beans. In contrast, for Northeastern farmers, weather related production problems such as low rainfall patterns are the most important constraints -- especially in the *postrera*. This finding supports the bean research program's recent decision to expand its research directed at relaxing water stress related production constraints (i.e., drought resistant varieties, water conservation agronomic practices).

Third, bean production patterns differ markedly from one season to the other. During the *postrera* beans are most commonly grown as a sole crop whereas in the *primera* beans are intercropped with corn, the primary staple crop. Therefore, during the *primera*, plant breeders should join with agronomists and socio-economists to study alternatives to increasing the productivity of bean/corn production systems. Increasing corn productivity in the primera would enable farmers to supply their corn needs using less land, thereby releasing land and other resources that could be reallocated to *primera* bean production.

Fourth, the performance of available technologies varied markedly across topographical regions. While flat-land bean farmers obtain higher yields and sell a larger proportion of their bean crop than do hill-side farmers, beans are also an important crop for hill-side farmers. Therefore, researchers must develop technologies which increase productivity in hill-side environments. Clearly, more sustainable production alternatives for the often marginalized hill-side farmers are needed to both reduce soil degradation and insure more equitable access to new technologies.

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

Sixth, given the government's commitment to market liberalization to promote economic development, plant breeders need to pay greater attention to the linkages between farmers' production decisions and the market. Both farmers and traders expressed concerns about the market acceptability of improved varieties such as Catrachita and Dorado. Therefore, in order to increase the domestic and regional competitiveness of the bean subsector, in screening new varieties 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 market conditions.

7.7.3 Implications for Agricultural Extensionists

As the agricultural extension program of the Ministry of Agriculture is restructured as a result of agricultural modernization program, less public resources and personnel will be available to provide extension services to farmers distributed over 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 (i.e., improved varieties, chemical inputs) than their Mideastern counterparts. Higher bean yields in the Northeastern Region are partly due to an expansion of the agricultural frontier, and therefore, are not sustainable in the long run. Hence, with greater access to modern technologies, Northeastern farmers' would likely be able to increase their bean yields to higher levels than in the past and at the same time make them more sustainable. Therefore, decision 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 decision makers. In Honduras, it was found that a large proportion of farmers get access to improved varieties through informal distribution channels (i.e., from relatives and friends). Therefore, the extension program should continue to support and analyze ways of improving the artisan seed distribution/production system.

Finally, on average Honduran farmers have low levels of formal education. Therefore, farmers' formal education level should be taken into account by the extension service when developing agricultural education materials. Greater attention should be given to creating graphic extension bulletins, and to facilitating practical training sessions under farmers conditions in order to more effectively communicate the results of agricultural researcher to the typical limited resource farmer with minimal formal education.

APPENDICES

APPENDIX A

Table A-1 Area Harvested (ha) for Staple Food Grains, 1981/82-1991/92, Honduras.

Year	Corn	Bean	Rice	Sorghum	Total
1982	345,904	78,031	21,645	59,555	505,135
1983	277,664	52,117	15,355	25,822	370,958
1984	315,107	51,757	22,211	52,099	441,174
1985	376,338	60,056	18,270	60,799	515,463
1986	294,690	68,996	14,952	14,048	392,686
1987	352,794	76,334	13,996	44,273	487,397
1988	350,285	67,593	21,186	27,660	466,724
1989	340,699	80,526	13,804	61,028	496,057
1990	358,031	82,886	17,244	66,623	524,784
1991	374,864	94,686	17,929	80,443	567,922
1992	438,143	112,000	21,357	75,071	646,571
Avg. growth rate 1980/81-1990/91	3.44%	5.08%	3.78%	30.64%	3.94%

Source: *Pronostico de Cosechas de Granos Basicos*, D.G.E.C.

Table A-2 Changes in Harvested Area (ha) for Staple Food Crops, 1980/81-1990/91, Honduras.

Year[a]	Corn	Beans	Rice	Sorghum	Total
1-2	-609	8,303	1,566	-3,615	5,645
2-3	-68,240	-25,914	-6,290	-33,733	-134,177
3-4	37,443	-360	6,856	26,277	70,216
4-5	61,231	8,299	-3,941	8,700	74,289
5-6	-81,648	8,940	-3,318	-46,751	-122,777
6-7	58,104	7,338	-956	30,225	94,711
7-8	-2,509	-8,741	7,190	-16,613	-20,673
8-9	-9,586	12,933	-7,382	33,368	29,333
9-10	17,332	2,360	3,440	5,595	28,727
10-11	16,833	11,800	685	13,820	43,138

[a]These figures indicate changes in area harvested from one harvesting year to the next. Negative values indicate a decreases in area,
positive values indicate an increases in area and negative numbers indicate a decrease in area. Year 1-2 indicates the time that
elapsed between harvesting seasons 1980/81 and 1981/82, etc.

Source: *Pronostico de Cosechas de Granos Basicos*, D.G.E.C.

Table A-3 Harvested Area Distribution for Staple Food Grains by Season, 1980/81-1990/91, Honduras.

Harvest Year[a]	Corn Area (%)		Bean Area (%)		Rice Area (%)		Sorghum Area (%)	
	Primera	*Postrera*	*Primera*	*Postrera*	*Primera*	*Postrera*	*Primera*	*Postrera*
1981	74.3	25.8	53.7	46.3	88.1	11.9	87.8	12.2
1982	77.0	23.0	51.2	48.8	97.9	2.1	89.7	10.3
1983	75.4	24.6	42.0	58.0	95.8	4.2	74.1	25.9
1984	76.5	23.5	44.2	55.8	83.1	16.9	91.5	8.5
1985	80.2	19.8	47.0	53.0	96.5	3.5	94.1	5.9
1986	72.1	27.9	46.4	53.6	89.4	10.6	47.4	52.6
1987	76.7	23.3	51.6	48.4	88.7	11.3	83.3	16.7
1988	82.8	17.2	61.9	38.1	93.2	6.8	93.8	6.2
1989	78.0	22.1	24.3	75.7	92.2	7.8	86.4	13.6
1990	79.0	21.0	29.8	70.3	88.5	11.5	78.8	21.3
1991	78.8	21.2	28.6	71.4	86.9	13.1	78.1	21.9
Avg.	77.3	22.7	43.7	56.3	91.0	9.1	82.3	17.7

[a]1981 refers to the 1980/81 agricultural year.

Source: *Pronostico de Cosechas de Granos Basicos*, D.G.E.C.

Table A-4 Bean Area Distribution by Region and Farm Size, 1991/92, Honduras.

Farm Size (has)	South (%)	Mid-West (%)	North (%)	Atlantic (%)	North-East (%)	Mid-East (%)	West (%)	National (%)
< 3.5	42.0	53.9	35.0	8.6	32.0	40.2	45.7	38.7
3.5-7.0	4.7	16.8	11.9	1.4	20.5	15.5	8.5	15.7
7.0-14.0	16.6	14.2	20.5	28.6	14.9	9.5	15.6	13.6
> 14.0	36.7	15.1	32.6	61.4	32.5	34.8	30.2	31.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
National Share (%)	3.4	9.0	10.4	0.4	33.6	31.5	11.8	

Source: SECPLAN. 1994. Encuesta Agricola Nacional 1991-92 (unpublished).

Table A-5 Total Staple Food Grains Production, 1980/81-1990/91, Honduras.

Harvest Year	Corn (mt)	Beans (mt)	Rice (mt)	Sorghum (mt)	Total (mt)
1980/81	388,217	35,943	35,937	52,216	512,313
1981/82	481,656	42,256	36,719	58,100	618,731
1982/83	366,493	30,698	21,962	32,300	451,453
1983/84	459,191	30,612	46,362	46,613	582,778
1984/85	507,857	32,899	48,698	52,486	641,940
1985/86	423,964	38,715	45,736	12,182	520,597
1986/87	484,079	40,066	34,326	19,125	577,596
1987/88	523,270	36,033	59,417	31,108	649,828
1988/89	441,407	52,462	31,984	53,637	579,490
1989/90	510,718	57,166	46,733	61,859	676,476
1990/91	559,142	73,770	44,972	81,343	759,227
Average	467,818	42,784	41,168	45,543	597,312

Source: *Pronostico de Cosechas de Granos Basicos*, D.G.E.C.

Table A-6 Percent Changes in Staple Food Grains Production, 1980/81-1990/91, Honduras.

Harvest Year[a]	Corn	Beans	Rice	Sorghum	Total
1-2	24.1	17.6	2.2	11.3	20.8
2-3	-23.9	-27.4	-40.2	-44.4	-27.0
3-4	25.3	-0.3	111.1	44.3	29.1
4-5	10.6	7.5	5.0	12.6	10.1
5-6	-16.5	17.7	-6.1	-76.8	-18.9
6-7	14.2	3.5	-25.0	57.0	11.0
7-8	8.1	-10.1	73.1	62.7	12.5
8-9	-15.6	45.6	-46.2	72.4	-10.8
9-10	15.7	9.0	46.1	15.3	16.7
10-11	9.5	29.1	-3.8	31.5	12.2
Annual Average	5.1	9.2	11.6	18.6	5.6

[a]Harvest Year 1-2 indicates the percentage change in production from 1980/81 to 1981/82, 2-3 indicates the percentagechange in production from 1982-83 to 1983-84, etc.

Source: *Pronostico de Cosechas de Granos Basicos*, D.G.E.C.

Table A-7 Seasonal Distribution (%) of Staple Food Grain Production, 1980/81-1990/91, Honduras.

Harvest Year	Corn		Beans		Rice		Sorghum	
	Primera	*Postrera*	*Primera*	*Postrera*	*Primera*	*Postrera*	*Primera*	*Postrera*
1980/81	73.5	26.5	56.1	43.9	89.3	10.7	87.5	12.5
1981/82	79.2	20.8	55.0	45.0	97.3	2.7	89.8	10.2
1982/83	82.3	17.7	44.5	55.5	98.3	1.7	80.1	19.9
1983/84	80.8	19.2	37.0	63.0	79.5	20.5	92.6	7.4
1984/85	80.1	19.9	48.7	51.3	95.7	4.3	93.3	6.7
1985/86	74.9	25.1	49.1	50.9	90.6	9.4	60.6	39.4
1986/87	48.2	51.8	50.9	49.22	87.4	12.6	74.9	25.1
1987/88	83.7	16.3	61.8	38.2	95.2	4.8	95.6	4.4
1988/89	87.4	12.7	18.0	82.0	87.6	12.4	83.8	16.2
1989/90	79.4	20.6	28.6	71.4	83.2	16.8	75.7	24.3
1990/91	81.8	18.2	28.9	71.1	80.0	20.0	67.1	32.9
Average	77.4	22.6	43.5	56.5	89.5	10.5	81.9	18.1

Source: SECPLAN. *Pronostico de postrera* (various years).

Table A-8 Total and Per Capita Bean Consumption, 1980/81-1989/90, Honduras.

Agricultural Year	Total Consumption ('000 mt.)	Consumption per Capita (kg)
1980/81	33.4	10.1
1981/82	34.6	10.1
1982/83	35.7	10.2
1983/84	36.9	10.2
1984/85	38.1	10.2
1985/86	39.4	10.3
1986/87	33.4	8.5
1987/88	30.0	7.0
1988/89	44.4	10.0
1989/90	47.8	10.4
1990/91	49.0	10.3
1991/92	46.6	9.5
1992/93	44.1	
Mean	39.5	9.7
C.V.[a]	15.8%	10.3%

[a] Coefficient of variation

Source: Ministry of Natural Resources. 1993. *Compendio Estadistico.*

Table A-9 Agronomic Characteristics of Improved Bean Varieties, Honduras.

Improved Variety	Seed Color	Days to: Flower	Days to: Maturity	Growth Habit[a]	gms/ 100 Seeds	Yield mt/ha	Release Year
Don Silvo	Dark Red	38	66-70	II	24	1.70	1993
Dorado	Dark Red	38	73-77	II	23	1.70	1990
Oriente	Shiny Red	35	63-65	II-III	25	1.56	1990
Catrachita	Shiny Red	35	63-65	II-III	29	1.43	1987
Danli-46	Dark Red	38	65-68	II	25	1.17	1965
Desarrural	Shiny Red	33	60-63	II-III	25	1.10	n.a.
Chingo-1R	Shiny Red	32	57-60	II-III	22	1.10	n.a.
Zamorano	Shiny Red	39	68-75	III	25	0.9	1952
Acacias-4	Opaque Red	38	68-70	II	22	1.65	n.a.
Esperanza	Red	45	85	I	39	1.3	n.a.
Porrillo Sintetico	Black	40	68-70	II	23	1.65	n.a.

[a]Growth Habit: Type II = bush; Type III = climbing. n.a. = Information not available to authors

Source: Ministry of Natural Resources

Table A-10 Reaction of Improved Bean Varieties to Main Bean Diseases, Honduras.

Improved Varieties	**Diseases**						
	BCMV	BGMV	CBB	WB	ANT	RUST	ALS
Don Silvo	R	R	I	S	I	I	S
Dorado	R	T	I	I	I	I	I
Oriente	R	S	S	I	S	I	S
Catrachita	R	I	S	S	I	I	S
Danli-46	S	S	S	S	I	S	S
Desarrural-1R	R	S	S	S	S	S	S
Chingo-1R	R	S	S	S	S	S	S
Zamorano	S	S	S	S	I	I	n.a.
Acacias-4	R	S	S	S	S	I	I
Esperanza-4	S	S	n.a.	n.a.	I	I	I

Disease Codes: BCMV=Bean Common Mosaic Virus; BGMV=Bean Golden Mosaic Virus; CBB=Common Blight Bacteria; WB=Web Blight; ANT.=Anthracnose; RUST=Bean Rust; ALS=Angular Leaf Spot.
Source: Ministry of Natural Resources

APPENDIX B

```
Regression Results from SPSS program.

      Total number of cases:       326 (Unweighted)
      Number of selected cases:    326
      Number of unselected cases: 0

      Number of selected cases:                326
      Number rejected because of missing data:  6
      Number of cases included in the analysis: 320


Dependent Variable Encoding:

Original        Internal
Value           Value
     .00        0
    1.00        1

Dependent Variable..   CATUNI     Used Catrachita any season?

Beginning Block Number  0.  Initial Log Likelihood Function

-2 Log Likelihood   323.01068

* Constant is included in the model.


Beginning Block Number  1.  Method: Enter
```

```
Variable(s) Entered on Step Number
1..       EDUHH      Formal Education level HH
          ATOTHA     Total farm area in has.
          REGCODE    Geopolitical Region Codes
          TOPCOD     Code for Topographical Region
          INSECT     Insecticide Use
          CREDIT     Received Credt. Last 5 years?
          FERT       Fertilizer Use

Estimation terminated at iteration number 5 because
Log Likelihood decreased by less than .01 percent.

 -2 Log Likelihood      257.854
 Goodness of Fit        297.618

                      Chi-Square    df Significance

 Model Chi-Square        65.157      7        .0000
 Improvement             65.157      7        .0000

Classification Table for CATUNI
                   Predicted
                  No       Yes     Percent Correct
                    N  ö    Y
Observed         òôôôôôôôôôôôôôôôó
   No      N     ö  237  ö   18  ö   92.94%
                 òôôôôôôôôôôôôôôôó
   Yes     Y     ö   46  ö   19  ö   29.23%
                 òôôôôôôôôôôôôôôôó
                            Overall  80.00%

---------------------- Variables in the Equation -----------------------
```

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
EDUHH	.0752	.0613	1.5034	1	.2201	.0000	1.0781
ATOTHA	.0065	.0029	4.8219	1	.0281	.0935	1.0065
REGCODE	1.1231	.4018	7.8144	1	.0052	.1342	3.0745
TOPCOD	-1.9367	.3739	26.8310	1	.0000	-.2773	.1442
INSECT	-1.6585	.5032	10.8606	1	.0010	-.1656	.1904
CREDIT	.3146	.3250	.9372	1	.3330	.0000	1.3698
FERT	.8404	.3636	5.3422	1	.0208	.1017	2.3172
Constant	-1.8882	.3808	24.5826	1	.0000		

Correlation Matrix:

	Constant	EDUHH	ATOTHA	REGCODE	TOPCOD	INSECT	CREDIT
Constant	1.00000	-.21989	-.05408	-.67591	-.09423	.04350	-.35903
EDUHH	-.21989	1.00000	-.11234	.04668	-.11224	-.02271	-.16223
ATOTHA	-.05408	-.11234	1.00000	-.03677	-.10437	-.31272	.09644
REGCODE	-.67591	.04668	-.03677	1.00000	-.20027	-.07518	-.05324
TOPCOD	-.09423	-.11224	-.10437	-.20027	1.00000	.09851	.07106
INSECT	.04350	-.02271	-.31272	-.07518	.09851	1.00000	-.13832
CREDIT	-.35903	-.16223	.09644	-.05324	.07106	-.13832	1.00000
FERT	-.03496	-.11740	.11296	-.23344	.04119	-.25494	-.03785

	FERT
Constant	-.03496
EDUHH	-.11740
ATOTHA	.11296
REGCODE	-.23344
TOPCOD	.04119
INSECT	-.25494
CREDIT	-.03785

```
FERT        1.00000


áááááá


      Total number of cases:       326 (Unweighted)
      Number of selected cases:    326
      Number of unselected cases: 0

      Number of selected cases:                326
      Number rejected because of missing data:  6
      Number of cases included in the analysis: 320


Dependent Variable Encoding:

Original       Internal
Value          Value
     .00       0
    1.00       1

Dependent Variable..   DORUNI      Used Dorado in any season?

Beginning Block Number  0.  Initial Log Likelihood Function

-2 Log Likelihood   273.97865

* Constant is included in the model.
```

```
Beginning Block Number  1.  Method: Enter

Variable(s) Entered on Step Number
1..        EDUHH      Formal Education level HH
           AGEHH      Age of HH
           ATOTHA     Total farm area in has.
           CREDIT     Received Credt. Last 5 years?
           FERT       Fertilizer Use
           REGCODE    Geopolitical Region Codes
           TOPCOD     Code for Topographical Region
           WORK#      # members who work in Field

Estimation terminated at iteration number 5 because
Log Likelihood decreased by less than .01 percent.

 -2 Log Likelihood      212.303
 Goodness of Fit       1008.802

                     Chi-Square    df Significance

 Model Chi-Square        61.675     8        .0000
 Improvement             61.675     8        .0000

Classification Table for DORUNI
                  Predicted
                 No       Yes     Percent Correct
                   N  ŏ    Y
Observed         ðôôôôôôôôôôôôôôôôð
   No      N     ŏ  265  ŏ    6  ŏ   97.79%
                 ðôôôôôôôôôôôôôôôôð
   Yes     Y     ŏ   35  ŏ   14  ŏ   28.57%
                 ðôôôôôôôôôôôôôôôôð
                            Overall  87.19%
```

--------------------- Variables in the Equation ----------------------

Variable	B	S.E.	Wald	df	Sig	R	Exp(B)
EDUHH	.0472	.0705	.4476	1	.5035	.0000	1.0483
AGEHH	-.0417	.0162	6.6482	1	.0099	-.1303	.9592
ATOTHA	-.0113	.0123	.8510	1	.3563	.0000	.9888
CREDIT	.7248	.3709	3.8177	1	.0507	.0815	2.0643
FERT	1.4044	.3686	14.5208	1	.0001	.2138	4.0732
REGCODE	1.4301	.5736	6.2159	1	.0127	.1240	4.1792
TOPCOD	.9342	.3937	5.6298	1	.0177	.1151	2.5451
WORK#	.2983	.1057	7.9582	1	.0048	.1475	1.3476
Constant	-3.2709	.9787	11.1704	1	.0008		

Correlation Matrix:

	Constant	EDUHH	AGEHH	ATOTHA	CREDIT	FERT	REGCODE
Constant	1.00000	-.45033	-.57574	.10214	-.28081	-.11983	-.47333
EDUHH	-.45033	1.00000	.39503	-.15180	-.08345	-.08773	.03506
AGEHH	-.57574	.39503	1.00000	-.27918	-.02636	-.06517	-.05514
ATOTHA	.10214	-.15180	-.27918	1.00000	-.02939	.05013	-.01313
CREDIT	-.28081	-.08345	-.02636	-.02939	1.00000	.06276	.06208
FERT	-.11983	-.08773	-.06517	.05013	.06276	1.00000	-.16379
REGCODE	-.47333	.03506	-.05514	-.01313	.06208	-.16379	1.00000
TOPCOD	-.18732	-.08812	-.25652	.09588	.17109	.26156	-.06154
WORK#	-.27211	.09164	-.27465	.01646	-.00506	.05754	.03630

	TOPCOD	WORK#
Constant	-.18732	-.27211
EDUHH	-.08812	.09164
AGEHH	-.25652	-.27465

```
ATOTHA        .09588    .01646
CREDIT        .17109   -.00506
FERT          .26156    .05754
REGCODE      -.06154    .03630
TOPCOD       1.00000    .30539
WORK#         .30539   1.00000


          * * * *   M U L T I P L E   R E G R E S S I O N   * * * *


Listwise Deletion of Missing Data

Equation Number 1    Dependent Variable..   KGHAPRI   Yield in Kg/ha beans/primera

Block Number  1.  Method:  Enter
   BEAHAS   BGMSEV   CATASDUM CATUNI   DORUNI   INTER    TOPCOD   BEFERHA
   REGCODE


Variable(s) Entered on Step Number
   1..    REGCODE   Geopolitical Region Codes
   2..    CATASDUM  Dummy for Catastrophe (i.e. yield 0)
   3..    BEAHAS    Hectares planted to beans
   4..    CATUNI    Used Catrachita any season?
   5..    BEFERHA   Lps. of fert. spent on fertilizer per ha
   6..    BGMSEV    SEVERE BGMV?
   7..    INTER     Intercropping?
   8..    TOPCOD    Code for Topographical Region
   9..    DORUNI     Used Dorado in any season?
```

Multiple R	.55706
R Square	.31031
Adjusted R Square	.26293
Standard Error	380.46407

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	9	8531939.44826	947993.27203
Residual	131	18962631.19449	144752.90988

F = 6.54904 Signif F = .0000

------------------------- Variables in the Equation -------------------------

Variable	B	SE B	Beta	Tolerance	VIF	T
BEAHAS	75.902807	22.905531	.254009	.896020	1.116	3.314
BGMSEV	25.480049	83.456899	.022704	.952036	1.050	.305
CATASDUM	-524.026768	100.433985	-.386417	.959874	1.042	-5.218
CATUNI	220.026967	82.531218	.206357	.878730	1.138	2.666
DORUNI	-99.456135	96.435715	-.081730	.838303	1.193	-1.031
INTER	-238.311846	81.487972	-.223506	.901374	1.109	-2.925
TOPCOD	140.403383	70.517440	.157204	.844534	1.184	1.991
BEFERHA	.184928	.143031	.099590	.887359	1.127	1.293
REGCODE	-65.498005	73.919785	-.068288	.886402	1.128	-.886
(Constant)	454.071584	70.212967				6.467

------ in -------

Variable Sig T

BEAHAS	.0012
BGMSEV	.7606
CATASDUM	.0000
CATUNI	.0086
DORUNI	.3043
INTER	.0041
TOPCOD	.0486
BEFERHA	.1983
REGCODE	.3772
(Constant)	.0000

Collinearity Diagnostics

Number	Eigenval	Cond Index	Variance Proportions Constant	BEAHAS	BGMSEV	CATASDUM	CATUNI	DORUNI
1	3.97480	1.000	.01073	.01683	.01355	.00952	.01185	.01574
2	1.10177	1.899	.00204	.00381	.05499	.15355	.00949	.11761
3	.98087	2.013	.00003	.06245	.03009	.22225	.09749	.01337
4	.88380	2.121	.00040	.17349	.02184	.09336	.37988	.00381
5	.76524	2.279	.00884	.01856	.65858	.00508	.05028	.03094
6	.70579	2.373	.00340	.03699	.01169	.26197	.04916	.00224
7	.63728	2.497	.01609	.12196	.07836	.14082	.02064	.48735
8	.51775	2.771	.00158	.56567	.06811	.11059	.02441	.30624
9	.28963	3.705	.03996	.00003	.00039	.00280	.31808	.00852
10	.14305	5.271	.91694	.00021	.06240	.00006	.03873	.01418

	INTER	TOPCOD	BEFERHA	REGCODE
1	.01489	.01418	.00727	.01307
2	.00060	.01398	.35720	.00002
3	.12821	.08454	.09089	.00012
4	.04912	.05073	.00466	.00054

```
 5    .01957   .02553   .06807   .02616
 6    .51532   .08291   .03508   .00031
 7    .01453   .02692   .17496   .01159
 8    .05664   .03135   .23016   .00060
 9    .19205   .53463   .03061   .37007
10    .00906   .13522   .00109   .57751


         * * * *   M U L T I P L E   R E G R E S S I O N   * * * *


Listwise Deletion of Missing Data

Equation Number 1    Dependent Variable..   KGHAPOS   Yield in Kg/ha per
bean/postrera
Block Number  1.  Method:  Enter
   BGMSEV   BEINPHA  CATUNI   DORUNI   CATASDUM TOPCOD   REGCODE  INSEPOS
   ATOTHA


Variable(s) Entered on Step Number
   1..    ATOTHA    Total farm area in has.
   2..    BGMSEV    SEVERE BGMV?
   3..    INSEPRO   Insects Main Prod. Prob. in Postrera?
   4..    DORUNI     Used Dorado in any season?
   5..    CATASDUM  Dummy for Catastrophe (i.e. yield 0)
   6..    CATUNI    Used Catrachita any season?
   7..    BEINPHA   Lps. spent of Input/ha of bean.
   8..    REGCODE   Geopolitical Region Codes
   9..    TOPCOD    Code for Topographical Region
```

Multiple R	.36498
R Square	.13321
Adjusted R Square	.08415
Standard Error	422.75720

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	9	4367271.25728	485252.36192
Residual	159	28417060.77176	178723.65265

F = 2.71510 Signif F = .0057

------------------------- Variables in the Equation -------------------------

Variable	B	SE B	Beta	Tolerance	VIF	T
BGMSEV	-83.379256	88.850896	-.072335	.917506	1.090	-.938
BEINPHA	.042170	.021096	.151911	.943942	1.059	1.999
CATUNI	59.474896	90.942498	.052904	.833037	1.200	.654
DORUNI	156.761688	92.960498	.128416	.940075	1.064	1.686
CATASDUM	-634.615863	250.849898	-.190261	.963855	1.038	-2.530
TOPCOD	194.200521	73.788834	.218752	.789100	1.267	2.632
REGCODE	-117.603075	75.547001	-.125105	.844047	1.185	-1.557
INSEPOS	-214.439085	86.594651	-.188429	.941555	1.062	-2.476
ATOTHA	-.486199	.578346	-.062968	.971699	1.029	-.841
(Constant)	553.376416	71.161304				7.776

------ in -------

Variable Sig T

BGMSEV	.3495
BEINPHA	.0473
CATUNI	.5141
DORUNI	.0937
CATASDUM	.0124
TOPCOD	.0093
REGCODE	.1215
INSEPRO	.0143
ATOTHA	.4018
(Constant)	.0000

Collinearity Diagnostics

Number	Eigenval	Cond Index	Variance Proportions Constant	BGMSEV	BEINPHA	CATUNI	DORUNI	CATASDUM
1	3.51463	1.000	.01447	.01582	.00206	.01456	.01725	.00205
2	1.12269	1.769	.00021	.16360	.24067	.04818	.00771	.24308
3	1.06019	1.821	.00004	.01271	.38225	.06479	.00463	.28643
4	.95761	1.916	.00003	.00037	.00041	.01230	.17822	.03446
5	.89946	1.977	.00003	.01620	.02089	.11578	.23103	.18357
6	.82558	2.063	.00028	.02544	.04208	.24693	.11101	.08964
7	.67948	2.274	.00037	.66068	.23292	.15470	.00075	.00803
8	.56561	2.493	.02418	.00001	.04572	.00007	.44008	.15015
9	.22816	3.925	.03314	.01968	.03267	.32083	.00440	.00094
10	.14659	4.897	.92725	.08548	.00034	.02186	.00491	.00165

	TOPCOD	REGCODE	INSEPRO	ATOTHA
1	.01840	.01683	.01679	.00927
2	.02051	.00421	.00068	.00023
3	.00266	.00092	.04703	.03413
4	.00070	.00005	.03645	.64426

5	.00631	.00375	.20092	.10689
6	.03541	.00125	.31158	.01687
7	.00753	.02106	.00334	.00199
8	.04332	.04963	.29488	.18150
9	.77221	.37676	.05333	.00485
10	.09295	.52554	.03499	.00001

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