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PROFITABILITY ANALYSIS OF BEAN PRODUCTION IN HONDURAS

by
Chhime Tshering

Department of Agricultural Economics
MICHIGAN STATE UNIVERSITY
East Lansing, MI 48824-1039

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ABSTRACT

In Honduras, dry beans are the second most important staple crop, next to maize, in terms of both production and consumption. During the past decade, agricultural scientists in Honduras, in collaboration with Bean/Cowpea CRSP scientists, have released numerous new varieties, developed improved bean-management practices, and actively worked with governmental agencies, NGOs, and farmer groups to ensure that these improved technologies are widely available to farmers. However, data on national bean production in Honduras fail to demonstrate that agricultural research has had an impact on bean production, yields, and area harvested. Given the situation, profitability analysis represents an alternative approach for assessing the farm-level impact of research.

This study analyzes the record keeping data collected from Honduran bean farmers in the main bean-growing regions during the period 1998-2000. The study assesses cost and pattern of input and labor use, and analyzes the profitability of bean production for farmers growing traditional and improved bean varieties. Further, the study identifies ways to improve record keeping studies to reduce the cost of future data collection.

The analysis showed that among the sample of farmers included in the record keeping surveys, farmers growing modern varieties had higher average yields and earned higher profits or suffered less loss than the farmers growing traditional varieties. However, the difference in yield for the traditional and modern farmers was statistically not significant (at 5% significance level) for three out of five of the data sets. The sensitivity analyses on enterprise gross margin showed that for traditional farmers, gross margins were more sensitive to yield and price changes than for modern farmers. The study found that none of the farmers in the sample completely followed the recommended practices for bean production and that the major share of the total production cost consisted of labor cost.

It recommends that in the future, efforts to assess profitability should utilize a single-round (post-harvest) or a two-round (mid-season and post-harvest) survey and the sample size should be increased to at least 26 farmers for each farmer group (*i.e.*, adopters and non-

adopters of improved bean varieties). Furthermore, it is recommended that the standard labor parameters--which were computed from the pooled data sets--should be used to estimate total labor cost and labor cost by type of farming operations. The study suggests that in the future, possible farmers to be included in the survey should be pre-screened to insure that all "traditional" and all "modern" farmers are relatively homogenous with respect to inputs used and the sample should include only farmers with a bean area of 0.50 hectare or more. Finally, additional research is needed to better understand what factors are responsible for the high variability in farmers yields, why few farmers follow the recommended bean production practices, whether or not these recommended practices are appropriate for limited-resource farmers who grow beans in marginal environments, and the potential for identifying labor-saving technologies that are appropriate for small-scale bean formers in Honduras.

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ACRONYMS AND ABBREVIATIONS

BANADESA	National Agriculture Development Bank (*Banco Nacional de Desarrollo Agricola*)
CIF	Cost Insurance and Freight
CRSP	Bean and Cowpea Collaborative Research Support Program
DICTA	Directorate Research, Science and Agricultural Technology (*Direccion de Investigacion Ciencia y Tecnologia Agropecuaria*)
EGM	Enterprise Gross Margin
FAO	Food and Agricultural Organization
FOB	Freight on Board
GDP	Gross Domestic Product
GI	Gross Income
IADP	Inter-American Development Bank
IHMA	Honduran Agricultural Marketing Institute (*Instituto Hondureno de Mercadeo Agricola*)
LMDSA	Law for the Modernization and Development of the Agricultural Sector (*Ley de Modernizacion y Desarrollo del Sector Agropecuario*)
MNR	Ministry of Natural Resources
MV	Modern Varieties
NGO	Non-Governmental Organization
PROFRIJOL	Regional Bean Research Program (*Programa Cooperativo Regional de Investigacion en Frijol*)
RK	Record Keeping
RFL	Return to Family Labor
SAG	Ministry of Agriculture (*Secretaria de Agricultura*)
SAP	Structural Adjustment Program
SD	Standard Deviation
TEC	Total Enterprise Cost
TV	Traditional Varieties

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CHAPTER I

INTRODUCTION

1.1 Problem Statement

In Honduras, dry beans are the second most important staple crop, next to maize, both in terms of production and consumption. The majority of the bean producers own less than five hectares of land. These small farmers produce 36% percent of Honduras' corn crop and 40% of the bean crop. These crops are the major source of protein for both rural and urban population.

Since the initiation of structural adjustment programs in early 1990s, government support to the Ministry of Natural Resources (MNR) for technology generation and extension had decreased considerably. As a result, increased pressure has been placed on collaborative research programs like the Bean/Cowpea Collaborative Research Support Program (CRSP) to support research and extension activities.

During the past decade, agricultural scientists in Honduras, in collaboration with Bean/Cowpea CRSP scientists have released numerous new varieties, developed improved bean management practices, and actively worked with governmental agencies, Non-Governmental Organizations (NGOs), and farmer groups to ensure that these improved technologies are widely available to farmers (Bernsten *et. al.*, 2000). However, analysis of aggregate national bean data for Honduras fail to demonstrate that agricultural research has had an impact on national production, yields, and area harvested. However, fluctuations in production, as reflected in time series data may be due to year-to-year variations in abiotic/biotic stress.

Given the situation, profitability analysis represents an alternative approach for assessing the farm-level impact of research. Since 1998, farm record keeping (RK) data has been collected by staff at *Escuela Agricola Panamericana* (*El Zamorano*). These data will be used for the profitability analysis. Besides profitability assessment, farm records can provide insights into farmers' input use and crop production problems. In addition, they can serve as an indicator of performance and measure of management improvement on the farm.

With regard to the RK data collection process, samples of approximately 20 farmers were selected (1998-2000), to represent traditional bean variety growers and modern bean variety growers. An enumerator visited each farmers at least twice a month throughout the season, to record information about bean operation, including inputs applied (type, amount, cost), labor used (male, female, hired, family, wage rate), and machinery used (hours, cost). However, the task proved time consuming and expensive. Therefore, there is a need to explore other approaches to reduce the amount of information to be collected, which would reduce the number of enumerator visits. One possibility could be to identify data/information that do not vary from year-to-year in order to come up with standard parameters that could be used in the future. If it is possible to reduce the amount of data to be collected from each farmer, it would be possible to increase the sample size, thereby giving more representative and statistically significant results.

Thus, given the importance of assessing the profitability of new bean technologies and the limitations associated with the farm RK data collection, there is a need to further explore options for improving the process for collecting and analyzing farm RK data.

1.2 Objectives

The general objective of this study is to assess the characteristics and profitability of bean production in Honduras and to identify ways to improve future Record Keeping studies, to reduce the cost of data collection.

Specific Objectives

- Estimate the per hectare cost of production, profits and returns to capital and labor.
- Analyze farmers' patterns of labor and input use, in order to estimate production costs, assess the types and level of technologies used, and identify the degree to which farmers follow the recommended bean production practices.
- Carry out sensitivity analysis to identify the most important determinants of profitability.
- Estimate standard labor parameters, for various operations in bean production, in order to minimize farm record information to be collected in the future.
- Validate the new procedures by using the standard labor parameters to reestimate profitability using the original data sets.
- Make recommendations regarding the type of data and the sample size required to achieve various level of confidence and detect varying levels of yield differences in the future that are statistically significant.

1.3 Thesis Outline

This study is divided into five chapters. Chapter I provides background about the research issues and identifies the research objectives. Chapter II provides an overview of Honduras,

its general economy, agriculture sector and the performance of bean subsector. Chapter III discusses literature review, data collection and the methods of analysis. Chapter IV characterizes the socioeconomic characteristics of the sample farmers, discuses the farmers' patterns of labor use, input use, and cost, followed by profitability and sensitivity analysis for each data sets and a summary of the empirical results. Chapter V discusses the implications for future record keeping analysis, and Chapter VI presents a summary and recommendations for future record keeping and future research.

CHAPTER II

AN OVERVIEW OF HONDURAS, HONDURAN ECONOMY, AGRICULTURE AND THE BEAN SUBSECTOR

2.1 Overview of Honduras:

2.1.1 Land and Climate:

The Republic of Honduras, located in Central America, stretches 175 miles across the isthmus from the Caribbean Sea to the Gulf of Fonseca on the Pacific Ocean. Honduras borders Guatemala on the northwest, El Salvador on the southwest, and Nicaragua on the southeast (Map 1). The country covers a total area of 43,278 square miles-about the size of Louisiana.

Based on physical geography, Honduras can be divided into three regions: the western and the central highlands, Costa de Mosquitos (*La Mosquitia*) in the east, and the north coast (*La Costa Norte*), including the Bay Islands (*Islas de la Bahia*) just offshore (The Latin American Alliance[1], 2001). *La Mosquitia* is a region of pine savannas, coastal lowlands and shallow lagoons. In spite of extensive deforestation since the mid 1960s, Honduras remains heavily forested. The central and western highlands are pine covered, and the eastern lowlands and the north coast have tropical hardwoods. The Olancho Forest Reserve is the largest pine forest in Latin America (CultureGrams[2], 2001).

Climate in Honduras varies according to elevation. It is subtropical in the lowlands and the temperate at the higher levels (CultureGrams, 2001). While Honduras is mountainous, it is the only Central American country without volcanoes. Rain falls

[1] Source: www.latinsynergy.org/hondurasinfo.htm
[2] A division of Millennial Star Network and Brigham Young University (www.culturegrams.com/country/premium/honduras/background/land.htm).

throughout the year on the north coast, while the rest of the country has its heaviest rainfall between May and November. Honduras receives an average rainfall of 150 inches a year (Pan American Health Service). March through May are the hottest months and the highest temperature reaches at 40^{o}C.

Map 1. Map of Honduras.

Periodically, Honduras is impacted by severe hurricanes. In October1998, heavy rains and high winds from Hurricane Mitch resulted in the loss of thousands of human lives, destructions of physical infrastructure and productive investments and deterioration of

country's natural resources[3]. Widespread devastation altered the nature, location, and course of many geographical features.

2.1.2 Social Indicators:

Most of the country's population is concentrated in the central and western upland valleys and along the north coast. Population density decreases to the south and east. Almost 50% of the population lives in rural settlements. The largest urban centers are the capital, Tegucigalpa, San Pedro Sula, and La Ceiba. (The Latin American Alliance, 2001).

The population of Honduras is estimated at 6.4 million (2001) with an annual growth rate of 2.4%. Forty-two percent of the populations is below 14 years of age and 54% belong to the age group of 15 to 65 years old. Poverty is widespread in Honduras. Fifty-one percent of rural population and 57% of the urban population live below poverty line. At the national level, 53% of the population lives below the poverty line (World Development Report, 2002)[4]. The per capita income for 2000 averaged US$ 2,390 (World Development Report, 2002). Seventy-three percent of the population (15 years and over) is literate[5] (1995 est.).

Ninety percent of the population is mestizo (mixed Amerindian and European), 7% is Amerindian (native Indian), 2% is black and 1% is of European descent. Spanish is the official and dominant language. While about 88% of the populations are Roman Catholic, various other Christian groups are active and law guarantees the freedom of religion (CultureGram, 2001).

2.1.3 Honduras Government:

Honduras is a democratic constitutional republic. The president, who is the chief of state and the head of government, governs with a cabinet and serves one four-year term. The

[3] Source: http://www.hondurasag.org/background/
[4] Information on poverty is based on 1993 survey.
[5] Source: www.countryreports.org/content/honduras.htm

judicial branch of government is independent. The unicameral *Congreso Nacional* (National Congress) has 134 seats. Two parties, the liberal party (PLH) and National party (PNH), dominate the congress. The Republic of Honduras is divided into 18 *departamentos*, *i.e.* provinces (CultureGrams, 2001).

2.1.4 The Honduran Economy:

Macroeconomic Policy: In the early-1990s, the Government of Honduras (GOH) launched a process of structural adjustment of the economy. In the initial program of adjustment, these reforms focused on liberalizing both trade policy and the financial sector, which included floating the national currency, removing controls on interest rates, food prices, and agriculture products, and eliminating restrictions on foreign trade. Subsequent sectoral reforms were initiated in infrastructure, agriculture, and environmental and social sectors.

Gross Domestic Product (GDP) and the Structure of the Economy[6]: In 2000, Honduras' GDP was estimated at US$ 5.9 billion. During 1980-1990, GDP grew at an annual rate of 2.7 %. For 1990-2000, the annual rate of growth averaged 3.2 %. However, the annual growth rate for the 1999 was negative 1.9%, due to damage done by hurricane Mitch. The estimated growth rate for the period 2000-04 is 4.1 % (World Bank, 2001).

Agriculture is the most important sector of the economy. In 2000, agriculture accounted for 18% of GDP, employed almost 50% of the labor force and accounted for two-thirds of the country's exports. The industry and service sectors accounted for 32% and 52% of the GDP, respectively. For the period 1990-1998, the average annual growth rates for agriculture, industry and service sector were 3.2%, 3.8% and 5.6%, respectively (World

[6] The source of Statistics reported in this section is from the World Development Report and World Bank Country Data.

Bank, 2001). However, in 1999 the annual growth rates of agriculture, industry and the service sector dropped to -8.5%, 2.6% and 0.5%, respectively, following hurricane Mitch which severely affected the agriculture and the service sectors.

In 2000, the value of total exports (FOB) was US$ 1.5 billion and the value of import (CIF) was US$ 2.9 billion (World Bank, 2001). The average annual growth rate for exports of goods and services in 1990-98 was 10.2 %, which is an increase of almost 8% from the average annual growth rate during 1980-90. However, the annual growth rate for exports of goods and services in 1999 was negative 11.2%, which was a record low. Honduras' major export commodities are bananas, coffee, sugar cane, shrimp, lobster, minerals, meat and lumber, while the major imports are machinery and transport equipment, chemical products, manufactured goods, fuel and oil, and foodstuffs.

2.2 The Agriculture Sector

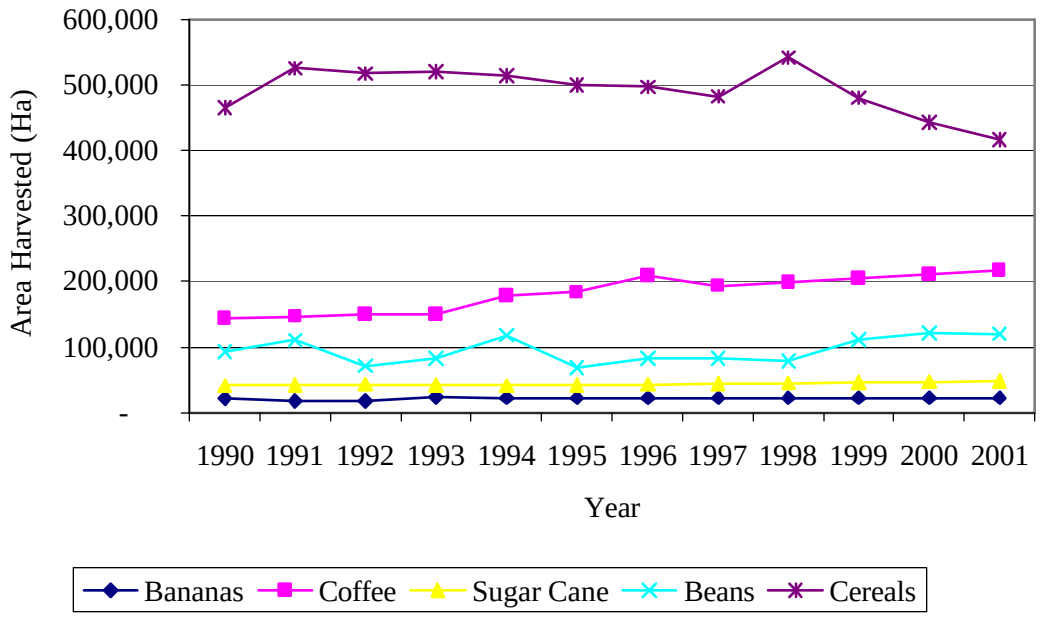
Historically, Honduras' economy depends on the export of a limited number of commodities-primarily bananas, coffee, and sugarcane; supplemented with exports of beef and lumber. In contrast, the traditional agricultural sector has largely met domestic food requirements.

Agriculture remains an important sector for the economy of Honduras. The primary agriculture sector generates approximately 70% of rural employment, accounts for 18% of total GDP and represents 63% of the value of the country's exports. Furthermore, agriculture and its related economic activities are particularly critical for the development of Honduras' rural economy.

2.2.1 Major Crops:

Honduras's major crops may be categorized into two types: traditional export crops and domestic food crops. The country's main export crops are banana, coffee and sugar cane, while the food crops are cereals[7] (mainly maize) and beans. Figure 2.1 compares the area harvested for these crops, from 1990-2001. In the last decade, area harvested for banana and sugar cane has remained stable, while the area harvested for cereals declined slightly. In contrasts, the area harvested for coffee and beans increased slightly during the later half of the decade.

Figure 2.1. Area Harvested of Major Crops in Honduras, 1990-2001.



Source: Derived from FAOSTAT database, 2002.

[7] Cereals include maize, paddy rice, sorghum, and wheat.

Traditional export crops (coffee, bananas, and sugar cane) account for more than 30% of the agriculture GDP, livestock and basic grains account for almost 25% and the forestry activities account for almost 10% (SAG/UPEG, 1990) (Table 2.1). In the 1990s, the agricultural GDP increased significantly, as a result of an increase in the production of non-traditional products such as vegetables, fruits, and African oil palm.

Table 2.1. Contributions to the Agricultural GDP by Principal Products, 1989-1991 Compared to 1996-1998, Honduras.

Products	1989-1991		1996-1998	
	Value (million US$)	Percent	Value (million US$)	Percent
Coffee	88	11.2	280	21.2
Bananas	111	14.1	94	7.1
Basic Grains	65	8.4	116	8.8
Sugar Cane	18	2.3	26	2.0
African Palm	7	0.9	41	2.2
Other Products (Fruits & Vegetables)	27	3.4	37	2.8
Livestock	167	21.2	199	15.1
Poultry	57	7.2	96	7.3
Forestry	117	14.8	129	9.8
Total Agricultural GDP	789	100	1,318	100

Source: SAG/UPEG. 1999. "*Compendio Estadistico Agropecuario*" Table 112

2.2.2 Government Policies Affecting the Agriculture Sector:

In 1992, Honduras's legislative approved the Law for the Modernization and Development of the Agricultural Sector (LMDSA[8]). This legislation is a very important landmark in the history of Honduras, as it introduced substantial change in the law that governs the agricultural sector. The new law was based on four principles: (i) the need to promote the development of commercial agriculture in such a way that it will complement the development of both the small-holder sector and the reformed agricultural sector; (ii) the need to strengthen public sector capacity to design sectoral policies; (iii) the need to

[8] *Ley de Modernizacion y Desarrollo del Sector Agro-pecuario*.

strengthen private sector participation in defining and implementing these policies; and (iv) the need to decentralize (at both the institutional and regional levels) the implementation of public services (IADB, 1999). Some of the reforms introduced under the law are discussed below briefly.

Agricultural Technology Policy. Until the beginning of the 1990s, most of Honduras' agricultural extension and technology services were implemented and financed by the Ministry of Natural Resources. However, both the provision and the quality of these services were deficient, and the expected results (in terms of productivity) had not been achieved, despite increases in funding (Martel, 1995). Under the new law, the Directorate of Agricultural Science and Technology (DICTA[9]) was created to improve the level of quality in the research and development of agricultural technologies. DICTA is now responsible for the design, direction, and implementation of research and extension program. In addition, it has a mandate to promote agricultural research in the private sector, with the objective of minimizing public sector participation in agricultural research.

Land Market Policy. Under LAMDSA, a new set of rules was enacted that legalizes agricultural land lease and promotes the development of land markets by establishing a more widespread and inclusive land-titling program (Martel, 1995). More secure land tenure is expected to promote more efficient resource use, including rapid adoption of new technology. However, the new rule has been received with mixed feelings. Some argue that, given the existing skewed land distribution structure, these reforms do not address productivity and equity issues.

[9] *Direccion de Ciencia y Tecnologia Agropecuaria*.

Macro Policy Change. Changes in the price control policy and the international trade, brought about by the structural adjustment program (SAP), have had a significant affect, on the agricultural sector.

During the 1970s and through the 1980s, the GOH - through the Agricultural Marketing Institute (IHMA) - maintained guaranteed producer prices to stimulate the production of basic grains and beans. However, large bean farmers benefited more than the small farmers did because small farmers consumed a large share of the production. By the end of 1989, the GOH initiated price liberalization (IADB, 1999). With the introduction of LAMDSA in 1992, the price guarantees were eliminated.

The two trade-related changes that occurred under the SAP are: (i) the elimination of the fixed exchange rate and adoption of flexible exchange rate, and (ii) signing of a free trade treaty with other Central American countries, which eliminated tariffs for major agricultural products traded in the region (Martel, 1995). These changes were expected to enhance the competitiveness of Honduran agricultural products in the Central American regional market.

2.3 The Bean Subsector

2.3.1 Beans in the Honduran Diet:

Following maize, beans are the second most important staple in the Honduran diet. In recent years (1997-1999), per capita bean consumption in Honduras has averaged 10 kg per year. For the period 1997-99, beans provided an average of 89 calories/person/day and 6 gm/person/day of proteins (FAO, 2000), which is the second most important source of proteins in the Honduran diet (after maize, 19.0 grams/person/day). Although all households

consume bean everyday, they are more important source of protein for lower income groups than for higher income households.

Honduran's primarily consume steamed or refried beans for their meals, which are served with fresh cheese and tortilla. Most often, onion is added to steamed and refried beans. The majority of the population eats beans three times a day.

2.3.2. Consumer Preferences:

Consumer preference for bean depends on color, cooking time, and cooked texture. Consumers prefer quick-cooking beans. Cooking time varies by variety, age and storage conditions. Beans consumed in Honduras can be grouped into three market classes: small light-red beans, small dark-red beans, and black beans. However, Martel (1995) reported that most households in Honduras prefer light red beans[10].

2.3.4. Domestic Consumption:

Total bean consumption is estimated by subtracting quantity used for seed and waste from the total domestic supply[11]. Available data (Table 2.2) indicates that average per capita consumption has increased from 8.35 kg in the 1980s to 9.64 kg in the 1990s – an increase of 15%[12]. In recent years (1997-99), per capita bean consumption in Honduras has averaged 10kg/person. The increase may be due to an increase in income and greater diversification of bean use.

[10] In Central America, consumer's market class preference varies from country-to-country. Consumers in Nicaragua, Honduras, El Salvador and Panama prefer red beans, while consumers in Guatemala and Costa Rica prefer black beans.

[11] Domestic Supply = Production + Imports – Exports + changes in Stock

[12] During this 20-year period (Table 2.2), per capita consumption ranged from high of 11.3 kg/person/year (1997) to a low of 6.4 kg (1987).

Table 2.2. Honduran Total and Per Capita Bean Consumption, 1980-1999.

Year	Consumption (MT)	Consumption per capita (kg)
1980	28,399	7.96
1981	28,692	7.78
1982	32,906	8.65
1983	33,031	8.41
1984	32,673	8.06
1985	33,076	7.91
1986	32,236	7.47
1987	28,628	6.43
1988	46,195	10.07
1989	50,727	10.73
1990	50,528	10.38
1991	53,252	10.62
1992	46,906	9.08
1993	54,690	10.29
1994	50,652	9.26
1995	50,286	8.94
1996	51,553	8.92
1997	67,002	11.28
1998	63,568	10.42
1999	44,856	7.17

Source: Computed from FAO online data, 2000.

Coincidentally, the average per capita bean consumption, for the period 1997-99, for the Central America was also10 kg. For the same period (1997-99), Nicaragua had the highest average per capita consumption (20.1 kg/person), followed by Belize, which averaged 14.2 kg /person (Table 2.3). The calories and protein contribution of beans to the Central American countries averaged 92 calories/person/day and 6gm/person/day, respectively. Nicaragua and Belize benefited the most from bean's nutritional contribution to calories and protein intake. Honduras stands fourth among the Central American countries in terms of per capita bean consumption.

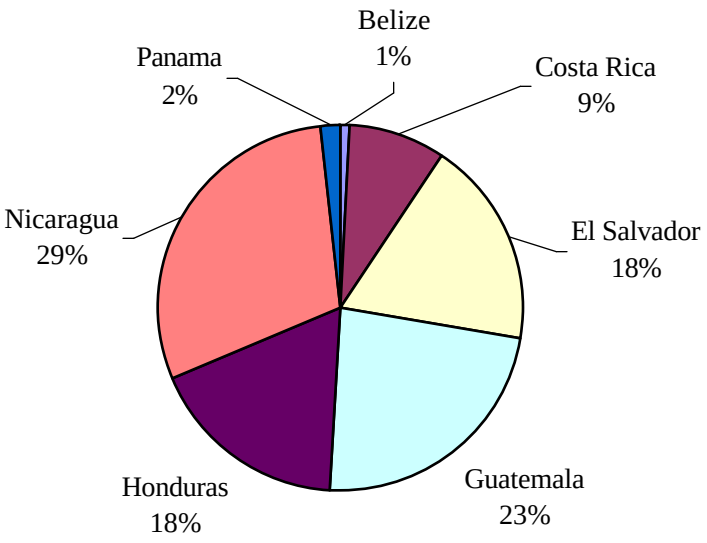
Table 2.3. Average Annual Per Capita Consumption and Nutritional Contribution of Bean in Central American Countries, 1997-99.

Country	Per Capita (Kg/year)	Protein (Gm/person/day)	Calories (Gm/person/day)
Belize	14.2	8.5	130.3
Costa Rica	7.3	4.4	67.4
El Salvador	9.9	6.0	91.2
Guatemala	6.9	4.1	63.6
Honduras	9.6	5.8	88.9
Nicaragua	20.1	12.0	184.0
Panama	2.0	1.2	18.2

Source: FAO Food Balance Sheet, 2000.

During the 1997-99 periods, Honduras and El Salvador ranked third (18% each) among Central American nations in terms of their share of total regional bean consumption (Figure 2.2). The top two consumers were Nicaragua (29%) and Guatemala (23%).

Figure 2.2. Share of Average Total Regional Bean Consumption for 1997-1999.



Source: Derived from FAO database, 2000.

If we separate out consumption by the country's preference for red and black beans, countries with a preference for red beans (*i.e.* Nicaragua, Honduras, El Salvador and Panama) account for 67% of the total beans consumed in the region and the countries that prefer black bean (*i.e.* the Guatemala and Costa Rica) account for 32% of total consumption (Table 2.4).

Table 2.4. Average Bean Supply and Consumption in Central American Countries, 1997-1999.

Country	Bean supply (MT)	Bean Consumption	
		Total (MT)	Share (%)
Belize	3,435	3,079	1
Costa Rica	30,576	27,944	9
El Salvador	66,168	59,688	18
Guatemala	85,043	74,536	23
Honduras	66,522	58,475	18
Nicaragua	108,323	96,440	29
Panama	6,319	5,469	2
TOTAL	366,386	325,631	100

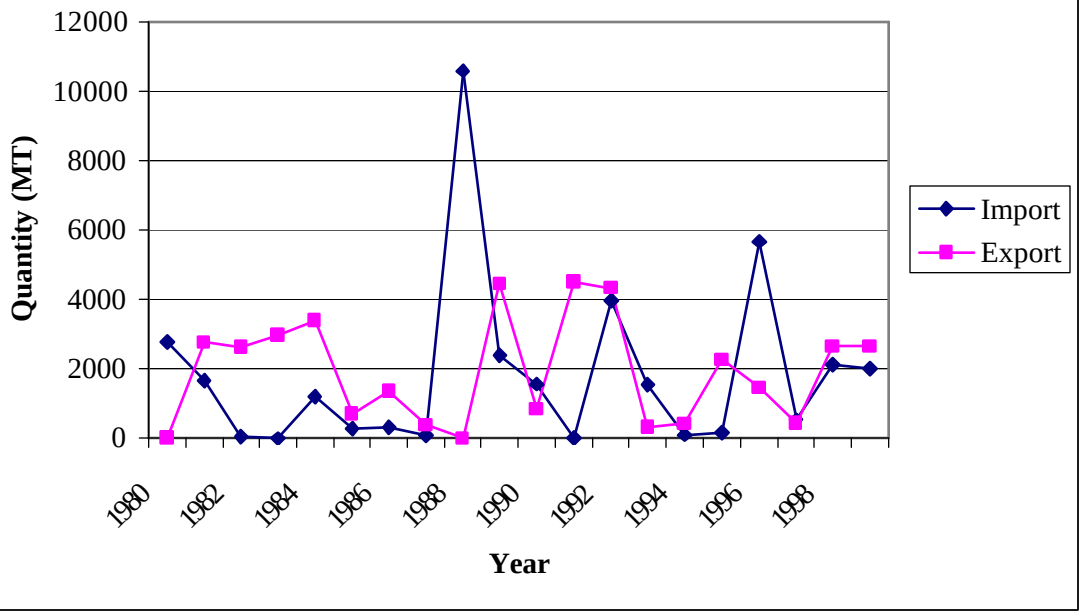
Source: Compiled from FAO database, 2000.

2.3.5. Bean Export and Import:

Over the 1980-1990 period, Honduras experienced significant fluctuations in both its bean export and import (Figure 2.3). Imports were highest in 1988 (10,568 MT) and exports were highest in 1991 (4,506 MT). During the 1980s, average annual bean imports (1,940 MT) exceeded exports (1,863 MT). In contrast, average exports (1,985 MT) in 1990s exceeded imports (1,773 MT). The general trend in export shows an increase in the quantity exported in the late-1980s and early-1990s, than decreasing to the early-1980s level by the end of the 1990s. The trend in import indicates that import have been increasing, but at a very slow rate. Honduras was net a exporter of beans in the 1980s, except during 1980 and 1988. However, in the 1990s, Honduran's export declined and the country was a net importer during the years1990, 1993, 1996, and 1997. Honduras mainly exports to El Salvador and

Guatemala and import from Nicaragua. Bean exports represent an opportunity to enhance the household income of the bean producers and a source of foreign exchange earning for the country.

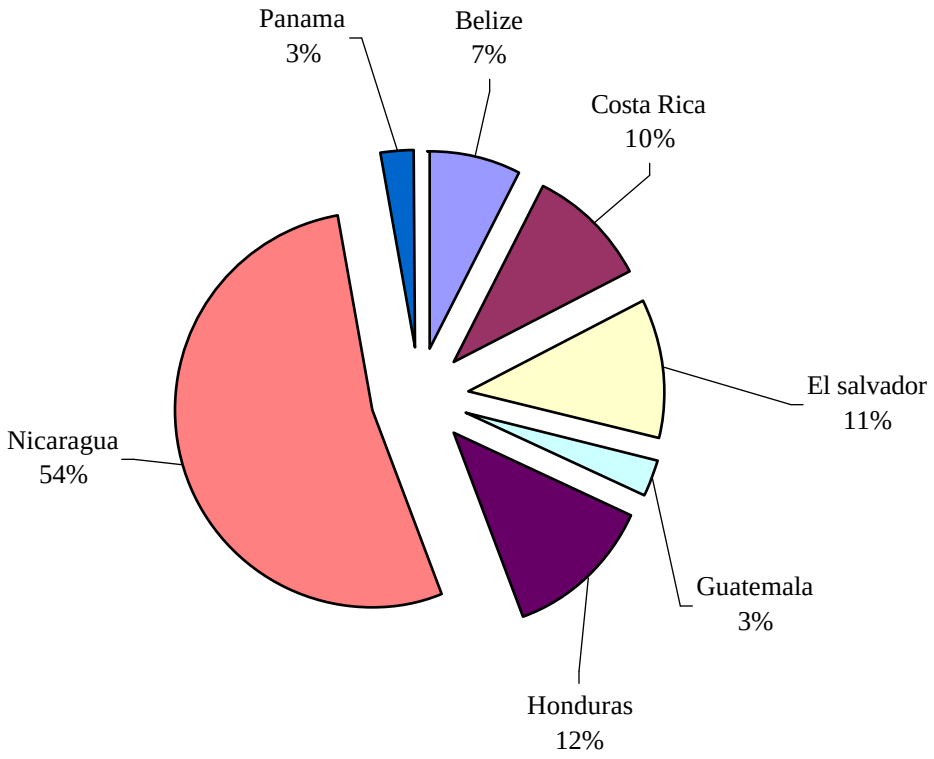
Figure 2.3. Dry Bean Trade of Honduras, 1980-1999



Source: Derived from FAO database, 2000.

FAO data indicate that in recent years, the region (Central America) has been a net importer of beans. During the 1990s, regional exports and import averaged 16,116 MT and 26,640 MT, respectively. Fifty-four percent of total regional exports (1990-99 average) came from Nicaragua, followed by Honduras, which contributed 12% (Figure 2.4). The largest importer in the region has been Costa Rica (28%), followed by El Salvador (27%).

Figure 2.4. Country Shares of Bean Exports in Central America, 1990-99.



Source: Derived from FAO database, 2000.

2.3.6. Production Analysis

Regional Perspectives

The three most important bean-producing areas in Honduras are the Mid-Eastern, the North-Eastern, and the Western region.

The Mid-Eastern region, which consists of the Departments of Francisco Moranzan and El Paraiso, accounted for 28% of the bean area and 21% of national production in 1999 (MNR, 2000). Topographically, the Mid-Eastern region has a number of small deep valleys. In addition to beans, maize, tobacco, cotton, and horticultural production are important farming enterprise (Martel, 1995).

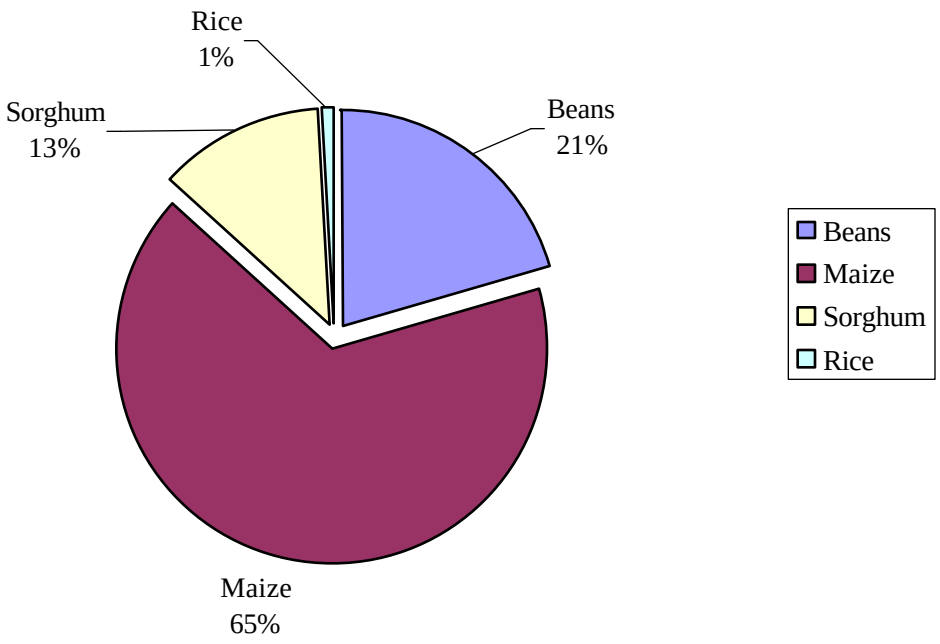
The North-Eastern Region, which accounted for 29% of total area and 33% of total national production in 1999 (MNR, 2000), encompasses the Department of Olancho.

The Western region, which accounted for 13% of the bean area and 15% of total national bean production in 1999 (MNR, 2000), encompasses the Departments of Copan, Lempira, and Ocotepeque. Bean production is concentrated in the more mountainous part of the Western region. The northern part of the Western region, which includes one of Honduras' most fertile valleys with abundant rainfall (1,600 mm per year), is dominated by tobacco, cattle, and corn production. Horticultural crops dominate the southern part of the Western region, which includes a much drier valley (Martel, 1995).

Bean Area, Production, and Yield

During the most recent three-year period (1999-2001), total area harvested for major grains (maize, rice, beans and sorghum) in Honduras averaged 568,385 Ha (FAO, 2002). Out of the total area, 21% was devoted to beans, which ranks second after maize that accounted 65% of the area harvested (Figure 2.5). The average annual growth rate of bean area and total production from 1980-2000 was 3.48% and 6.75%, respectively.

Figure 2.5. Average Area Harvested for Major Cereals in Honduras, 1999-2001.

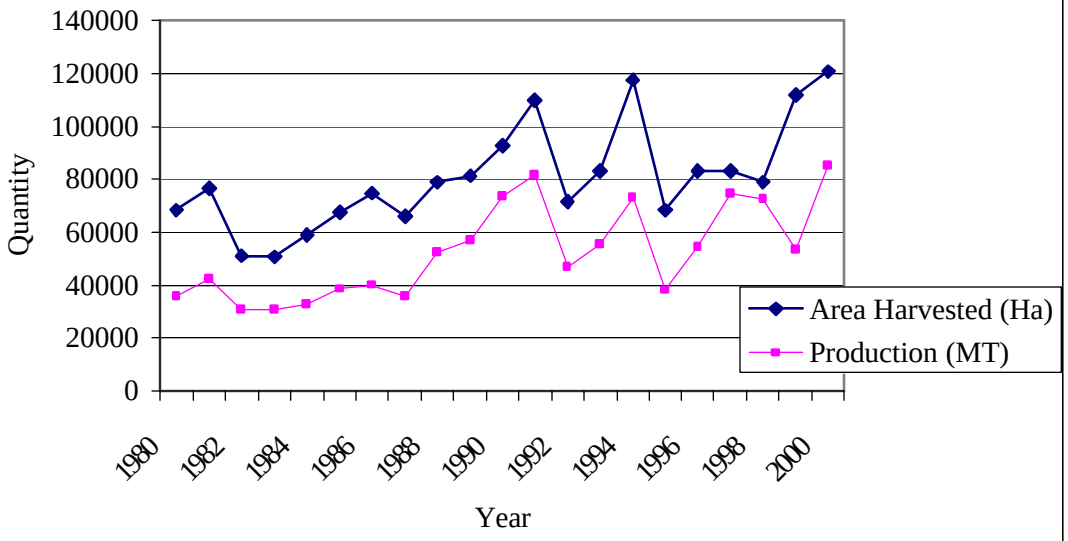


Source: Derived from FAO database, 2002.

For the period 1998-2000, Honduras' bean area (harvested) averaged 103,725ha. During the period of 1990-2000, the area harvested was highest (120,706 ha) in 2000 and the lowest (68,273 ha) in 1995 (FAO, 2002).

During the past 11 years (1990-00), bean production averaged 64,364 MT, which is 62% higher than average production during the 1980s. However, production varied from year-to-year, as shown in Figure 2.6. Within the period of 1980-2000, production was highest (84,980 MT) in 2000, while the lowest level (30,543 MT) occurred in 1983 (FAO, 2002).

Figure 2.6. Honduran Dry Bean Production and Area Harvested, 1980-2000.

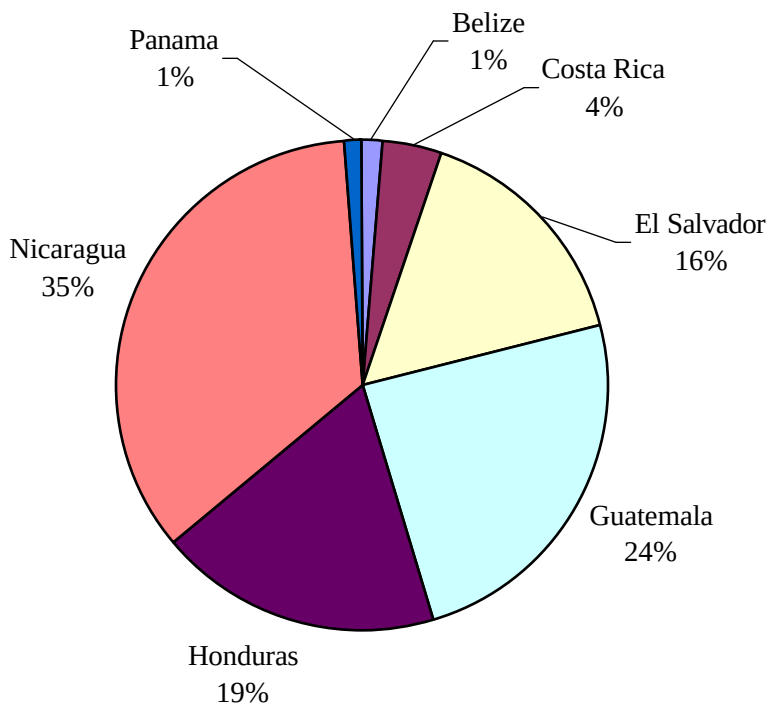


Source: Derived from FAO database, 2002.

During the past two decades, parallel trend are apparent between production and area harvested (Figure 2.6). As production is a function of area harvested and yield, this suggests that increase in area contributed significantly to the increase in production.

During the past two decades, there has been a gradual increase in the total regional (Central America) bean production, which may be attributed to adoption of improved technologies and increase in the land area devoted to bean. In the most recent three-year period (1998-2000), average total production of the Central American nations averaged 376,889 MT (FAO, 2002). Among the countries, Nicaragua produced 35% of total production, followed by Guatemala (24%), Honduras (19%) and El Salvador (16%). The remaining 6% is shared by Belize, Costa Rica and Panama (Figure 2.7).

Figure 2.7. Central American Average Bean Production by Country, 1998-2000.

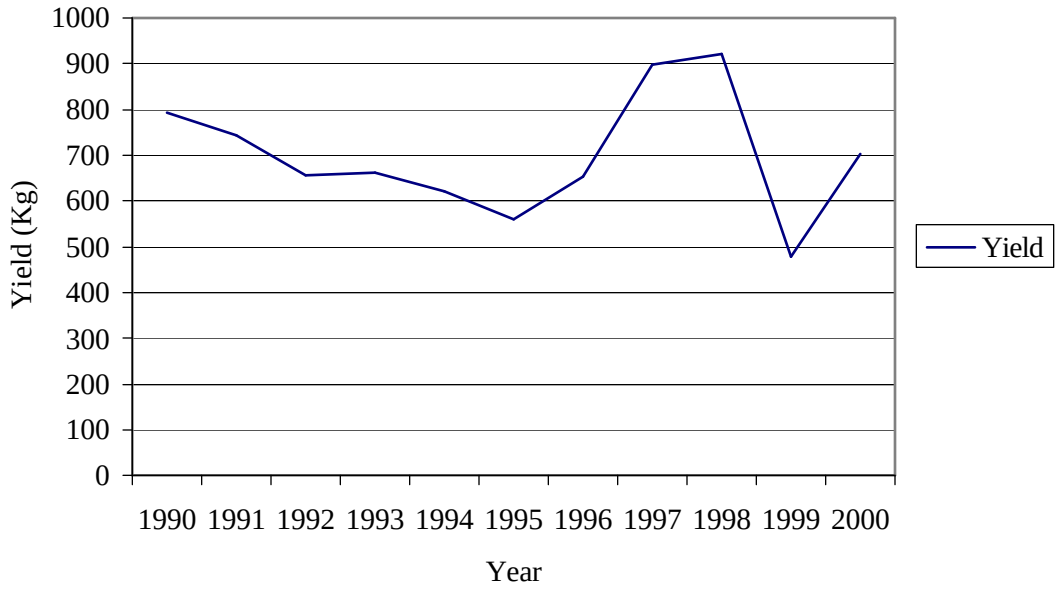


Source: Derived from FAO database, 2002.

Yields

During the period 1990-2000 (Figure 2.8), bean yields in Honduras have varied considerably from year-to-year. During the 1990-2000 period, yield averaged 699 kg/ha, which was 19% higher than the average yield in the 1980s (*i.e.* 585 kg/ha). During the last decade, the lowest yield was reported in 1999 (479 kg/ha) and the highest (922 kg/ha) in 1998. The low yield in 1999 was due to the crop damage caused by hurricane Mitch, which hit the country in late-October 1998.

Figure 2.8. Honduras: Bean Yield in MT, 1990-2000



Source: Derived from FAO database, 2002.

2.3.7. Production System, Farm Size and Commercial Orientation.

Honduras has two agricultural seasons, the *primera* (May – August) and *postrera* (September – December). Farmers plant beans during both the seasons. Beans are typically relay cropped with maize in the *primera* season and planted as monoculture in the *postrera.* Approximately 67% of the national bean output is produced during the *postrera* (SECPLAN, 1993), with two regions, the North-Eastern and the Mid-Eastern, accounting for 70% of the national total production. Ninety-four percent of beans produced in Mid-eastern region are harvested in the *postrera* season. In contrast, the beans grown in North-Eastern region are 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%.

Almost 80% of the Honduran bean farmers are small farmers, whose total farm area averages 3.5 ha or less, with 20% having less than 1 ha. On the other hand, 15% of the bean farmers own more than 14 ha (Martel, 1995).

National data (SECPLAN, 1994) indicate the Mid-Eastern bean farmers market 63% of their total bean production, while North-Eastern farmers market only 53%. One of the reasons could be the presence of urban centers. The Mid-Eastern region is more densely populated with larger urban centers, namely Tegucigalpa (580,000 population), the capital of Honduras, and Danli (30,000 population). In contrast, the two largest urban centers in the North-Eastern region are Juticalpa and Catacamas, with a population of only 20,000 and 18,000, respectively (Martel, 1995). The other reason for the difference in the marketed share of total production could be because the headquarters for the National Bean program and Zamorano, the leading agricultural teaching and research center in Honduras, are located in the Mid-Eastern region. Thus, farmers of Mid-Eastern region have greater access to new technologies and the inputs and they are better able to produce marketable surplus.

2.3.8. Production Inputs, Credit and Extension

One of the constraints to increasing bean production is farmers' limited use of inputs, such as improved seeds, fertilizers and plant protection chemicals (herbicides, insecticides, and fungicides). Further, the lack of support services like credit and extension services is a disincentive for farmers to adopt these improved production technologies. While most Honduran bean farmers apply few modern inputs (MRN, 1988), informal interviews with farmers suggested that bean farmers in Mid-eastern region apply higher input levels than the farmers in other regions of the country (Martel, 1995).

Labor: Farmers in Honduras use both family labor and hired labor for bean production. For traditional as well as the improved farming systems, the greatest demand for labor occur during the land clearing, weeding, and harvesting periods (Martel, 1995). Cash flow constraints determine the type of labor employed throughout the farming season. Martel reported that under the traditional system, land clearing and weeding are generally carried out by family labor, while hired labor is employed mainly at harvest when the cash flow constraint is relaxed. The demand for labor is very high during the harvest season, both for small and large farmer, as it is done manually under a time constraint. The time constraint arises from the threat of damage by fungi and insects if the harvest is delayed and the threat of theft, if the farmer leaves the ready-to-harvest crop in the field too long (Martel, 1995).

Improved seeds: Honduras' principal bean breeding program is located at Zamorano. Since 1987, Zamarano has released seven improved bean varieties[13]. In addition to breeding, Zamarano produces foundation seed of improved varieties, which are multiplied by *Zamorano*, the National Bean Program (under the DICTA), Hondugenet (a private seed company), and NGOs (Mather *et. al*, 2002). Mather also reported that both Zamorano and Hondugenet sell certified seed directly to farmers, which is packaged in 50 lb bags and sold exclusively from Zamorano's campus and Hondugenet's facilities in Tegucigalpa. In addition, various NGOs distribute improved seed to small-scale farmers associated with their outreach projects. However, due to the absence of formal seed distribution system, most farmers' plant saved seed (59%) or obtained seed from a neighbor (29%). While a recent study indicated widespread adoption of improved bean varieties, the rate of diffusion is slow

[13] Improved varieties that were released are Catrachita (1987), Oriente (1990), Dorado (1990), Don Silvio (1993), DICTA 113 (1996), DICTA 122 (1996), and Tio Canela (1996).

and since few farmers' plant certified seed, the quality of their seed is poor (Mather, *et. al*, 2002).

Credit: Framers can obtain credit from informal sources or the formal sources, such as the National Agriculture Development Bank (*Banco Nacional de Desarrollo Agricola*, or BANADESA), savings and loan coops and private development organizations (IADB, 1999). However, the services of BANADESA and other formal institutions do not reach the majority of small farmers, especially those bean producers who plant less than 1 ha of beans. Two constraints preventing the further development of the financial system, particularly in the area of rural finance, are the weak process of bank supervision and the lack of an effective legal, regulatory and institutional framework to govern secured transaction (IADB, 1999). On the other hand, informal agents are far more accessible to bean farmers. These informal credit agents are mostly local rural traders or traders from nearby urban centers. Typically, these traders use the expected harvest as collaterals for the loan (Martel, 1995). Lower transaction cost and easy accessibility are key incentives for farmers to obtain loans from informal sources. However, the interests charged are much higher than interest charged by formal sources.

Chemical Inputs: Private agro-chemical distributors, who sell these inputs to wholesalers and the retailers, import all of their chemical inputs. Private agricultural input retailers market these inputs in most urban centers that have a population of greater than 10,000 (Martel, 1995). In some locations, BANADESA also operates input retail stores. Local traders play an important role in distributing inputs from urban centers to the farm gate by either providing transport services or acting as intermediaries between the input stores and farmers (Martel, 1995). The use of chemical inputs varies among region. Martel (1995),

found that farmers in the Mid-Eastern region used more chemical inputs than those in the other two regions.

Extension and Technology Generation: Until the early 1990s, most of the agricultural extension and technology services in Honduras were financed and implemented by the government. Under the system, the expected results in terms of higher productivity were not achieved, because both the quality and provision of services proved to be deficient. In order to improve the level of quality in research and development of agricultural technologies, DICTA was created under the LMDSA[14]. DICTA was mandated to design, direct, and execute all research and extension programs, and is responsible for promoting agricultural research in the private sector to minimize public sector participation in agricultural research. Under this new institutional arrangement, *Zamorano*, in collaboration with Bean/Cowpea CRSP and PROFRIJOL, are responsible for conducting most of the technical research on beans (Martel, 1995).

Since its' restructuring in the early 1990s, MNRs staff has been reduced significantly. As such, the extension service has been limited to serving organized peasant groups who, as a cooperative (or any other formal organization), request technical assistance (Martel, 1995). Under this arrangement, individual farmers have much less access to extension services.

In support of the field extension effort, the MNR and *Zamorano* publish technical and popular agricultural bulletins that deal with wide range of topics such as bean diseases, improved varieties, fertilization, and entomology and plant protection issues. The MNRs publications are intended for extension staff. *Zamorano's* bulletins, which are more technical, are intended for extension staff and field technicians. While these publications serve a purpose, they are not widely distributed (Martel, 1995).

[14] LMDSA (1992) introduces substantial changes to the series of laws that previously governed the sector.

2.3.9. Bean Marketing System[15]

In the 1980s, bean marketing was dominated by a governmental parastatal, the Honduran Agricultural Marketing Institute (IHMA). IHMA was established in 1978 with the objective of improving the basic grains marketing system. Its specific responsibilities were to: 1) provide a direct marketing channel between producers and 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 (Martel, 1995). Price guarantees were designed to minimize variability in farmer's annual income, with the expectation that this would stimulate investment in agriculture, which in turn might lead to higher production. However, IHMA's impact on the production and marketing of beans had been minimal.

Under the structural adjustment program (SAP) in early-1990s, the marketing parastatal was dismantled, price controls were eliminated and rules on international trade was relaxed. As a part of SAP, the role of IHMA was reduced to buying and selling strategic reserves of corn and beans through public bidding, managing a market information system, and providing storage and technical assistance to basic grain producers.

Wholesale and Retail markets[16]:

The principal marketing channel agents are farmers, wholesalers, local traders, regional traders[17], Salvadorian traders[18], IHMA, BANASUPRO, bean packers, bean processors, and urban retail markets.

[15] Based on Martel, 1995
[16] Based on Martel, 1995.
[17] Regional bean traders operate over a larger geographical area than the local traders.
[18] These are traders from El Salvador who enter with manufactured merchandise for sale to wholesalers and retailers in major cities and purchase full truckloads of beans for resale in El Salvador.

Agricultural wholesale markets, who trade beans in large quantities, are found in all the urban centers. The buildings used by the wholesalers are either owned or rented by the traders. Most buildings have the capacity to maintain stock of up to 30 MT. Large traders typically purchase their stocks from small traders located in the rural areas, or travel to the rural areas and purchase directly from farmers.

Bean retailing is done through several types of retail outlets, including the street vendors, city-market vendors, corner stores, mini-markets, supermarkets, food-marketing parastatal (BANASUPRO), and Farmers' market fairs.

Street vendors, who are found in the major cities, use wooden structures, which can be easily assembled and rolled up. City-market vendors rent retail posts at the municipal markets in major cities. In addition to the beans, they sell cereals, vegetables and fruits.

Corner stores (*Pulperias*) are found in urban neighborhoods and rural villages. Some of the corner stores located in the urban neighborhoods sell processed beans, while those located in rural villages sell unprocessed dry beans.

Mini-markets are common in middle class urban neighborhoods. They are normally bigger than corner stores and most of them sell pre-packet beans in plastic bags of 1 or 5 lb. In addition to the beans, both corner stores and mini-markets sell other food products and household goods.

Supermarkets (large modern food retail stores), which serve the middle and middle-upper class in the cities, are located strategically in commercial areas. Bean products sold in these facilities include processed (refried beans – frozen, canned and flexi-pack) and unprocessed (dry) bean in bags of 1 or 5 lb.

BANASUPRO, the food retailing parastatal, manages a national chain of food stores. It was established in 1980 with the mandate to serve poor consumers by assuring a stable supply of basic consumer goods at subsidized prices. Dry Beans are one of the items sold through this facility.

In addition, beans produced by small-scale farmers are sold at farmers' market fairs. These markets are designed to provide farmers with an opportunity to sell their products directly to consumers. These fairs, which occur on Saturday, exist in most of the major cities.

CHAPTER III

LITERATURE REVIEW, DATA COLLECTION AND METHODOLOGIES

3.1 Literature Review:

Record keeping refers to keeping, filing, categorizing and maintaining farm financial and production[19] information. It can be accomplished through a variety of methods, from basic hand record-keeping method to an elaborate computerized system. To convert farm records/data into useful information, record analysis must be carried out and the findings reported. Record analysis refers to evaluating farm records. The process of evaluation allows the farmer/farm manager to make informed decisions based on actual farm performance. Therefore, establishing and using an effective farm record keeping system for farm operation aids in farm planning, informed decision-making and analysis of both production and financial records. Accurate records and the resulting analysis help farmers to make financial and production decisions, comply with tax laws and other governmental regulations and support loan applications (Gerloff, D.C. *et. al.*, 1995).

Farm records are often kept with the expectation that there will be several uses made of the records. Hopkins and colleagues view accounting information as a tool to assist the manager in: (1) evaluating the firm's financial position, relative to its objectives; (2) measuring economic performance; (3) controlling the daily routine operation of the business; and (4) evaluating alternative strategies for controlling resources (citation from Harsh, *et.al*, 1981). Other uses of the records include providing information needed for partnership and tenant-landlord settlements, monitoring the progress of the business over time, and providing the basis for settling litigation claims (Harsh, *et.al*., 1981). The number of potential uses of

[19] Production records are items that relate to quantities of inputs and levels of production by enterprise and/or by resource type.

records in the business is endless. However, what are important uses for one farmer/farm manager may not be as important for others. Therefore, what the farmer/farm manager desires from his record system will influence the design of the system and the type of information recorded.

A good record system remains an essential component of a well-managed farm operation. However, despite the long, sustained and widespread advocacy of farm record systems by experts in many countries, few small-scale farmers use record keeping for planning and control (McConnell, *et.al.*,). This could be due to farmers' lack of information, their limited education and/or the type of farming systems, which may not demand such tools for managing their farms. Generally, the majority of the farmers in the developing countries are subsistence farmers, who primarily use traditional inputs, cultivate on small land holdings, and have limited knowledge/skills to carry out farm record keeping. This is not to suggest that farmers in the developing countries do not carry out planning and control. Rather, they exercise these functions in informal ways rather than by using formal systems.

In establishing a farm record system, the farmer/farm manager has a number of options. These options relate to the kind of records, the extent of detail, and the type of accounting system to use. Some of the common options at hand are detailed versus generalized accounting system, single entry versus double-entry accounting system, cash versus accrual accounting system, computerized versus manual record system, and total farm accounting versus cost accounting or partial enterprises accounting. Each option has its own advantage and disadvantages and the cost associated with various accounting system varies. In essence, the record keeper must weigh the opportunity cost of time spent and the resources used in keeping records against the benefits derived from the records kept.

3.2 Data Collection

The farm record keeping data that are analyzed in this study were collected from small-scale Honduran bean farmers by *Zamorano* staff during the period 1998-2000. Rather than using a formal sampling frame, the farmers were selected to represent farmers who used two levels of technology, traditional technology and modern technology. Table 3.1 shows the sample size, village and the department for each strata by season and year. These sites (*Olancho*, **Yoro** and *El Paraiso*) were located in the main bean-growing regions of Honduras (Map 2).

Map 2. Honduras Map.

Table 3.1 Locations, Department and Sample Size by Season/Year and Farmer Type.

Season/ Year	Locality	Municipality	Department	Sample Size (N)	Traditional (N)	Modern (N)
Primera 1998	El barro	Danli	El Paraiso	4	0	4
	Arauli	Danli	"	4	0	4
	Robledal	Sn Matias	"	4	2	2
	Limones	Moroceli	"	4	4	0
	Lavandero	Guinope	"	4	0	4
Total N				**20**	**6**	**14**
Primera 1999	Silica	Silica	Olancho	5	2	3
	Zuntul	Silica	"	1	1	0
	Quilinchuch	Silica	"	1	1	0
	El Ocotal	El Rosario	"	3	1	2
	El Rosorio	El Rosario	"	1	0	1
	El Pino	El Rosario	"	4	4	0
	Yupite	El Rosario	"	4	1	3
Total N				**19**	**10**	**9**
Postrera 1999	Silica	Silica	Olancho	7	3	4
	Zuntul	Silica	"	1	0	1
	El Ocotal	El Rosario	"	3	0	3
	El Rosorio	El Rosario	"	1	0	1
	El Pino	El Rosario	"	4	3	1
	Yupite	El Rosario	"	4	3	1
Total N				**20**	**9**	**11**
Primera 2000	Santa Cruz	Yorito	Yoro	5	0	5
	La Ladera	Yorito	"	4	2	2
	Pueblo Viejo	Yorito	"	5	4	1
	Mina Honda	Yorito	"	5	1	4
Total N				**18**	**6**	**12**
Postrera 2000	Santa Cruz	Yorito	Yoro	5	5	0
	La Ladera	Yorito	"	4	2	2
	Pueblo Viejo	Yorito	"	5	1	4
	Mina Honda	Yorito	"	5	5	0
Total N				**19**	**13**	**6**

The reporting unit for the survey is the person in the family in charge of the bean farm. During the initial visit, the enumerators drew a map of the farmers' field and collected basic socioeconomic information about the farmers' household and the bean operation. Throughout the cropping season, the enumerator visited the farmer at least twice a month to record information on the farmers' bean operation.

The data that were collected included farm area devoted to beans, inputs applied (type, amount, cost), labor used (male, female, hired, family, wage rate) for each operation, and machinery used (hours, cost). After harvest, the enumerator recorded the harvest and the price that the farmers received at sale of his/her bean crop. For the analysis, data were than entered into spreadsheet and read into SPSS for data cleaning, organization and analysis.

3.3 Data Analysis:

To characterize the bean production systems for traditional and modern farmers and to assess their profitability, the farm record data were analyzed and average quantity and cost of various inputs (such as seed, fertilizer, herbicide, insecticide and fungicide) used per hectare was computed for each group of farmers for comparison and to be used for profitability analysis. Further, labor use (man-days/ha) and its associated cost per hectare by type of operation were analyzed and compared between traditional and modern farmers. Labor use and cost per hectare by operation was segregated into family and hired labor to gain a better understanding of the composition of labor and distribution of cost.

To assess the costs and returns of traditional and modern farmers, enterprise budgeting was used for each data set as an analytical tool. The following values for revenue, cost and returns were estimated for traditional and modern farmers.

Revenue:

Gross Income (GI), is defined as the value of the total bean output produced. GI was computed by multiplying average yield by average price at farm level. GI includes the output produced during the year, which may be sold, used for household consumption, used on the farm for seed, used for payments in kind; or kept in store for future sale (ending stock). Non-market transactions are valued at their opportunity cost (average market price).

Costs:

(a) Operating cost refers to the sum of input cost, traction contract cost and hired labor cost. Input cost consists of value or expenses incurred on seeds, fertilizer, insecticides, fungicides, and herbicides, while the traction cost consist of the opportunity cost or the hire cost for using tractors or oxen for primary land tillage. Non-purchased inputs, such as owned seeds were valued at their opportunity cost, *i.e.* market price.

(b) Opportunity Cost of Equity Capital is the amount that the farmer would otherwise be able to earn at the same risk level as investing on bean production. It was computed at 12% of cash/operating cost[20].

(c) Opportunity Cost of Family Labor is the value of the family labor used, which is valued at local wage rate (*i.e.* the average of the cost paid for hired labor).

(d) Total Enterprise Cost (TEC) refers to the value of all inputs used in production. It is the sum of operating cost, opportunity cost of equity capital, and the opportunity cost of family labor. Total cost are generally divided into total variable cost and total fixed cost. However, in this analysis, total fixed cost are excluded since the fixed costs were minimal. The study did not assign price for the land, given the difficulty of estimating land values.

[20] Operating Cost consists of expenses incurred on seeds, agrochemicals, traction contract cost and hired labor cost.

Returns:

(a) Enterprise Gross Margin (EGM) is defined here as the difference between GI and Operating cost.

(b) Return to Family Land, Labor and Management were computed by deducting operating cost and the opportunity cost of equity capital from GI.

(c) Return to Family Land, Labor and Management per Day was computed by dividing Return to Family Land, Labor and Management by the number of family labor days used. While the standard practice is to value family labor at its opportunity cost, this assumes that wage labor opportunities exist in the community. However, this is so often not the case. Thus, this measure provides an alternative estimate of profitability – i.e. the implicit daily wage a farm family earns from growing beans.

(d) Return to Family Land and Management is the difference between the GEI and TEC, which includes the opportunity cost of family labor and equity capital as part of costs. It measures the reward to the family for farmers' management and land.

The results from enterprise budgets were used for sensitivity analysis to assess the degree by which the farmers' enterprise gross margin vary when alternative yields and prices were substituted for the actual average values used in the budgets.

Finally, standard parameter of labor man-days/ha for various farming operations in bean production was computed. These standard parameters were mainly computed to reduce the amount of data that would be collected for future farm record keeping. In so doing, some resources could be saved and diverted to increase the sample size, thereby giving results that are more representative. These standard parameters were drawn from pooled sample (N=96) of all the data sets used in this study. For land preparation, manual weeding and other

activities, the survey data were used to estimate mean and the median as the standard man-days/ha for these farming operations. For harvesting and threshing, standard labor man-days (mean and the median) were computed based on the assumption that the number for labor man-days/ha for each of the operation was dependent on the quantity of harvest (*i.e.* yield). For planting, standard labor man-days/ha (mean and the median) was based on the assumption that the labor man-days/ha required was dependent on the seed rate used. Standard labor parameter for application of fertilizer, herbicide, insecticide and fungicide was based on the number of days per application for a one-hectare bean farm. These standard parameters (mean and the median) were validated for each data set using the actual yield, price, seed rate, aggregated input cost, traction contract cost, wage rate, and average number of agrochemical (fertilizer, herbicide, insecticide and fungicide) applications to evaluate the results (Profitability), using these parameters, compared to the results obtained when using the actual data.

3.4 Characteristics of the Study Area[21]

Primera 1999, El Paraiso.

The sample farmers in the data set are from the localities of *El Barro, Arauli*, *Robledal*, *Limones* and *Lavanderos*. The average annual rainfall for these localities ranged from 800 to 1,400 mm. The nearest city for *El Barro, Arauli* and *Robledal* is *Danli*, while for *Limones* and *Lavanderos* it is *Tegucigalpa*, the capital of Honduras (Appendix 1).

[21] Source: Dr. Juan Carlos Rosas, Director, Programa de Investigaciones en Frijol, Escuela Agricola Panamericana, Zamorano, Honduras.

Postrera and Primera 1999, Olancho.

The sample farmers in the data set are from the localities of *Silca, Zuntul, El Ocotal*, *El Rosario, El Pino* and *Yupite*. The majority of these localities are located in plain areas with an average annual rainfall ranging from 1,200 to 2,000mm. The nearest city to these localities is *Juticalpa* (Appendix 1).

Postrera and Primera 2000, Yoro.

The sample farmers in this data set come are from the localities of *Santa Cruz, La Ladera, Pueblo Viejo* and *Mina Honda*. They are all located in hilly area with an average annual rainfall ranging from 1,600 to 2,000 mm. The nearest city for all the localities is *Yoro* (Appendix 1).

CHAPTER IV

PROFITABILITY ANALYSIS OF BEAN PRODUCTION

In this chapter, first, the socioeconomic characteristics of the sample of record keeping farmers are described, followed by the analysis of each of the five data sets. At the end of the chapter, the overall results are synthesized.

4.1 Socio-Economic Characteristic of the Sample Farmers

Across all sites, the samples of the bean farmers were similar in terms of their socioeconomic characteristics (Table 4.1).

Across the sites/seasons, farmers' mean ages ranged from 39 (*Primera & Postrera* 1999, *Olancho*) to 43 (*Primera* 1998, *El Paraiso*). Farmers' education ranged from 3 to 5 years. At all sites, the number of family members per households ranged from 4 to 6, and the number of children ranged from 2 to 3. Farmers cultivated a total land area, ranging from 1.25 to 3.23 hectares and their bean area ranged from 0.41 hectares to 0.95.

Table 4.1. Socioeconomic Characteristics of the Sample Farmers, Honduras.

Characteristics	***El Paraiso*** (Year 1998)	***Olancho*** (Year 1999)	***Yoro*** (Year 2000)
Farmers Age (Yrs.)	43	39	40
Farmers Education (Yrs.)	5	4	3
Family size	4	5	6
Number of Children in the family	2	3	3
Farm size (Ha)	3.23	1.50	1.25
Bean Area (Ha)	0.95	0.99	0.41

Note: The figures used above are averages.

4.2 Department: Yoro, Honduras, Postrera 2000.

The sample included 13 farmers, who planted traditional bean varieties and six farmers who planted modern bean varieties. In the discussion that follows, farmers who planted traditional varieties are referred to as traditional farmers and those who planted modern varieties are referred to as modern farmers.

4.2.1 Patterns and Costs of Labor Use

Labor Use by Type of Operation: On average, traditional farmers used a total of 75.5 man-days/ha, compared to 101.6 man-days/ha for modern farmers (Table 4.2.1.1).

In addition, Table 4.2.1.1 reports the mean number of man-days and associated cost of family and hired labor, by farming operation, for modern and traditional farmers. Because the number of farmers who carried out each operation varied greatly, the mean reported is the mean man-days (costs) for those farmers who actually carried out the respective operations. In this regard, the sum of the means of family and hired labor man-days under each farming operation (Table 4.2.1.1) do not represent the total average man-days for the respective operation.

Table 4.2.1.1. Labor Use (average man-days/ha), *Postrera* 2000, *Yoro*, Honduras.

Operation and Labor Type	Traditional (N = 13)				Modern (N = 6)			
		No. of Days[a]		Cost		No. of Days[a]		Cost
	n	Mean	S.D.[b]	(US$/ha)[c]	n	Mean	S.D[b]	(US$/ha)[c]
Land Preparation:								
Family	13	12.7	6.1	28.2	4	15.0	11.7	33.3
Hired	8	8.9	5.0	14.7	5	16.7	7.7	37.7
Planting:								
Family	13	9.3	4.9	20.6	4	11.9	8.8	26.4
Hired	11	6.0	3.2	10.5	5	11.2	3.6	21.9
App. Fertilizer:								
Family	1	1.2	N.A.	2.8	1	7.5	N.A.	16.7
Hired	1	1.2	N.A.	2.8	0	NA	N.A.	NA
App. Herbicide:								
Family	6	3.0	1.0	6.8	1	2.5	N.A.	5.6
Hired	5	3.0	1.1	5.7	1	2.5	N.A.	5.7
App. Insecticide:								
Family	5	4.2	3.5	9.4	4	2.9	1.4	6.5
Hired	4	2.8	1.6	5.0	4	2.3	0.4	5.2
App. Fungicide:								
Family	0	N.A.	N.A.	N.A.	0	N.A.	N.A.	N.A.
Hired	0	N.A.	N.A.	N.A.	0	N.A.	N.A.	N.A.
Manual Weeding:								
Family	7	10.17	4.72	22.56	3	6.68	5.21	14.82
Hired	3	5.01	4.34	14.15	5	10.94	7.82	21.32
Harvesting:								
Family	12	12.4	6.5	27.6	6	12.9	15.5	28.6
Hired	8	6.6	4.1	16.2	4	9.00	3.9	11.5
Threshing:								
Family	10	8.9	6.7	19.8	2	5.0	3.5	11.1
Hired	6	4.3	1.1	8.4	2	8.8	1.8	17.00
Others:								
Family	12	7.1	4.0	15.7	5	9.9	2.9	22.1
Hired	1	2.4		5.5	2	5.1	2.4	16.0
Total Mean[d]:								
Family	*13*	*55.4*	*27.0*	*123.0*	*6*	*47.7*	*42.8*	*105.9*
Hired	*13*	*20.2*	*7.6*	*32.0*	*5*	*53.9*	*11.3*	*108.6*
Total		***75.5***		***155.0***		***101.6***		***214.6***

Note: a/ Converted from hours to number of days using 8 hours equal to one day.
b/ Standard Deviation of the number of days.
c/ Family Labor is valued at its opportunity cost.
d/ Calculated as the weighted average.

For the traditional farmers, the largest share of total labor was used for land preparation (24.0%), followed by harvesting (20.6%), planting (19.0%), threshing (11.7%), a combination of other activities such as cleaning and watering (8.9%), manual weeding (8.8%), and agrochemical applications (7.0%) (Table 4.2.1.2).

For modern farmers, the largest share of total labor was used for land preparation (25.8%), followed by harvesting (20.4%), planting (18.6%), manual weeding (13.4%), sum of other activities such as watering, cleaning and winnowing (10.8%), threshing (5.0%), and application of agrochemicals (6.1%) (Table 4.2.1.3).

With respect to their source of labor, traditional farmers' total labor consisted of 73.4% family labor and 26.6% hired labor, while modern farmers' total labor consisted of 51.5% family labor and 48.5% hired labor.

Table 4.2.1.2 Sum and Percentage of Traditional Farmers (N = 13) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Postrera* 2000, *Yoro.*

Type of Operation	Family Labor[a] (man-days/ha)	%of TL[b]	Hired Labor[a] (man-days/ha)	% of TL[b]	Total Labor[c] (man-days/ha)	% of TL[b]
Land Preparation	165.0	16.8	71.0	7.2	236.0	24.0
Planting	120.5	12.3	66.5	6.8	186.9	19.0
App. Fertilizer	1.3	0.1	1.3	0.1	2.5	0.3
App. Herbicide	18.3	1.9	15.0	1.5	33.3	3.4
App. Insecticide	21.2	2.2	11.3	1.1	32.5	3.3
App. Fungicide		0.0		0.0	0.0	0.0
Manual Weeding	71.2	7.2	15.0	1.5	86.2	8.8
Harvesting	149.0	15.2	52.9	5.4	201.9	20.6
Threshing	89.3	9.1	25.8	2.6	115.1	11.7
Others	84.9	8.6	2.5	0.2	87.4	8.9
Total Labor Man-days	**720.8**	**73.4**	**261.1**	**26.6**	**981.9**	**100.0**

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
b/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
c/ Is the sum of family and hired labor man-days/ha.

Table 4.2.1.3 Sum and Percentage of Modern Farmers (N = 6) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Postrera* 2000, *Yoro.*

Type of Operation	Family Labor[a] (man-days/ha)	% of TL[b]	Hired Labor[a] (man-days/ha)	% of TL[b]	Total Labor[c] (man-days/ha)	% of TL[b]
Land Preparation	83.5	15.0	60.1	10.8	143.6	25.8
Planting	47.6	8.6	55.9	10.1	103.5	18.6
App. Fertilizer	7.5	1.4	0.0	0.0	7.5	1.4
App. Herbicide	2.5	0.4	2.5	0.4	5.0	0.9
App. Insecticide	11.7	2.1	9.2	1.7	20.9	3.8
App. Fungicide		0.0		0.0	0.0	0.0
Manual Weeding	20.0	3.6	54.7	9.8	74.7	13.4
Harvesting	77.2	13.9	35.9	6.5	113.1	20.4
Threshing	10.0	1.8	17.5	3.2	27.6	5.0
Others	49.7	8.9	10.1	1.8	59.9	10.8
Total Labor Man-days	**286.4**	**51.5**	**269.4**	**48.5**	**555.8**	**100.0**

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
b/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
c/ Is the sum of family and hired labor man-days/ha.

Labor Costs[22] by Type of Operations: Total labor costs for the traditional farmers averaged US$155.0/ha, compared to US$214.6/ha for modern farmers (Table 4.2.1.1).

For traditional farmers, the largest share of total labor cost per hectare was for land preparation (22.9%), followed by harvesting (20.6%), planting (17.8%), threshing (12.1%), a combination of other activities such as cleaning, watering and winnowing (10.1%), manual weeding (9.7%) and agrochemical application (6.8%) (Table 4.2.1.4).

For modern farmers, the largest share of total labor cost was for land preparation (27.3%), followed by harvesting (18.4%), planting (18.2%), manual weeding (12.8%), a combination of other activities such as watering, cleaning and winnowing (12.1%), agro chemical applications (6.4%), and threshing (4.8%) (Table 4.2.1.5).

For traditional farmers, hired labor cost accounted for 16.4% of average total labor cost per hectare, compared to 46.1% for modern farmers.

[22] Family Labor is valued at the wage rate (i.e. US$2.22/day) for *postrera* 2000.

Table 4.2.1.4 Sum and Percentage of Traditional Farmers (N = 13) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Postrera* 2000, *Yoro.*

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	366.2	19.1	73.6	3.8	439.8	22.9
Planting	267.3	13.9	73.6	3.8	340.9	17.8
App. Fertilizer	2.8	0.1	2.8	0.1	5.6	0.3
App. Herbicide	40.6	2.1	22.6	1.2	63.3	3.3
App. Insecticide	47.1	2.5	15.1	0.8	62.2	3.2
App. Fungicide		0.0		0.0	0.0	0.0
Manual Weeding	158.0	8.2	28.3	1.5	186.3	9.7
Harvesting	330.7	17.2	64.8	3.4	395.5	20.6
Threshing	198.2	10.3	33.7	1.8	231.9	12.1
Others	188.5	9.8	5.5	0.3	194.0	10.1
Total Labor Cost	1599.4	83.3	320.1	16.7	1919.6	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
b/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
c/ Is the sum of family and hired labor cost per hectare.

Table 4.2.1.5 Sum and Percentage of Modern Farmers (N = 6) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Postrera* 2000, *Yoro.*

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	133.4	11.3	188.7	16.0	322.1	27.3
Planting	105.6	9.0	109.5	9.3	215.1	18.2
App. Fertilizer	16.7	1.4	0.0	0.0	16.7	1.4
App. Herbicide	5.6	0.5	5.7	0.5	11.2	1.0
App. Insecticide	25.9	2.2	20.8	1.8	46.7	4.0
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	44.5	3.8	106.6	9.0	151.1	12.8
Harvesting	171.4	14.5	45.9	3.9	217.3	18.4
Threshing	22.2	1.9	34.0	2.9	56.2	4.8
Others	110.4	9.4	32.1	2.7	142.5	12.1
Total Labor Cost	635.6	53.9	543.1	46.1	1178.7	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
b/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
c/ Is the sum of family and hired labor cost per hectare by operation.

4.2.2 Patterns and Costs of Input Use

Seed: Farmers in the sample most commonly planted seed that they had saved from their previous harvest or obtained from other farmers. From the sample of 19 farmers, 13 farmers used traditional varieties (TV) at an average seed rate of 53.3Kg/ha (Table 4.2.2.1)

and six farmers used modern varieties (MV), which they planted at an average seed rate of 54.3kg/ha. Average total cost per hectare for seed (valued at its opportunity cost) was US$33.1/ha for traditional farmers and US$30.9/ha for modern farmers (Table 4.2.2.1). Traditional farmers mostly planted *Concha Rosada* and all of the modern farmers planted *TC-75*.

Fertilizer: Only two farmers (one traditional and one modern farmer) in the sample used fertilizer. The traditional farmer used 2.9kg/ha of *urea* (45-0-0) but no cost was reported, while the modern farmer used 59.0kg/ha (*urea and micronutrients*) at an average cost of US$32.0/ha (Table 4.2.2.1).

Herbicide: Eight farmers in the sample used herbicide, out of which seven were traditional and one was a modern farmer. The traditional farmers used an average quantity of 1.91 liters/ha at an average cost of US$11.0/ha, while the modern farmer used an average of 1.4 liters/ha at a cost of US$8.5/ha (Table 4.2.2.1). All of the farmers used *Paraquat*.

Insecticide: Eleven farmers used insecticides, out of which six were traditional farmers and five were modern farmers. Traditional farmers used an average quantity of 1.2 liters/ha at an average cost of US$11.1/ha, while the modern farmers used 0.9 liters/ha at an average cost of US$7.4/ha (Table 4.2.2.1). Forty-five percent of farmers who applied insecticide used *Methyl Parathion*, while the rest used *Cialotrina* (27%), *Endosulfan* (18%), and *methamidofos* (9%).

Table 4.2.2.1. Average Quantity and Cost of Input Use Per Hectare by Type of Farmer, *Postrera* 2000, *Yoro*, Honduras.

Item	Traditional (N= 13)			Modern (N=6)			Total (N=19)		
	n[a]	Qtty[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)
Seed (Kg/ha)	13	53.3	33.1	6	54.3	30.9	19	53.6	32.4
Fertilizer (Kg/ha)	1	2.9	0.0	1	50.0	32.0	2	26.4	32.0
Herbicide (l/ha)	7	1.9	11.0	1	1.4	8.5	8	1.9	10.7
Insecticide (l/ha)	6	1.2	11.1	5	0.9	7.4	11	1.1	9.4
Fungicide (g/ha)	0	NA	NA	0	NA	NA	0	NA	NA
Traction Contract[c] (days/ha)	0	NA	NA	0	NA	NA	0	NA	NA

a/ Number of farmers by type using the particular item.
b/ Mean quantity per hectare.
c/ Cost per hectare of traction contract includes oxen or a tractor hired/used.

4.2.3 Profitability Analysis

Various measures of costs and returns are reported in the Table 4.2.3.1 and presented below.

Revenue:

Yield, Price and Gross Income: On average, traditional farmers obtained a yield of 288kg/ha (S.D = 159) and modern farmers obtained 423.3kg/ha (S.D = 326). Modern farmers received an average price of US$0.64/kg, while traditional farmers received only US$0.51/kg. Traditional farmers earned a Gross Income (GI)[23] of US$146.9/ha, which was much lower than US$270.9/ha earned by the modern farmers.

Costs:

Total Enterprise Cost (TEC): For traditional farmers, TEC averaged US$208.4/ha, which consisted of the opportunity cost of family labor (59.0%), input cost (21.2%), hired labor cost (15.4%), and opportunity cost of equity capital (4.4%) (Table 4.2.3.2). Operating cost, excluding the opportunity cost of equity capital and family labor, averaged US$76.2/ha (Table 4.2.3.1).

[23] Gross Income was calculated by multiplying average yield by average price received in the market.

For modern farmers, TEC averaged US$276.6, which consists of the opportunity cost of hired labor (39.3%), family labor cost (38.3%), input cost (15.8%), and the opportunity cost of equity capital (6.6%) (Table 4.2.3.2). Operating cost, excluding the opportunity cost of equity capital and family labor, averaged US$152.4/ha (Table 4.2.3.1).

Per unit Cost of Production (*i.e.* total enterprise cost divided by the average yield) for traditional farmers was US$0.72/ha compared to US$0.65/ha for modern farmers.

Returns:

Enterprise Gross Margin (*i.e.* GI less operating cost) for traditional farmers averaged US$70.7/ha, while it was US$118.5/ha for modern farmers.

Returns to Family Land, Labor and Management (RFLLM) (*i.e.* EGM less the opportunity cost of equity capital) for traditional farmers averaged US$61.5/ha, compared to US$100.3/ha for modern farmers.

Returns to Family Land, Labor and Management per Day (*i.e.* RFLLM divided by number of family labor days) for traditional farmers averaged US$1.1/day, while it was US$2.1/Day for modern farmers.

Return to Family Land and Management (*i.e.* TEC deducted from GI) for traditional farmers averaged *minus* US$61.5/ha, while it averaged *minus* US$5.7 for the modern farmers.

Table 4.2.3.1. Average Yields, Prices, Costs and Returns by Type of Farmers, *Postrera* 2000, *Yoro*, Honduras.

Items	Traditional (N=13)	Modern (N=6)	Sig. (t-test)[a]
Revenue:			
Average Yield (Kg./ha)	288.0	423.3	0.23
Adjusted Price (US$/Kg)	0.5	0.6	0.01*
(1) Gross Income (US$/ha)	146.9	270.9	0.06**
Costs:			
Input Cost[b] (US$/ha)	44.2	43.7	0.97
Cost of Equipment (US$/ha)	0.0	0.0	
Hired Labor Cost (US$/ha)	32.0	108.6	0.04*
(2) Total Operating Cost (US$/ha)	76.2	152.4	
(3) Opportunity Cost of Equity Capital[c] (US$/ha)	9.1	18.3	
(4) Family Labor			
(4.1) Number of Family Labor Days/ha	55.4	47.7	0.70
(4.2) Family Labor Cost[d] (US$/ha)	123.0	105.9	0.70
(5) Total Enterprise Cost (US$/ha) [*2+3+4.2*]	208.4	276.6	
(6) Per Unit Cost[e] (US$/kg)	0.7	0.6	
Profitability Measures			
(7) Enterprise Gross Margin (US$/ha) *[1-2]*	70.7	118.5	0.21
(8) Return to Family Land, Labor and Management (US$/ha) *[7-3]*	61.5	100.3	
(9) Return to Family Land, Labor and Management per Day (US$/Day) *[8/4.1]*	1.1	2.1	
(10) Return to Family Land and Management (US$/ha) *[8-4.2 or 1-5]*	**-61.5**	**-5.7**	

a/ T-test for equality of means:

* Significant at 5% significance level.

** Significant at 10% significant level.

b/ Mean of the aggregated total cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).

c/ Opportunity cost of equity capital was valued at 12% of Operating Cost.

d/ Opportunity cost family labor was valued at the wage rate of US$2.22/Day.

e/ Computed by dividing total enterprise cost by average yield.

Table 4.2.3.2. Average Total Enterprise Cost (US$/ha), *Postrera* 2000, *Yoro*, Honduras.

Item	Traditional (N=13)		Modern (N= 6)		Total (N=19)	
	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC
Input Costs[a]	44.2	21.2	43.7	15.8	44.0	20.2
Traction Hire Costs	NA	NA	NA	NA	NA	NA
Family Labor cost	123.0	59.0	105.9	38.3	117.6	54.0
Hired Labor Cost	32.0	15.4	108.6	39.3	45.4	20.9
Equity Capital Cost	9.1	4.4	18.3	6.6	10.7	4.9
Total Enterprise Cost (TEC)	208.4	100.0	276.6	100.0	217.8	100.0

a/ Total aggregate mean of the cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).

4.2.4 Sensitivity Analysis[24]:

The results of the sensitivity analysis are reported for traditional (Table 4.2.4.1) and modern (Table 4.2.4.2) farmers, with respect to a ± 50 percent change in bean yield and bean price, holding operating cost[25] constant.

For traditional farmers (Table 4.2.4.1), holding operating cost (US$76.2/ha) and one of either yield (288.0kg/ha) or price (US$0.51/kg) constant, the EGM falls below zero with a 50% decrease in price or yield. On the other hand, holding only operating cost constant, EGM falls below zero with 30% decrease in price and yield.

For modern farmers (Table 4.2.4.2), holding operating cost (US$152.4) and one of either yield (423.3kg/ha) or price (US$0.64/ha) constant, EGM falls below zero with a 50% decrease in price or yield. On the other hand, holding operating cost constant, EGM falls below zero with 20% decrease in both price and 30% in yield and vice versa.

Table 4.2.4.1 Traditional Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Postrera 2000, Yoro, Honduras.

		Bean Price (US$/Kg)										
		0.26	0.31	0.36	0.41	0.46	0.51	0.56	0.61	0.66	0.71	0.77
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
143.99	-50%	-39.5	-32.1	-24.8	-17.4	-10.1	-2.76	4.59	11.93	19.27	26.62	33.96
172.78	-40%	-32.1	-23.3	-14.5	-5.69	3.12	11.93	20.7	29.55	38.36	47.18	55.99
201.58	-30%	-24.8	-14.5	-4.23	6.05	16.3	26.62	36.9	47.18	57.46	67.74	78.02
230.38	-20%	-17.4	-5.69	6.05	17.8	29.6	41.3	53.1	64.8	76.55	88.3	100.1
259.17	-10%	-10.1	3.12	16.3	29.55	42.8	55.99	69.2	82.42	95.64	108.9	122.1
287.97	0%	-2.76	11.9	26.6	41.3	56	70.67	85.4	100.1	114.7	129.4	144.1
316.77	10%	4.59	20.7	36.9	53.05	69.2	85.36	102	117.7	133.8	150	166.1
345.56	20%	11.93	29.6	47.2	64.8	82.4	100.1	118	135.3	152.9	170.5	188.2
374.36	30%	19.27	38.4	57.5	76.55	95.6	114.7	134	152.9	172	191.1	210.2
403.16	40%	26.62	47.2	67.7	88.3	109	129.4	150	170.5	191.1	211.7	232.2
431.96	50%	33.96	56	78	100.1	122	144.1	166	188.2	210.2	232.2	254.3

[24] Operating cost (input and hired labor cost) is held constant, assuming that yield changes are due to weather related risk.

[25] The operating costs do not include the opportunity cost of family labor and equity capital. Thus, the positive scenario may change if we included these cost.

Table 4.2.4.2 Modern Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Postrera 2000, Yoro, Honduras.

	Bean Price (US$/Kg)											
		0.32	0.38	0.45	0.51	0.58	0.64	0.70	0.77	0.83	0.90	0.96
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
211.65	-50%	-84.6	-71.1	-57.6	-44	-30.5	-16.9	-3.37	10.17	23.72	37.26	50.81
253.97	-40%	-71.1	-54.84	-38.6	-22.3	-6.08	10.17	26.43	42.68	58.94	75.19	91.45
296.30	-30%	-57.6	-38.59	-19.6	-0.66	18.3	37.26	56.23	75.19	94.15	113.1	132.1
338.63	-20%	-44	-22.34	-0.66	21.01	42.68	64.35	86.03	107.7	129.4	151	172.7
380.96	-10%	-30.5	-6.08	18.3	42.68	67.06	91.45	115.8	140.2	164.6	189	213.4
423.29	0%	-16.9	10.17	37.26	64.35	91.45	118.5	145.6	172.7	199.8	226.9	254
465.62	10%	-3.37	26.43	56.23	86.03	115.8	145.6	175.4	205.2	235	264.8	294.6
507.95	20%	10.17	42.68	75.19	107.7	140.2	172.7	205.2	237.7	270.2	302.8	335.3
550.28	30%	23.72	58.94	94.15	129.4	164.6	199.8	235	270.2	305.5	340.7	375.9
592.61	40%	37.26	75.19	113.1	151	189	226.9	264.8	302.8	340.7	378.6	416.5
634.94	50%	50.81	91.45	132.1	172.7	213.4	254	294.6	335.3	375.9	416.5	457.2

4.3 ***Department: Yoro, Honduras, Primera 2000.***

The sample included 6 farmers, who planted traditional bean varieties and 12 farmers who planted modern bean varieties. In the discussion that follows, farmers who planted traditional varieties are referred to as traditional farmers and those who planted modern varieties are referred to as modern farmers.

4.3.1 Patterns and Costs of Labor Use

Labor Use by Type of Operation: On average, traditional farmers used a total of 122.6 man-days/ha, compared to 56.5man-days/ha for modern farmers (Table 4.3.1.1).

In addition, Table 4.3.1.1 reports the mean number of man-days and associated cost of family and hired labor, by farming operation, for modern and traditional farmers. Because the number of farmers who carried out each operation varied greatly, the mean reported is the mean man-days (costs) for those farmers who actually carried out the respective operations. In this regard, the sum of the means for family and hired labor man-days under each farming

operation (Table 4.3.1.1) do not represent the total average man-days for the respective operation.

Table 4.3.1.1. Labor Use (average man-days/ha), *Primera* 2000, *Yoro*, Honduras.

Operation and Labor Type	Traditional (N = 6)				Modern (N = 12)			
		No. of Days[a]		Cost		No. of Days[a]		Cost
	n	Mean	S.D.[b]	(US$/ha)[c]	n	Mean	S.D[b]	(US$/ha)[c]
Land Preparation:								
Family	6	11.9	10.0	25.7	10	4.1	3.7	8.9
Hired	4	20.7	13.8	24.8	11	8.4	4.9	16.3
Planting:								
Family	6	6.8	3.9	14.7	10	3.5	2.1	7.6
Hired	5	11.2	5.8	20.6	10	7.3	4.4	18.1
App. Fertilizer:								
Family	0	NA	NA	NA	2	1.5	1.0	3.2
Hired	0	NA	NA	NA	0	NA	NA	NA
App. Herbicide:								
Family	6	5.3	2.8	11.4	6	2.4	2.6	5.3
Hired	0	NA	NA	NA	7	3.2	1.5	9.7
App. Insecticide:								
Family	3	3.3	1.5	7.2	7	2.8	3.3	6.1
Hired	2	1.8	0.8	4.5	4	2.0	0.6	4.6
App. Fungicide:								
Family	0	NA	NA	NA	0	NA	NA	NA
Hired	0	NA	NA	NA	1	2.5	NA	5.8
Manual Weeding:								
Family	4	23.7	21.7	51.4	7	4.7	3.4	10.1
Hired	3	13.2	1.2	21.8	5	6.5	6.3	16.9
Harvesting:								
Family	5	26.4	16.2	57.1	9	8.0	9.0	17.3
Hired	4	14.8	8.3	50.9	9	7.0	4.2	13.7
Threshing:								
Family	4	9.3	2.5	20.1	10	3.6	3.6	7.9
Hired	3	3.2	3.2	4.3	7	8.3	9.1	20.0
Others:								
Family	3	3.3	1.4	7.2	9	4.0	2.4	8.7
Hired	1	5.0		11.5	2	1.3	1.7	3.8
Total Mean[d]:								
Family	*6*	*71.2*	*49.5*	*154.3*	*12*	*24.3*	*21.5*	*52.5*
Hired	*5*	*51.3*	*16.5*	*100.9*	*11*	*32.2*	*19.2*	*76.9*
Total		***122.6***		***255.2***		***56.5***		***129.4***

Note: a/ converted from hours to number of days using 8 hours equal to one day.
B/ Standard Deviation of the number of days.
C/ Family Labor is valued at its opportunity cost.
D/ Calculated as the weighted average.

For the traditional farmers, the largest share of total labor was used for harvesting (28.0%), followed by land preparation (22.5%), manual weeding (19.7%), planting (14.2%),

threshing (6.8%), agrochemical applications (6.6%), and a combination of other activities such as cleaning and watering (2.2%) (Table 4.3.1.2).

For modern farmers, the largest share of total labor was used for harvesting (21.0%), followed by land preparation (20.7%), planting (16.8%), threshing (14.6%), agrochemocal application (10.5%), manual weeding (10.1%), and a combination of other activities such as watering, cleaning and winnowing (6.0%) (Table 4.3.1.3).

With respect to their source of labor, traditional farmers' total labor consisted of 62.6% family labor and 37.4% hired labor, while modern farmers' total labor consisted of 45.0% family labor and 55.0% hired labor.

Table 4.3.1.2 Sum and Percentage of Traditional Farmers (N = 6) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Primera 2000, Yoro.*

Type of Operation	**Family Labor[a] (man-days/ha)**	**%of TL[b]**	**Hired Labor[a] (man-days/ha)**	**% of TL[b]**	**Total Labor[c] (man-days/ha)**	**% of TL[b]**
Land Preparation	71.2	10.4	82.7	12.1	154.0	22.5
Planting	40.7	6.0	56.0	8.2	96.7	14.2
App. Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0
App. Herbicide	31.6	4.6	0.0	0.0	31.6	4.6
App. Insecticide	9.9	1.5	3.7	0.5	13.6	2.0
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	94.9	13.9	39.6	5.8	134.5	19.7
Harvesting	131.9	19.3	59.2	8.7	191.1	28.0
Threshing	37.1	5.4	9.6	1.4	46.6	6.8
Others	10.0	1.5	5.0	0.7	15.0	2.2
Total Labor Man-days	427.3	62.6	255.9	37.4	683.2	100.0

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
B/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
C/ Is the sum of family and hired labor man-days/ha.

Table 4.3.1.3 Sum and Percentage of Modern Farmers (N = 12) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Primera* 2000, *Yoro.*

Type of Operation	Family Labor[a] (man-days/ha)	% of TL[b]	Hired Labor[a] (man-days/ha)	% of TL[b]	Total Labor[c] (man-days/ha)	% of TL[b]
Land Preparation	41.3	6.4	92.1	14.3	133.4	20.7
Planting	35.1	5.4	73.2	11.4	108.2	16.8
App. Fertilizer	2.3	0.4	0.0	0.0	2.3	0.4
App. Herbicide	14.7	2.3	22.4	3.5	37.1	5.8
App. Insecticide	19.6	3.0	7.9	1.2	27.5	4.3
App. Fungicide	0.0	0.0	2.5	0.4	2.5	0.4
Manual Weeding	32.7	5.1	32.4	5.0	65.2	10.1
Harvesting	71.9	11.1	63.3	9.8	135.2	21.0
Threshing	36.5	5.7	57.8	9.0	94.3	14.6
Others	36.2	5.6	2.6	0.4	38.8	6.0
Total Labor Man-days	290.2	45.0	354.2	55.0	644.4	100.0

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
B/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
C/ Is the sum of family and hired labor man-days/ha.

Labor Costs[26] by Type of Operations: Total labor costs for the traditional farmers averaged US$255.2/ha, compared to US$129.4/ha for modern farmers (Table 4.3.1.1).

For traditional farmers, the largest share of total labor cost per hectare was for harvesting (34.2%), followed by manual weeding (18.9%), land preparation (17.7%), planting (13.4%), agrochemical applications (6.9%), threshing (6.5%), and combination of other activities such as cleaning, watering and winnowing (2.3%) (Table 4.3.1.4).

For modern farmers, the largest share of total labor cost was for harvesting (19%), followed by land preparation (28.0%), planting (17.1%), threshing (15.7%), agrochemical applications (13.0%), manual weeding (11.1%), and combination of other activities such as watering, cleaning and winnowing (6.2%) (Table 4.3.1.5).

For traditional farmers, hired labor costs accounted for 35.3% of average total labor cost per hectare, compared to 54.9% for modern farmers.

[26] Family Labor is valued at the wage rate (i.e. US$2.17/day) for *primera* 2000.

Table 4.3.1.4 Sum and Percentage of Traditional Farmers (N = 6) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Primera* 2000, *Yoro.*

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	154.4	10.8	99.2	6.9	253.6	17.7
Planting	88.2	6.2	103.0	7.2	191.2	13.4
App. Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0
App. Herbicide	68.5	4.8	0.0	0.0	68.5	4.8
App. Insecticide	21.6	1.5	9.0	0.6	30.5	2.1
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	205.6	14.4	65.3	4.6	270.9	18.9
Harvesting	285.7	20.0	203.5	14.2	489.2	34.2
Threshing	80.3	5.6	12.9	0.9	93.2	6.5
Others	21.7	1.5	11.5	0.8	33.2	2.3
Total Labor Cost	925.9	64.7	504.3	35.3	1430.2	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
B/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
C/ Is the sum of family and hired labor cost per hectare.

Table 4.3.1.5 Sum and Percentage of Modern Farmers (N = 12) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Primera* 2000, *Yoro.*

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	89.4	6.4	162.9	11.6	252.3	18.0
Planting	75.9	5.4	162.8	11.6	238.8	17.1
App. Fertilizer	6.5	0.5	3.8	0.3	10.3	0.7
App. Herbicide	31.9	2.3	68.2	4.9	100.1	7.2
App. Insecticide	42.5	3.0	23.1	1.6	65.5	4.7
App. Fungicide	0.0	0.0	5.8	0.4	5.8	0.4
Manual Weeding	70.9	5.1	84.6	6.0	155.5	11.1
Harvesting	155.7	11.1	109.5	7.8	265.2	19.0
Threshing	79.1	5.7	140.2	10.0	219.4	15.7
Others	78.4	5.6	7.7	0.5	86.1	6.2
Total Labor Cost	630.2	45.1	768.5	54.9	1398.7	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
B/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
C/ Is the sum of family and hired labor cost per hectare by operation.

4.3.2 Patterns and Costs of Input Use

Seed: Farmers in the sample mostly planted seed saved from previous harvest or obtained from other farmers. From the sample of 18 farmers, six farmers used traditional varieties at an average seed rate of 49.5kgs/ha and 12 farmers used modern bean varieties,

which they planted at an average seed rate of 46.4kg/ha (Table 4.3.2.1). Average total cost for seed used was US$34.7/ha for traditional farmers and US$29.5/ha for modern farmers (Table 4.3.2.1). All traditional farmers planted *Concha Rosada* and all of the modern farmers planted *TC-75*.

Fertilizer: Four farmers (two traditional and two modern farmers) in the sample used fertilizer. The traditional farmers used 16.1kg/ha at an average cost of US$5.8/ha, while the modern farmers used 18.4kg/ha at an average cost of US$5.5/ha (Table 4.3.2.1). Two farmers (one traditional and one modern) used *urea*, while the other traditional and modern farmers used *micronutrients* and *18-46-0*, respectively.

Herbicide: Fifteen farmers in the sample used herbicide, out of which six were traditional and nine were modern farmers. The traditional farmers used 2.1 liters/ha at an average cost of US$12.6/ha, while the modern farmers used 2.5 liters/ha at an average cost of US$15.00/ha (Table 4.3.2.1). All of the farmers used *Paraquat*.

Insecticide: Nine farmers used insecticide, out of which three were traditional farmers and six were modern farmers. Traditional farmers used 1.4 liters/ha at an average cost of US$14.1/ha, while the modern farmers used 0.4 liters/ha at an average cost of US$11.1/ha (Table 4.3.2.1). The most common insecticides used were *Methyl Parathion*, *Cialotrina* and *Endosulfan*.

Fungicide: Only one traditional farmer in the sample used fungicide. The farmer used 1.4g/ha at an average cost of US$14.4/ha (Table 4.3.2.1).

Equipment Hired: Eight farmers in the sample rented pumps for applying agrochemicals. Two of them were traditional farmers and the other six were modern farmers.

The traditional farmers used the pumps[27] for an average of 0.9 man-days/ha and paid an average amount of US$7.7/ha. The modern farmers used the pumps[26] for an average of 2.7 days/ha and paid an average of US$ 11.1/ha (Table 4.3.2.1).

Table 4.3.2.1. Average Quantity and Cost of Input Use Per Hectare by Type of Farmer, *Primera* 2000, *Yoro*, Honduras.

Item	Traditional (N= 6)			Modern (N=12)			Total (N=18)		
	n[a]	Qtty[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)
Seed (Kg/ha)	6	49.5	34.7	12	46.4	29.5	18	47.4	31.2
Fertilizer (Kg/ha)	2	16.1	5.8	2	18.4	5.5	4	17.3	5.6
Herbicide (l/ha)	6	2.1	12.6	9	2.5	15.0	15	2.3	14.0
Insecticide (l/ha)	3	1.4	14.1	6	0.4	11.1	9	0.7	12.1
Fungicide (g/ha)	1	1.4	14.4	0	NA	NA	1	1.4	14.4
Equipment Hire[c] (days/ha)	2	0.9	7.7	6	2.7	11.1	8	2.2	10.3

a/ Number farmers under each category using the particular item.
B/ Mean quantity
c/ Cost per hectare of equipment hire, mainly pump for applying fertilizer, fungicide and insecticide.

4.3.3 Profitability Analysis

Various measures of costs and returns are reported in the Table 4.3.3.1 and presented below.

Revenue:

Yield, Price and Gross Income (GI): On average, traditional farmers obtained a yield of 248.7kg/ha (S.D. = 238) and the modern farmers obtained 303.9kg/ha (S.D. =277). Traditional farmers received an average price of US$0.45/kg, while the modern farmers received US$0.47/kg. Traditional farmers' GI averaged US$111.9/ha, while it averaged US$142.9/ha for modern farmers.

[27] Hand sprayers and knap-sacks

Costs:

Total Enterprise Cost (TEC): For traditional farmers, TEC averaged US$341.7/ha, which consisted of the opportunity cost of family labor (45.2%), hired labor cost (29.5%), input cost (17.2%), the opportunity cost of equity capital (5.9%), and equipment hire cost (2.3%) (Table 4.3.3.2). Operating cost, excluding the opportunity cost of equity capital and family labor, was US$167.30/ha (Table 4.3.3.1).

For the modern farmers, TEC averaged US$203.9/ha, which consists of hired labor cost (37.7%), opportunity cost of family labor (25.8%), input cost (23.1%), opportunity cost of equity capital (8%), and equipment hire cost (5.5%) (Table 4.3.3.2). Operating cost, excluding the opportunity cost of equity capital and family labor, was US$135.2/ha.

Per unit Cost of Production (*i.e.* total enterprise cost divided by the average yield) for traditional farmers was US$1.37/ha compared to US$0.67/ha for modern farmers.

Returns:

Enterprise Gross Margin (EGM) (*i.e.* GI less Operating Cost) for traditional farmers averaged *minus* US$55.4/ha, while it averaged US$7.7/ha for modern farmers.

Return to Family Land, Labor and Management (RFLLM) (*i.e.* EGM less the opportunity cost of equity capital) for traditional farmers' averaged *minus* US$75.5/ha, while it averaged *minus* US$8.5/ha for modern farmers.

Return to Family Land, Labor and Management per Day (i.e. RFLLM divided by man-days of the family labor) for traditional farmers averaged *minus* US$1.1/day, while the modern farmers averaged *minus* US$0.3/day.

Return to Family Land and Management (*i.e.* TEC deducted from GI) for the traditional farmers averaged *minus* US$229.8/ha, while it averaged *minus* US$61.1/ha for the modern farmers.

Table 4.3.3.1. Average Yields, Prices, Costs and Returns by Type of Farmers, *Primera* 2000, *Yoro*, Honduras.

Items	Traditional (N=6)	Modern (N=12)	Sig. (t-test)[a]
Revenue:			
Average Yield (Kg./ha)	248.7	303.9	0.65
Adjusted Price (US$/Kg)	0.5	0.5	0.50
(1) Gross Income	111.9	142.9	0.50
Costs:			
Input Cost[b] (US$/ha)	58.7	47.2	0.31
Cost of Equipment (US$/ha)	7.7	11.1	0.72
Hired Labor Cost (US$/ha)	100.9	76.9	0.45
(2) Total Operating Cost (US$/ha)	167.3	135.2	
(3) Opportunity Cost of Equity Capital[c] (US$/ha)	20.1	16.2	
(4) Family Labor			
(4.1) Number of Family Labor Days/ha	71.2	24.3	0.07**
(4.2) Family Labor[d] Cost (US$/ha)	154.3	52.6	0.07**
(5) Total Enterprise Cost (US$/ha) [*2+3+4.2*]	341.7	203.9	
(6) Per Unit Cost[e] (US$/Kg)	1.4	0.7	
Profitability Measures			
(7) Enterprise Gross Margin (US$/ha) [*1-2*]	-55.4	7.7	0.08**
(8) Return to Family Land, Labor and Management (US$/ha) [*7-3*]	-75.5	-8.5	
(9) Return to Family Land, labor and Management per day (US$/day) [*8/4.1*]	-1.1	-0.3	
(10) Return to Family Land and Management (US$/ha) [*8-4.2 or 1-5*]	-229.8	-61.1	

a/ T-test for equality of means:

* Significant at 5% significance level.

** Significant at 10% significant level.

b/ Mean of the aggregated total cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).

c/ Opportunity cost of equity capital was valued at 12% of Operating Cost.

d/ Opportunity cost family labor was valued at the wage rate of US$2.17/Day.

e/ Computed by dividing total enterprise cost by average yield.

Table 4.3.3.1. Average Total Enterprise Cost (US$/ha), *Primera* 2000, *Yoro*, Honduras.

Item	Traditional (N=6)		Modern (N= 12)		Total (N=18)	
	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC
Input Cost[a]	58.7	17.2	47.2	23.1	51.0	21.8
Equipment Hire Cost[b]	7.7	2.3	11.1	5.5	10.3	4.4
Family Labor Cost	154.3	45.2	52.6	25.8	86.5	36.9
Hired Labor Cost	100.9	29.5	76.9	37.7	70.7	30.2
Equity Capital Cost	20.1	5.9	16.2	8.0	15.8	6.8
Total Enterprise Cost (TEC)	341.7	100.0	203.9	100.0	234.3	100.0

a/ Total aggregate mean of the cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).
b/ Hire of pump for applying fertilizer, fungicide and insecticide.

4.3.4 Sensitivity Analysis[28]:

The results of the sensitivity analysis are reported for traditional (Table 4.3.4.1) and modern (Table 4.3.4.2) farmers with respect to a ± 50 percent change of bean yield and price, holding operating cost[29] constant.

For traditional farmers (Table 4.3.4.1), holding operating cost (US$167.3/ha) and one of either yield (248.7kg/ha) or price (US$0.45/kg) constant, EGM (*minus* US$55.4/ha), became positive with a 50% increase in price or yield. Holding only the operating cost constant, EGM became positive with 30% increase in price and 20% increase in yield and *vice versa*.

For modern farmers (Table 4.3.4.2), holding operating cost (US$135.2/ha) and one of either yield (303.9kg/ha) or price (US$0.47) constant, EGM falls below zero with a 10% decrease in price or yield.

[28] Operating cost (input and hired labor cost) are held constant, assuming that yield changes are due to weather related risk.
[29] The operating costs do not include the opportunity cost of family labor and equity capital. Thus, the scenario will be worse if we included these cost.

Table 4.3.4.1 Traditional Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Primera 2000, Yoro, Honduras.

	Bean Price (US$/Kg)											
		0.23	0.27	0.32	0.36	0.41	0.45	0.5	0.54	0.59	0.63	0.68
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
124.36	-50%	-139.3	-133.7	-128	-122.5	-116.9	-111	-105.7	-100.2	-94.55	-88.95	-83.36
149.23	-40%	-133.7	-127	-120	-113.6	-106.9	-100	-93.43	-86.71	-80	-73.28	-66.57
174.1	-30%	-128.1	-120.3	-112	-104.6	-96.79	-89	-81.12	-73.28	-65.45	-57.61	-49.78
198.98	-20%	-122.5	-113.6	-105	-95.67	-86.71	-77.8	-68.81	-59.85	-50.9	-41.95	-32.99
223.85	-10%	-116.9	-106.9	-96.8	-86.71	-76.64	-66.6	-56.5	-46.42	-36.35	-26.28	-16.2
248.72	0%	-111.3	-100.2	-89	-77.76	-66.57	-55.4	-44.18	-32.99	-21.8	-10.61	0.59
273.59	10%	-105.7	-93.43	-81.1	-68.81	-56.5	-44.2	-31.87	-19.56	-7.25	5.06	17.37
298.46	20%	-100.2	-86.71	-73.3	-59.85	-46.42	-33	-19.56	-6.13	7.3	20.73	34.16
323.34	30%	-94.55	-80	-65.5	-50.9	-36.35	-21.8	-7.25	7.3	21.85	36.4	50.95
348.21	40%	-88.95	-73.28	-57.6	-41.95	-26.28	-10.6	5.06	20.73	36.4	52.07	67.74
373.08	50%	-83.36	-66.57	-49.8	-32.99	-16.2	0.59	17.37	34.16	50.95	67.74	84.53

Table 4.3.4.2. Modern Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Primera 2000, Yoro, Honduras.

	Bean Price (US$/Kg)											
		0.24	0.28	0.33	0.38	0.42	0.47	0.52	0.56	0.61	0.66	0.71
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
151.97	-50%	-99.5	-92.3	-85.16	-78	-70.9	-63.73	-56.59	-49.5	-42.31	-35.16	-28.02
182.36	-40%	-92.3	-83.73	-75.16	-66.6	-58	-49.45	-40.88	-32.3	-23.74	-15.16	-6.59
212.76	-30%	-85.2	-75.16	-65.16	-55.2	-45.2	-35.16	-25.16	-15.2	-5.16	4.83	14.83
243.15	-20%	-78	-66.59	-55.16	-43.7	-32.3	-20.88	-9.45	1.98	13.41	24.83	36.26
273.55	-10%	-70.9	-58.02	-45.16	-32.3	-19.5	-6.59	6.26	19.12	31.98	44.83	57.69
303.94	0%	-63.7	-49.45	-35.16	-20.9	-6.59	7.69	21.98	36.26	50.55	64.83	79.12
334.33	10%	-56.6	-40.88	-25.16	-9.45	6.26	21.98	37.69	53.4	69.12	84.83	100.6
364.73	20%	-49.5	-32.31	-15.16	1.98	19.12	36.26	53.4	70.55	87.69	104.8	122
395.12	30%	-42.3	-23.74	-5.16	13.41	31.98	50.55	69.12	87.69	106.26	124.8	143.4
425.52	40%	-35.2	-15.16	4.83	24.83	44.83	64.83	84.83	104.8	124.83	144.8	164.8
455.91	50%	-28	-6.59	14.83	36.26	57.69	79.12	100.55	122	143.4	164.8	186.3

4.4 ***Department: Olancho, Honduras, Postrera 1999.***

The sample included 9 farmers who planted traditional bean varieties and 11 farmers who planted modern bean varieties. In the discussion that follows, farmers who planted traditional varieties are referred to as traditional farmers and those who planted modern varieties are referred to as modern farmers.

4.4.1 Patterns and Costs of Labor Use

Labor Use by Type of Operation: On average, traditional farmers used 36.4man-days/ha, compared to 37.5man-days/ha for modern farmers (Table 4.4.1.1).

In addition, Table 4.4.1.1 reports the mean number of man-days and associated cost of family and hired labor, by farming operation, for modern and traditional farmers. Because the number of farmers who carried out each operation varied greatly, the mean reported is the mean man-days (costs) for those farmers who actually carried out the respective operations. In this regard, the sum of the means for family and hired labor man-days under each farming operation (Table 4.4.1.1) do not represent the total average man-days for the respective operation.

Table 4.4.1.1. Labor Use (average man-days/ha), *Postrera* 1999, *Olancho*, Honduras.

Operation and Labor Type	Traditional (N =9)				Modern (N =11)			
		No. of Days[a]		Cost		No. of Days[a]		Cost
	n	Mean	S.D.[b]	(US$/ha)[c]	n	Mean	S.D[b]	(US$/ha)[c]
Land Preparation:								
Family	9	6.3	13.8	16.6	5	3.2	2.2	8.4
Hired	6	8.7	5.7	18.9	10	8.9	4.6	23.4
Planting:								
Family	8	2.4	2.0	6.2	6	1.9	1.7	4.9
Hired	8	8.8	7.5	19.1	11	5.8	4.0	15.6
App. Fertilizer:								
Family	0	NA	NA	NA	0	NA	NA	NA
Hired	0	NA	NA	NA	2	2.7	0.8	7.3
App. Herbicide:								
Family	5	1.4	0.5	3.7	5	1.1	0.2	2.8
Hired	2	2.0	1.8	4.2	4	2.1	1.2	6.4
App. Insecticide:								
Family	3	1.1	0.3	2.8	3	1.1	0.3	2.9
Hired	0	NA	NA	NA	3	2.7	3.2	7.5
App. Fungicide:								
Family	0	NA	NA	NA	1	1.1	NA	2.8
Hired	0	NA	NA	NA	0	NA	NA	NA
Manual Weeding:								
Family	2	0.8	0.4	2.1	1	0.7		1.9
Hired	2	7.5	1.5	13.7	4	8.3	1.6	22.6
Harvesting:								
Family	9	1.0	0.8	2.7	7	2.7	3.4	7.0
Hired	9	6.9	4.7	13.3	10	9.7	3.3	24.3
Threshing:								
Family	7	0.7	0.4	2.0	6	0.9	0.4	2.3
Hired	7	2.2	1.7	7.5	10	4.0	1.5	13.1
Others:								
Family	2	2.7	2.3	7.0	0	NA	NA	NA
Hired	0	NA	NA	NA	0	NA	NA	NA
Total Mean[d]:								
Family	*9*	*12.0*	*16.7*	*31.5*	*10*	*6.2*	*6.1*	*16.2*
Hired	*9*	*24.4*	*19.4*	*52.7*	*11*	*31.3*	*14.6*	*84.9*
Total		***36.4***		***84.2***		***37.5***		***101.1***

Note: a/ converted from hours to number of days using 8 hours equal to one day.
b/ Standard Deviation of the number of days.
c/ Family Labor is valued at its opportunity cost.
d/ Calculated as the weighted average.

For the traditional farmers, the largest share of total labor was used for land preparation (33.4%), followed by planting (27.3%), harvesting (21.9%), threshing (6.3%), manual weeding (5.1%), agrochemical applications (4.4%), and a combination of other activities such as cleaning and watering (1.6%) (Table 4.4.1.2).

For modern farmers, the largest share of total labor was used for harvesting (28.4%), followed by land preparation (26.0%), planting (18.4%), threshing (11.1%), manual weeding (8.3%), and agrochemical application (7.8%) (Table 4.4.1.3).

With respect to their source of labor, traditional farmers' total labor consisted of 32.9% family labor and 67.1% hired labor, while modern farmers' total labor consisted of 15.2% family labor and 84.8% hired labor.

Table 4.4.1.2. Sum and Percentage of Traditional Farmers (N = 9) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Postrera 1999, Olancho*.

Type of Operation	**Family Labor[a] (man-days/ha)**	**%of TL[b]**	**Hired Labor[a] (man-days/ha)**	**% of TL[b]**	**Total Labor[c] (man-days/ha)**	**% of TL[b]**
Land Preparation	57.0	17.4	52.4	16.0	109.5	33.4
Planting	19.0	5.8	70.5	21.5	89.5	27.3
App. Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0
App. Herbicide	7.1	2.2	3.9	1.2	11.0	3.4
App. Insecticide	3.2	1.0	0.0	0.0	3.2	1.0
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	1.6	0.5	15.0	4.6	16.6	5.1
Harvesting	9.4	2.9	62.4	19.0	71.7	21.9
Threshing	5.3	1.6	15.4	4.7	20.7	6.3
Others	5.4	1.6	0.0	0.0	5.4	1.6
Total Labor Man-days	107.9	32.9	219.7	67.1	327.6	100.0

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
b/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
c/ Is the sum of family and hired labor man-days/ha.

Table 4.4.1.3 Sum and Percentage of Modern Farmers (N = 11) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Postrera* 1999, *Olancho*.

Type of Operation	Family Labor[a] (man-days/ha)	% of TL[b]	Hired Labor[a] (man-days/ha)	% of TL[b]	Total Labor[c] (man-days/ha)	% of TL[b]
Land Preparation	16.0	3.9	89.5	22.0	105.5	26.0
Planting	11.2	2.8	63.4	15.6	74.6	18.4
App. Fertilizer	0.0	0.0	5.4	1.3	5.4	1.3
App. Herbicide	5.4	1.3	8.5	2.1	13.9	3.4
App. Insecticide	3.3	0.8	8.2	2.0	11.5	2.8
App. Fungicide	1.1	0.3	0.0	0.0	1.1	0.3
Manual Weeding	0.7	0.2	33.1	8.1	33.8	8.3
Harvesting	18.8	4.6	96.7	23.8	115.5	28.4
Threshing	5.2	1.3	40.0	9.8	45.2	11.1
Others	0.0	0.0	0.0	0.0	0.0	0.0
Total Labor Man-days	61.7	15.2	344.8	84.8	406.5	100.0

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
b/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
c/ Is the sum of family and hired labor man-days/ha.

Labor Costs[30] by Type of Operations: Average total labor costs for the traditional farmers averaged US$84.2/ha, compared to US$101.1/ha for modern farmers (Table 4.4.1.1).

For traditional farmers, the largest share of total labor cost per hectare was for land preparation (34.7%), followed by planting (26.7%), harvesting (19.1%), threshing (8.8%), agrochemical applications (4.7%), manual weeding (4.2%), and a combination of other activities such as cleaning, watering and winnowing (1.9%) (Table 4.4.1.4).

For modern farmers, the largest share of total labor cost was for harvesting (26.7%), followed by land preparation (25.2%), planting (18.4%), threshing (13.2%), manual weeding (8.4%), and agrochemical applications (8.1%) (Table 4.4.1.5).

For traditional farmers, hired labor cost accounted for 62.6% of average total labor cost per hectare, compared to 85.2% for modern farmers.

[30] Family Labor is valued at the wage rate (i.e. US$2.63/day) for *postrera 1999*.

Table 4.4.1.4 Sum and Percentage of Traditional Farmers (N = 9) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Postrera* 1999, *Olancho*.

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	149.9	19.8	113.5	15.0	263.4	34.7
Planting	49.8	6.6	152.5	20.1	202.4	26.7
App. Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0
App. Herbicide	18.6	2.5	8.3	1.1	27.0	3.6
App. Insecticide	8.5	1.1	0.0	0.0	8.5	1.1
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	4.2	0.6	27.5	3.6	31.7	4.2
Harvesting	24.6	3.2	119.8	15.8	144.5	19.1
Threshing	13.8	1.8	52.6	6.9	66.5	8.8
Others	14.1	1.9	0.0	0.0	14.1	1.9
Total Labor Cost	283.6	37.4	474.3	62.6	757.9	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
b/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
c/ Is the sum of family and hired labor cost per hectare.

Table 4.4.1.5 Sum and Percentage of Modern Farmers (N = 11) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Postrera* 1999, *Olancho*.

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	42.0	3.8	233.7	21.3	275.7	25.2
Planting	29.5	2.7	171.8	15.7	201.3	18.4
App. Fertilizer	0.0	0.0	14.7	1.3	14.7	1.3
App. Herbicide	14.2	1.3	25.8	2.4	40.0	3.7
App. Insecticide	8.6	0.8	22.6	2.1	31.1	2.8
App. Fungicide	2.8	0.3	0.0	0.0	2.8	0.3
Manual Weeding	1.9	0.2	90.6	8.3	92.5	8.4
Harvesting	49.4	4.5	243.0	22.2	292.4	26.7
Threshing	13.7	1.2	131.3	12.0	145.0	13.2
Others	0.0	0.0	0.0	0.0	0.0	0.0
Total Lab;or Cost	162.1	14.8	933.4	85.2	1095.5	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
b/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
c/ Is the sum of family and hired labor cost per hectare by operation.

4.4.2 Patterns and Costs of Input Use

Seed: Farmers in the sample most commonly used seed saved from previous harvest. From the sample of 20 farmers, nine farmers planted traditional varieties and 11 farmers planted modern varieties. The average seed rate for traditional farmers was 46.7kg/ha at an

average cost of US$27.5/ha, while the modern farmers seed rate was 51.4kg/ha at an average cost of US$28.5/ha (Table 4.4.2.1). Traditional farmers planted *Chimino* and *Rojo*, while the modern farmers planted *TC-75* and *Dorado*.

Fertilizer: None of the traditional farmers in the sample used fertilizer, while one modern farmer did. The modern farmer used 0.8kg/ha of *Foliar Fertilizer* at a cost of US$5.5/ha (Table 4.4.2.1).

Herbicide: Twelve farmers in the sample used herbicide, out of which five were traditional farmers and seven were modern farmers. Traditional farmers used an average of 1.7 liters/ha at an average cost of US$13.7/ha, while the modern farmers used 1.4 liters/ha at an average cost of US$10.1/ha (Table 4.4.2.1). Most of the farmers applied *Paraquat*, while few applied *Fluziflop*.

Insecticide: Eight farmers in the sample used insecticide, out of which three were traditional farmers and five were modern farmers. Traditional farmers used an average of 0.6 liters/ha at an average cost of US$4.8/ha, while the modern farmers used an average of 0.8 liters/ha at an average cost of US$5.8/ha (Table 4.4.2.1). Almost all the farmers who applied insecticide used *Methyl Parathion*, while one of them used *Methamidifos*.

Fungicide: None of the traditional farmers used fungicide, while one modern farmer used 1.4g/ha at a cost of US$14.7/ha (Table 4.4.2.1).

Traction Contract: Nineteen farmers in the sample used animal traction for primary land tillage, out of which eight were traditional farmers and eleven were modern farmers. Traditional farmers used animal traction equal to 4.8 days/ha at an average cost of US$36.2/ha, while the modern farmers used animal traction equal to 5.1 days/ha at an average cost of US$36.1/ha (Table 4.4.2.1).

Table 4.4.2.1. Average Quantity and Cost of Input Use Per Hectare by Type of Farmer, *Postrera 1999, Olancho*, Honduras.

Item	Traditional (N=9)			Modern (N=11)			Total (N=20)		
	n[a]	Qtty[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)
Seed (Kg/ha)	9	46.7	27.5	11	51.4	28.5	20	49.4	27.7
Fertilizer (Kg/ha)	0	NA	NA	1	0.8	5.5	1	0.8	5.5
Herbicide (l/ha)	5	1.7	13.7	7	1.4	10.1	12	1.5	11.6
Insecticide (l/ha)	3	0.6	4.8	5	0.8	5.8	8	0.7	5.5
Fungicide (g/ha)	0	NA	NA	1	1.4	14.7	1	1.4	14.7
Traction Contract[c] (days/ha)	8	4.8	36.3	11	5.1	36.1	19	5.0	36.2

a/ Number farmers under each category using the particular item.
b/ Mean quantity
c/ Cost per hectare of oxen hired/used for land preparation.

4.4.3 Profitability Analysis

Various measures of costs and returns are reported in the Table 4.4.3.1 and presented below.

Revenue:

Yield, Price and Gross Income (GI): On average, traditional farmers obtained a yield of 361.4kg/ha (S.D. = 153) and the modern farmers obtained 641.7kg/ha (S.D. = 306). Traditional farmers received an average price of US$0.52/kg, while the modern farmers received US$0.51/kg. GI for traditional farmers averaged US$187.9/ha, while it averaged US$327.3/ha for modern farmers.

Costs:

Total Enterprise Cost (TEC): For traditional farmers, TEC averaged US$176.0/ha, which consist of hired labor cost (29.9%), input cost (22.7%), animal traction cost (20.6%), opportunity cost of family labor (17.9%), and the opportunity cost of equity capital (8.8%) (Table 4.4.3.2). Operating cost, excluding opportunity cost of equity capital and family labor, was US$128.99/ha (Table 4.4.3.1).

For modern farmers, TEC was US$193.7/ha, which consists of hired labor cost (43.8%), input cost (19.4%), animal traction cost (18.7%), opportunity cost of equity capital (9.8%), and opportunity cost of family labor (8.4%) (Table 4.4.3.2). Operating cost, excluding the opportunity cost of equity capital and family labor, was US$158.5/ha (Table 4.4.3.1).

Per unit Cost of Production (*i.e.* total enterprise cost divided by the average yield) for traditional farmers was US$0.49/ha compared to US$0.30/ha for modern farmers.

Returns:

Enterprise Gross Margin (EGM) (*i.e.* GI less operating cost) for traditional farmers averaged US$58.9/ha, while it averaged US$168.8/ha for modern farmers.

Return to Family Land, Labor and Management (RFLLM) (*i.e.* EGM less the opportunity cost of equity capital) for traditional farmers' averaged US$43.4/ha, compared to US$149.8/ha for modern farmers.

Return to Family Land, labor and Management per Day (*i.e.* RFLLM divided by the number of family labor days) for traditional farmers' averaged US$3.6/day, while the modern farmers' averaged US$24.2/day.

Return to Family Land and Management (*i.e*. TEC deducted from GI) for traditional farmers was US$11.9/ha, while it was US$133.6/ha for the modern farmers (Table 4.4.3.1).

Table 4.4.3.1. Average Yields, Prices, Costs and Returns by Type of Farmers, *Postrera* 1999, *Olancho*, Honduras.

Items	Traditional (N=9)	Modern (N=11)	Sig. (t-test)[a]
Revenue:			
Average Yield (Kg./ha)	361.4	641.7	0.02*
Adjusted Price (US$/Kg)	0.5	0.5	0.49
(1) Gross Income (US$/ha)	187.9	327.3	0.04*
Costs:			
Input Cost[b] (US$/ha)	40.0	37.5	0.70
Traction Contract Cost (US$/ha)	36.3	36.1	0.99
Hired Labor Cost (US$/ha)	52.7	84.9	0.12***
(2) Total Operating Cost (US$/ha)	129.0	158.5	
(3) Opportunity Cost of Equity Capital[c] (US$/ha)	15.5	19.0	
(4) Family Labor			
(4.1) Number of Family Labor Days/ha	12.0	6.2	0.30
(4.2) Family Labor Cost[d] (US$/ha)	31.5	16.2	0.30
(5) Total Enterprise Cost (US$/ha) [*2+3+4.2*]	176.0	193.7	
(6) Per Unit Cost[e] (US$/kg)	0.5	0.3	
Profitability Measures			
(7) Enterprise Gross Margin (US$/ha) [*1-2*]	58.9	168.8	0.07**
(8) Return to Family Land, Labor and Management (US$/ha) [*7-3*]	43.4	149.8	
(9) Returns to Family Land, Labor and Management per Day (US$/day) [*8/4.1*]	3.6	24.2	
(10) Return to Family Land and Management (US$/ha) [*8-4.2 or 1-5*]	11.9	133.6	

a/ T-test for equality of means:

* Significant at 5% significance level.

** Significant at 10% significant level.

B/ Mean of the aggregated total cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).

C/ Opportunity cost of equity capital was valued at 12% of Operating Cost.

D/ Opportunity cost family labor was valued at the wage rate of US$2.63/Day.

E/ Computed by dividing total enterprise cost by average yield.

Table 4.4.3.2. Average Total Enterprise Cost (US$/ha), *Postrera* 1999, *Olancho*, Honduras.

Item	Traditional (N=9)		Modern (N=11)		Total (N=20)	
	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC
Input Cost[a]	40.0	22.7	37.5	19.4	38.6	20.4
Traction Contract Cost[b]	36.3	20.6	36.1	18.7	36.2	19.1
Family Labor cost	31.5	17.9	16.2	8.4	23.5	12.4
Hired Labor Cost	52.7	29.9	84.9	43.8	73.4	38.7
Equity Capital Cost	15.5	8.8	19.0	9.8	17.8	9.4
Total Enterprise Cost (TEC)	176.0	100.0	193.7	100.0	189.4	100.0

a/ Total aggregate mean of the cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).
B/ Cost per hectare of animal traction for land preparation.

4.4.4 Sensitivity Analysis[31]:

The results of the sensitivity analysis are reported for traditional (Table 4.4.4.1) and modern (Table 4.4.4.2) farmers with respect to a ± 50 percent change in bean yield and bean price, holding operating cost[32] constant.

For traditional farmers (Table 4.4.4.1), holding operating cost (US$129.0/ha) and one of either yield (361.4kg/ha) or price (US$0.52/kg) constant, EGM falls below zero with a 40% decrease in price or yield. Holding operating cost constant, EGM falls below zero with a 20% decrease in price and yield.

For modern farmers (Table 4.4.4.2), holding operating cost (US$158.5) and one of either yield (641.7kg/ha) or price (US$0.51/kg) constant, EGM remained *positive* with a 50% decrease in price or yield. Holding operating cost constant at US$ 158.5/ha, EGM would fall below zero with a 20% decrease in yield and 40% decrease in price and *vice versa*.

[31] Operating cost (input and hired labor cost) are held constant, assuming that yield changes are due to weather related risk.
[32] The operating costs do not include the opportunity cost of family labor and equity capital. Thus, the positive scenario may change if we included these cost.

Table 4.4.4.1 Traditional Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Postrera 1999, Olancho, Honduras.

	Bean Price (US$/Kg)											
		0.26	0.31	0.36	0.42	0.47	0.52	0.57	0.62	0.68	0.73	0.78
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
180.69	-50%	-82.01	-72.62	-63.22	-53.83	-44.43	-35.03	-25.64	-16.24	-6.85	2.55	11.94
216.82	-40%	-72.62	-61.34	-50.07	-38.79	-27.52	-16.24	-4.97	6.31	17.58	28.86	40.13
252.96	-30%	-63.22	-50.07	-36.91	-23.76	-10.61	2.55	15.7	28.86	42.01	55.16	68.32
289.1	-20%	-53.83	-38.79	-23.76	-8.73	6.31	21.34	36.37	51.41	66.44	81.47	96.5
325.23	-10%	-44.43	-27.52	-10.61	6.31	23.22	40.13	57.04	73.96	90.87	107.78	124.69
361.37	0%	-35.03	-16.24	2.55	21.34	40.13	58.92	77.71	96.5	115.3	134.09	152.88
397.51	10%	-25.64	-4.97	15.7	36.37	57.04	77.71	98.38	119.05	139.72	160.4	181.07
433.64	20%	-16.24	6.31	28.86	51.41	73.96	96.5	119.05	141.6	164.15	186.7	209.25
469.78	30%	-6.85	17.58	42.01	66.44	90.87	115.3	139.72	164.15	188.58	213.01	237.44
505.92	40%	2.55	28.86	55.16	81.47	107.78	134.09	160.4	186.7	213.01	239.32	265.63
542.06	50%	11.94	40.13	68.32	96.5	124.69	152.88	181.07	209.25	237.44	265.63	293.81

Table 4.4.4.2 Modern Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Postrera 1999, Olancho, Honduras.

	Bean Price (US$/Kg)											
		0.26	0.31	0.36	0.41	0.46	0.51	0.56	0.61	0.66	0.71	0.77
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
320.84	-50%	-76.67	-60.3	-43.94	-27.58	-11.21	5.15	21.51	37.87	54.24	70.6	86.96
385.01	-40%	-60.3	-40.67	-21.03	-1.4	18.24	37.87	57.51	77.14	96.78	116.42	136.05
449.18	-30%	-43.94	-21.03	1.88	24.78	47.69	70.6	93.51	116.42	139.32	162.23	185.14
513.34	-20%	-27.58	-1.4	24.78	50.96	77.14	103.33	129.51	155.69	181.87	208.05	234.23
577.51	-10%	-11.21	18.24	47.69	77.14	106.6	136.05	165.5	194.96	224.41	253.86	283.32
641.68	0%	5.15	37.87	70.6	103.33	136.05	168.78	201.5	234.23	266.95	299.68	332.41
705.85	10%	21.51	57.51	93.51	129.51	165.5	201.5	237.5	273.5	309.5	345.5	381.49
770.02	20%	37.87	77.14	116.42	155.69	194.96	234.23	273.5	312.77	352.04	391.31	430.58
834.18	30%	54.24	96.78	139.32	181.87	224.41	266.95	309.5	352.04	394.58	437.13	479.67
898.35	40%	70.6	116.42	162.23	208.05	253.86	299.68	345.5	391.31	437.13	482.94	528.76
962.52	50%	86.96	136.05	185.14	234.23	283.32	332.41	381.49	430.58	479.67	528.76	577.85

4.5 ***Department: Olancho, Honduras, Primera 1999.***

The sample included 10 farmers, who planted traditional bean varieties and nine farmers, who planted modern bean varieties. In the discussion that follows, farmers who planted traditional varieties are referred to as traditional farmers and those who planted modern varieties are referred to as modern farmers.

4.5.1 Patterns and Costs of Labor Use

Labor Use by Type of Operation: On average, traditional farmers used a total of 34.6man-days/ha, compared to 46.8man-days/ha for modern farmers (Table 4.5.1.1).

In addition, Table 4.5.1.1 reports the mean number of man-days and associated cost of family and hired labor, by farming operation, for modern and traditional farmers. Because the number of farmers who carried out each operation varied greatly, the mean reported is the mean man-days (costs) for those farmers who actually carried out the respective operations. In this regard, the sum of the means for family and hired labor man-days under each farming operation (Table 4.5.1.1) do not represent the total average man-days for the respective operation.

Table 4.5.1.1. Labor Use (average man-days/ha), *Primera*, 1999, *Olancho*, Honduras.

Operation and Labor Type	Traditional (N =10)				Modern (N =9)			
		No. of Days[a]		Cost		No. of Days[a]		Cost
	n	Mean	S.D.[b]	(US$/ha)[c]	n	Mean	S.D[b]	(US$/ha)[c]
Land Preparation:								
Family	9	3.4	3.3	9.2	6	1.9	0.6	5.2
Hired	8	4.3	3.6	10.7	8	8.6	5.7	21.7
Planting:								
Family	9	1.7	1.6	4.5	4	1.6	.9	4.4
Hired	9	5.0	3.5	11.3	9	7.0	4.3	15.2
App. Fertilizer:								
Family	0	NA	NA	NA	0	NA	NA	NA
Hired	0	NA	NA	NA	2	1.671	0.8	3.8
App. Herbicide:								
Family	6	1.7	0.7	4.5	4	1.7	1.7	4.5
Hired	3	2.3	1.8	6.0	5	2.2	1.6	6.7
App. Insecticide:								
Family	1	1.1		2.9	1	1.1	0	2.9
Hired	2	2.1	0	5.6	3	1.4	0.6	3.9
App. Fungicide:								
Family	0	NA	NA	NA	0	NA	NA	NA
Hired	0	NA	NA	NA	0	NA	NA	NA
Manual Weeding:								
Family	8	3.8	5.5	10.2	3	1.9	1.1	5.1
Hired	8	6.0	4.0	14.7	8	10.6	5.5	25.7
Harvesting:								
Family	6	2.9	4.9	8.0	4	1.2	0.6	3.4
Hired	8	7.4	6.6	14.8	8	11.2	6.4	26.6
Threshing:								
Family	4	0.9	0.4	2.5	4	1.2	0.6	3.4
Hired	8	3.3	2.5	10.2	9	4.4	3.2	16.2
Others:								
Family	3	0.2	0.0	0.6	1	2.5	NA	6.7
Hired	0	NA	NA	NA		NA	NA	NA
Total Mean[d]:								
Family	*9*	*12.1*	*14.5*	*32.6*	*7*	*6.3*	*4.3*	*17.0*
Hired	*10*	*22.5*	*19.1*	*52.3*	*9*	*40.5*	*15.7*	*103.1*
Total		***34.6***		***84.9***		***46.8***		***120.0***

Note: a/ converted from hours to number of days using 8 hours equal to one day.
B/ Standard Deviation of the number of days.
C/ Family Labor is valued at its opportunity cost.
D/ Calculated as the weighted average.

For the traditional farmers, the largest share of total labor was used for manual weeding (23.6%), followed by harvesting (23.1%), land preparation (19.6%), planting (17.9%), threshing (9.0%), agrochemical applications (6.7%), and a combination of other activities such as cleaning and watering (0.2%) (Table 4.5.1.2).

For modern farmers, the largest share of total labor was used for harvesting (23.2%), followed by manual weeding (22.2%), land preparation (19.6%), planting (17.0%), threshing (10.9%), agrochemical application (6.4%), and a combinations of other activities (0.6%) (Table 4.5.1.3).

With respect to their source of labor, traditional farmers' total labor consisted of 32.7% family labor and 67.3% hired labor, while modern farmers' total labor consisted of 10.8% family labor and 89.2% hired labor (Table 4.5.1.3).

Table 4.5.1.2 Sum and Percentage of Traditional Farmers (N = 10) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Primera 1999, Olancho*.

Type of Operation	**Family Labor[a] (man-days/ha)**	**%of TL[b]**	**Hired Labor[a] (man-days/ha)**	**% of TL[b]**	**Total Labor[c] (man-days/ha)**	**% of TL[b]**
Land Preparation	30.8	9.2	34.7	10.4	65.5	19.6
Planting	15.0	4.5	44.7	13.4	59.7	17.9
App. Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0
App. Herbicide	10.1	3.0	6.8	2.0	16.9	5.1
App. Insecticide	1.1	0.3	4.3	1.3	5.4	1.6
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	30.4	9.1	48.4	14.5	78.8	23.6
Harvesting	17.6	5.3	59.5	17.8	77.1	23.1
Threshing	3.8	1.1	26.3	7.9	30.1	9.0
Others	0.6	0.2	0.0	0.0	0.6	0.2
Total Labor Man-days	109.3	32.7	224.7	67.3	334.1	100.0

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
B/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
C/ Is the sum of family and hired labor man-days/ha.

Table 4.5.1.3 Sum and Percentage of Modern Farmers (N = 9) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Primera* 1999, *Olancho*.

Type of Operation	Family Labor[a] (man-days/ha)	% of TL[b]	Hired Labor[a] (man-days/ha)	% of TL[b]	Total Labor[c] (man-days/ha)	% of TL[b]
Land Preparation	11.6	2.8	68.5	16.8	80.1	19.6
Planting	6.6	1.6	62.9	15.4	69.5	17.0
App. Fertilizer	0.0	0.0	3.2	0.8	3.2	0.8
App. Herbicide	6.7	1.6	11.0	2.7	17.7	4.3
App. Insecticide	1.1	0.3	4.3	1.0	5.4	1.3
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	5.7	1.4	85.0	20.8	90.7	22.2
Harvesting	5.0	1.2	90.0	22.0	95.0	23.2
Threshing	5.0	1.2	39.7	9.7	44.7	10.9
Others	2.5	0.6	0.0	0.0	2.5	0.6
Total Labor Man-days	44.2	10.8	364.6	89.2	408.8	100.0

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
B/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
C/ Is the sum of family and hired labor man-days/ha.

Labor Costs[33] by Type of Operations: Total labor costs for the traditional farmers averaged US$84.9/ha, compared to US$120.0/ha for modern farmers (Table 4.5.1.1).

For traditional farmers, the largest share of total labor cost per hectare was for manual weeding (24.4%), followed by land preparation (20.6%), harvesting (20.3%), planting (16.0%), threshing (11.2%), agrochemical applications (7.2%), and a combination of other activities such as cleaning, watering and winnowing (0.2%) (Table 4.5.1.4).

For modern farmers, the largest share of total labor cost was for harvesting (21.6%), followed by manual weeding (21.2%), land preparation (19.6%), threshing (15.2%), planting (14.8%), agrochemical applications (7.0%), and a combinations of other activities (0.6%) (Table 4.5.1.5).

For traditional farmers, hired labor cost accounted for 64.0% of average total labor cost per hectare, compared to 88.7% for modern farmers.

[33] Family Labor is valued at the wage rate (i.e. US$2.69/day) for *primera 1999*.

Table 4.5.1.4 Sum and Percentage of Traditional Farmers (N = 10) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Primera* 1999, *Olancho*.

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	82.7	10.1	85.9	10.5	168.5	20.6
Planting	40.2	4.9	90.5	11.1	130.7	16.0
App. Fertilizer	0.0	0.0	0.0	0.0	0.0	0.0
App. Herbicide	27.2	3.3	17.9	2.2	45.1	5.5
App. Insecticide	2.9	0.4	11.3	1.4	14.1	1.7
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	81.6	10.0	117.7	14.4	199.2	24.4
Harvesting	47.4	5.8	118.6	14.5	165.9	20.3
Threshing	10.1	1.2	81.3	10.0	91.4	11.2
Others	1.7	0.2	0.0	0.0	1.7	0.2
Total Labor Cost	293.7	36.0	523.0	64.0	816.7	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
B/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
C/ Is the sum of family and hired labor cost per hectare.

Table 4.5.1.5 Sum and Percentage of Modern Farmers (N = 9) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Primera* 1999, *Olancho*.

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	31.1	3.0	173.8	16.6	204.9	19.6
Planting	17.8	1.7	136.7	13.1	154.4	14.8
App. Fertilizer	0.0	0.0	7.7	0.7	7.7	0.7
App. Herbicide	17.9	1.7	33.6	3.2	51.5	4.9
App. Insecticide	2.9	0.3	11.8	1.1	14.6	1.4
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	15.4	1.5	206.0	19.7	221.4	21.2
Harvesting	13.5	1.3	212.6	20.3	226.1	21.6
Threshing	13.5	1.3	145.7	13.9	159.1	15.2
Others	6.7	0.6	0.0	0.0	6.7	0.6
Total Labor Cost	118.7	11.3	927.8	88.7	1046.5	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
B/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
C/ Is the sum of family and hired labor cost per hectare by operation.

4.5.2 Patterns and Costs of Input use

Seed: Most of the farmers in the sample planted seed saved from the previous harvest. From the sample of 19 farmers, 10 farmers used traditional varieties and nine farmers used modern varieties. Traditional farmers used an average seed rate of 41.8kg/ha at an average

cost of US$22.9/ha, while the modern farmers used an average seed rate of 53.1kg/ha at an average cost of US$42.7/ha (Table 4.5.2.1). Traditional varieties grew were *Chimino*, *Rojo* and *Olanchito* and the modern varieties grew were *Dorado*, *TC-75* and *Danli*.

Fertilizer: None of the traditional farmers used fertilizers, while two modern farmers used *12-24-12.* These modern farmers used an average quantity of 97.4kg/ha at an average cost of US$19.9/ha (Table 4.5.2.1).

Herbicide: Thirteen farmers in the sample used herbicide, of which six were traditional farmers and seven were modern farmers. Traditional farmers used an average of 2.2 liters/ha at an average cost of US$12.8/ha, while the modern farmers used an average of 2.2 liters/ha at an average cost of US$15.4/ha (Table 4.5.2.1). Twelve farmers used *Paraquat* and one farmer used *Fluziflop.*

Insecticide: Two traditional farmers and three modern farmers used insecticide. Traditional farmers used an average of 0.9 liters/ha at an average cost of US$5.2/ha, while the modern farmers used 0.7 liters/ha at an average cost of US$3.4/ha (Table 4.5.2.1). All these farmers used *Methyl Parathion*.

Fungicide: None of the farmers in the sample used fungicide.

Traction Contract: Eighteen farmers in the sample used animal traction for primary tillage[34], of which ten were traditional farmers and eight were modern farmers. Traditional farmers used animal traction equal of 4.5 days/ha at an average cost of US$35.0/ha, while the modern farmers used animal traction equal to 5.9 days/ha at an average cost of US$32.8/ha (Table 4.5.2.1).

[34] Ploughing and row making.

Table 4.5.2.1. Average Quantity and Cost of Input Use Per Hectare by Type of Farmer, *Primera 1999, Olancho*, Honduras.

Item	Traditional (N=10)			Modern (N=9)			Total (N=19)		
	n[a]	Qtty[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)
Seed (Kg/ha)	10	41.8	22.9	8	53.1	42.7	18	46.5	31.7
Fertilizer (Kg/ha)	0	NA	NA	2	97.4	19.9	2	97.4	19.9
Herbicide (l/ha)	6	2.2	12.8	7	2.2	15.4	13	2.2	14.2
Insecticide (l/ha)	2	0.9	5.2	3	0.7	3.4	5	0.8	4.1
Fungicide (g/ha)	0	NA	NA	0	NA	NA	0	NA	NA
Traction Contract[c] (days/ha)	10	4.5	35.0	8	5.9	32.8	18	5.1	34.0

a/ Number farmers under each category using the particular item.
b/ Mean quantity
c/ Cost per hectare of oxen hired/used for land preparation.

4.5.3 Profitability Analysis

Various measures of costs and returns are reported in the Table 4.5.3.1 and presented below.

Revenue:

Yield, Price and Gross Income (GI): On average, traditional farmers obtained a yield of 325.1kg/ha (S.D. = 207) and the modern farmers obtained 707.4kg/ha (S.D. = 440). Traditional farmers received an average price of US$0.49/kg and the modern farmers received US$0.51/kg. Traditional farmers earned a GI of US$159.3/ha, while the modern farmers earned US$360.8/ha.

Costs:

Total Enterprise Cost (TEC): For traditional farmers, TEC averaged US$161.8/ha, which consist of hired labor cost (32.3%), animal traction cost (21.7%), opportunity cost of family labor (20.2%), input cost (17.3%), and the opportunity cost of equity capital (8.6%) (Table 4.5.3.2). Operating cost, excluding opportunity cost of equity capital and family labor, was US$115.30/ha (Table 4.5.3.1).

For modern farmers, TEC was US$231.2/ha, which consists of hired labor cost (44.6%), input cost (24.0%), animal traction cost (14.2%), opportunity cost of equity capital (9.9%), and opportunity cost of family labor (7.3%) (Table 4.5.3.2). Operating cost, excluding opportunity cost of equity capital and family labor, was US$191.3/ha (Table 4.5.3.1).

Per unit Cost of Production (*i.e.* total enterprise cost divided by the average yield) for traditional farmers was US$0.50/ha compared to US$0.33/ha for modern farmers.

Returns:

Enterprise Gross Margin (EGM) (*i.e.* GI less operating cost) for traditional farmers averaged US$44.0/ha, compared to US$169.5/ha for modern farmers.

Return to Family Land, Labor and Management (RFLLM) (*i.e.* EGM less the opportunity cost of equity capital) for traditional farmers' averaged US$30.1/ha, while it averaged US$146.5/ha for modern farmers.

Return to Family Land, Labor and Management per Day (*i.e.* RFLLM divided by number of family labor days) for traditional farmers' averaged US$2.5/day, while it averaged US$23.2/day for modern farmers.

Return to Family Land and Management (*i.e.* TEC deducted from GI) for traditional farmers averaged *minus* US$2.5/ha, while it averaged US$129.6/ha for the modern farmers.

Table 4.5.3.1 Average Yields, Prices, Costs and Returns by Type of Farmers, *Primera* 1999, *Olancho*, Honduras.

Items	Traditional (N=10)	Modern (N=9)	Sig. (t-test)[a]
Revenue:			
Average Yield (Kg./ha)	325.1	707.4	0.04*
Adjusted Price (US$/Kg)	0.5	0.5	0.37
(1) Gross Income (US$/ha)	159.3	360.8	0.03*
Costs:			
Input Cost[b] (US$/ha)	28.0	55.5	0.02*
Traction Contract Cost (US$/ha)	35.0	32.8	0.82
Hired Labor Cost (US$/ha)	52.3	103.1	0.04*
(2) Total Operating Cost (US$/ha)	115.3	191.3	
(3) Opportunity Cost of Equity Capital[c] (US$/ha)	13.8	23.0	
(4) Family Labor			
(4.1) Number of Family Labor Days/ha	12.1	6.3	0.23
(4.2) Family Labor Cost[d] (US$/ha)	32.6	17.0	0.23
(5) Total Enterprise Cost (US$/ha) [*2+3+4.2*]	161.8	231.2	
(6) Per Unit Cost[e] (US$/kg)	0.5	0.3	
Profitability Measures			
(7) Enterprise Gross Margin (US$/ha) [*1-2*]	44.0	169.5	0.09**
(8) Return to Family Land, Labor and Management (US$/ha) [*7-3*]	30.1	146.5	
(9) Returns to Family Land, Labor and Management per Day (US$/day) [*8/4.1*]	2.5	23.2	
(10) Return to Land and Management (US$/ha) [*8-4.2 or 1-5*]	-2.5	129.6	

a/ T-test for equality of means:

* Significant at 5% significance level.

** Significant at 10% significant level.

b/ Mean of the aggregated total cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).

c/ Opportunity cost of equity capital was valued at 12% of Operating Cost.

d/ Opportunity cost family labor was valued at the wage rate of US$2.69/Day.

e/ Computed by dividing total enterprise cost by average yield.

Table 4.5.3.2. Average Total Enterprise Cost (US$/ha), *Primera* 1999, *Olancho*, Honduras.

Item	Traditional (N=10)		Modern (N=9)		Total (N=19)	
	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC
Input Cost[a]	28.0	17.3	55.5	24.0	41.7	21.3
Traction Contract Cost[b]	35.0	21.7	32.8	14.2	34.0	17.3
Family Labor cost	32.6	20.2	17.0	7.3	25.8	13.1
Hired Labor Cost	52.3	32.3	103.1	44.6	76.4	38.9
Equity Capital Cost	13.8	8.6	23.0	9.9	18.3	9.3
Total Enterprise Cost (TEC)	161.8	100.0	231.2	100.0	196.1	100.0

a/ Total aggregate mean of the cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).

b/ Cost per hectare of oxen hired/used for land preparation.

4.5.4 Sensitivity Analysis[35]:

The results of the sensitivity analysis are reported for traditional (Table 4.5.4.1) and modern (Table 4.5.4.2) farmers with respect to a ± 50 percent change in bean price and yield, holding operating cost[36] constant.

For traditional farmers (Table 4.5.4.1), holding operating cost (US$115.3/ha) and one of either yield (325.1kg/ha) or price (US$0.49/kg) constant, EGM falls below zero with a 30% decrease in price or yield. Holding operating cost constant, EGM falls below zero with a 10% decrease in price and 20% decrease in yield and *vice versa*.

For modern farmers (Table 4.5.4.2), holding operating cost (US$191.3) and one of either yield (707.4kg/ha) or price (US$0.51/kg) constant, EGM falls below zero with a 50% decrease in price or yield. Holding operating cost constant at US$ 191.3/ha, EGM would fall below zero with a 30% decrease in yield and price.

Table 4.5.4.1 Traditional Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Primera 1999, Olancho, Honduras.

		Bean Price (US$/Kg)										
		0.25	0.29	0.34	0.39	0.44	0.49	0.54	0.59	0.64	0.69	0.74
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
162.53	-50%	-75.48	-67.5	-59.55	-51.59	-43.63	-35.66	-27.7	-19.74	-11.8	-3.81	4.16
195.03	-40%	-67.52	-58	-48.4	-38.85	-29.29	-19.74	-10.18	-0.62	8.93	18.49	28.05
227.54	-30%	-59.55	-48.4	-37.26	-26.11	-14.96	-3.81	7.34	18.49	29.64	40.79	51.94
260.04	-20%	-51.59	-38.9	-26.11	-13.36	-0.62	12.12	24.86	37.6	50.35	63.09	75.83
292.55	-10%	-43.63	-29.3	-14.96	-0.62	13.71	28.05	42.38	56.72	71.05	85.39	99.72
325.05	0%	-35.66	-19.7	-3.81	12.12	28.05	43.97	59.9	75.83	91.76	107.7	123.6
357.56	10%	-27.7	-10.2	7.34	24.86	42.38	59.9	77.42	94.94	112.5	130	147.5
390.06	20%	-19.74	-0.62	18.49	37.6	56.72	75.83	94.94	114.1	133.2	152.3	171.4
422.57	30%	-11.77	8.93	29.64	50.35	71.05	91.76	112.5	133.2	153.9	174.6	195.3
455.07	40%	-3.81	18.49	40.79	63.09	85.39	107.7	130	152.3	174.6	196.9	219.2
487.58	50%	4.16	28.05	51.94	75.83	99.72	123.6	147.5	171.4	195.3	219.2	243.1

[35] Operating cost (input and hired labor cost) are held constant, assuming that yield changes are due to weather related risk.

[36] The operating costs do not include the opportunity cost of family labor and equity capital. Thus, the positive scenario will change if we included these cost.

Table 4.5.4.2. Modern Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Primera 1999, Olancho, Honduras.

	Bean Price (US$/Kg)											
		0.26	0.31	0.36	0.41	0.46	0.51	0.56	0.61	0.66	0.71	0.77
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
353.72	-50%	-101.1	-83.06	-65	-46.98	-28.94	-10.9	7.13	25.17	43.21	61.25	79.29
424.46	-40%	-83.06	-61.42	-39.8	-18.12	3.53	25.17	46.82	68.47	90.12	111.8	133.4
495.2	-30%	-65.02	-39.77	-14.5	10.74	36	61.25	86.51	111.8	137	162.3	187.5
565.94	-20%	-46.98	-18.12	10.74	39.61	68.47	97.33	126.2	155.1	183.9	212.8	241.7
636.69	-10%	-28.94	3.53	36	68.47	100.9	133.4	165.9	198.4	230.8	263.3	295.8
707.43	0%	-10.91	25.17	61.25	97.33	133.4	169.5	205.6	241.7	277.7	313.8	349.9
778.17	10%	7.13	46.82	86.51	126.2	165.9	205.6	245.3	284.9	324.6	364.3	404
848.92	20%	25.17	68.47	111.8	155.1	198.4	241.7	284.9	328.2	371.5	414.8	458.1
919.66	30%	43.21	90.12	137	183.9	230.8	277.7	324.6	371.5	418.4	465.3	512.2
990.4	40%	61.25	111.8	162.3	212.8	263.3	313.8	364.3	414.8	465.3	515.9	566.4
1061.15	50%	79.29	133.4	187.5	241.7	295.8	349.9	404	458.1	512.2	566.4	620.5

4.6. ***Department: El Paraiso, Honduras, Primera 1998.***

The sample included 6 farmers, who planted traditional bean varieties and 14 farmers, who planted modern bean varieties. In the discussion that follows, farmers who planted traditional varieties are referred to as traditional farmers and those who planted modern varieties are referred to as modern farmers.

4.6.1 Patterns and Costs of Labor Use

Labor Use by Type of Operation: On average, traditional farmers used a total of 79.7man-days/ha, compared to 104.8man-days/ha for modern farmers (Table 4.6.1.1).

In addition, Table 4.6.1.1 reports the mean number of man-days and associated cost of family and hired labor, by farming operation, for modern and traditional farmers. Because the number of farmers who carried out each operation varied greatly, the mean reported is the mean man-days (costs) for those farmers who actually carried out the respective operations. In this regard, the sum of the means for family and hired labor man-days under each farming

operation (Table 4.6.1.1) do not represent the total average man-days for the respective operation.

Table 4.6.1.1. Labor Use (average man-days/ha), *Primera*, 1998, El Paraiso, Honduras.

Operation and Labor Type	Traditional (N =6)				Modern (N =14)			
		No. of Days[a]		Cost		No. of Days[a]		Cost
	n	Mean	S.D.[b]	(US$/ha)[c]	n	Mean	S.D[b]	(US$/ha)[c]
Land Preparation:								
Family	4	6.6	4.5	16.8	4	40.7	34.4	103.7
Hired	1	7.6		17.0	2	15.0	3.0	33.4
Planting:								
Family	6	5.6	5.2	14.3	12	6.3	9.8	16.1
Hired	4	5.3	2.6	11.1	10	8.7	5.2	19.6
App. Fertilizer:								
Family	2	2.5	0.5	6.4	5	7.6	9.1	19.4
Hired	2	3.1	0.3	6.3	6	2.2	1.3	4.6
App. Herbicide:								
Family	2	1.2	0.3	3.0	0	NA	NA	NA
Hired	1	1.1		32.5	3	3.2	1.5	6.6
App. Insecticide:								
Family	3	1.1	0.0	2.9	7	6.2	8.2	15.8
Hired	0	NA	NA	NA	8	3.6	2.1	7.6
App. Fungicide:								
Family	0	NA	NA	NA	1	0.9		1.2
Hired	0	NA	NA	NA	2	1.4	0.7	2.7
Manual Weeding:								
Family	6	8.8	6.6	22.5	8	24.3	20.5	62.0
Hired	3	27.9	11.6	60.1	10	30.7	18.2	65.2
Harvesting:								
Family	5	7.1	4.4	18.2	5	11.3	8.9	28.7
Hired	4	17.3	6.9	35.6	11	14.1	5.8	30.4
Threshing:								
Family	2	4.5	1.7	11.4	7	4.5	3.2	11.5
Hired	1	13.0		57.8	9	7.6	4.1	24.0
Others:								
Family	3	2.2	1.5	5.7	4	4.5	4.7	11.5
Hired	0	NA	NA	NA	4	5.1	3.1	12.5
Total Mean[d]:								
Family	*6*	*29.2*	*10.7*	*74.4*	*14*	*44.4*	*63.3*	*113.1*
Hired	*4*	*50.5*	*28.0*	*121.8*	*12*	*60.3*	*30.1*	*135.7*
Total		***79.7***		***196.2***		***104.8***		***248.8***

Note: a/ Converted from hours to number of days using 8 hours equal to one day.
b/ Standard Deviation of the number of days.
c/ Family Labor is valued at its opportunity cost.
d/ Calculated as the weighted average.

For the traditional farmers, the largest share of total labor was used for manual weeding (26.3%); followed by harvesting (27.8%), planting (14.5%), land preparation

(9.0%), threshing (5.8%), agrochemical applications (4.8%), and a combination of other activities such as cleaning and watering (1.8%) (Table 4.6.1.2).

For modern farmers, the largest share of total labor was used for manual weeding (37.3%), followed by harvesting (15.7%), land preparation (14.3%), planting (12.2%), agrochemical application (10.2%), threshing (7.5%), and a combinations of other activities (2.8%) (Table 4.6.1.3).

With respect to their source of labor, traditional farmers' total labor consisted of 46.5% family labor and 53.5% hired labor, while modern farmers' total labor consisted of 46.2% family labor and 53.8% hired labor.

Table 4.6.1.2 Sum and Percentage of Traditional Farmers (N = 6) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Primera 1998, El Paraiso*.

Type of Operation	Family Labor[a] (man-days/ha)	%of TL[b]	Hired Labor[a] (man-days/ha)	% of TL[b]	Total Labor[c] (man-days/ha)	% of TL[b]
Land Preparation	26.3	7.0	7.6	2.0	34.0	9.0
Planting	33.7	8.9	21.1	5.6	54.8	14.5
App. Fertilizer	5.0	1.3	6.1	1.6	11.2	3.0
App. Herbicide	2.4	0.6	1.1	0.3	3.5	0.9
App. Insecticide	3.4	0.9	0.0	0.0	3.4	0.9
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	53.1	14.1	83.8	22.2	136.8	36.3
Harvesting	35.7	9.5	69.2	18.3	104.9	27.8
Threshing	9.0	2.4	13.0	3.4	22.0	5.8
Others	6.7	1.8	0.0	0.0	6.7	1.8
Total Labor Man-days	175.3	46.5	201.9	53.5	377.2	100.0

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
b/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
c/ Is the sum of family and hired labor man-days/ha.

Table 4.6.1.3 Sum and Percentage of Modern Farmers (N = 14) Family, Hired and Total Labor Use (man-days/ha) by Operation, *Primera* 1998, *El Paraiso*.

Type of Operation	Family Labor[a] (man-days/ha)	% of TL[b]	Hired Labor[a] (man-days/ha)	% of TL[b]	Total Labor[c] (man-days/ha)	% of TL[b]
Land Preparation	162.9	12.1	30.1	2.2	193.0	14.3
Planting	75.9	5.6	88.6	6.6	164.6	12.2
App. Fertilizer	38.1	2.8	13.2	1.0	51.2	3.8
App. Herbicide	0.0	0.0	9.5	0.7	9.5	0.7
App. Insecticide	43.4	3.2	29.0	2.2	72.4	5.4
App. Fungicide	1.0	0.1	2.9	0.2	3.8	0.3
Manual Weeding	194.8	14.5	306.9	22.8	501.7	37.3
Harvesting	56.3	4.2	154.8	11.5	211.1	15.7
Threshing	31.6	2.3	68.8	5.1	100.5	7.5
Others	18.1	1.3	20.3	1.5	38.3	2.8
Total Labor Man-days	622.0	46.2	724.1	53.8	1346.1	100.0

a/ It represents the sum of labor man-days/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor man-days/ha by type of labor and operation.
b/ Represents the percent of the total labor man-days, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TL = (Family or hired Labor man-days per hectare / Total sum of Labor man-days per hectare)*100.
c/ Is the sum of family and hired labor man-days/ha.

Labor Costs[37] by Type of Operations: Total labor costs for the traditional farmers averaged US$196.2/ha, compared to US$248.8/ha for modern farmers (Table 4.6.1.1).

For traditional farmers, the largest share of total labor cost/ha was for manual weeding (33.8%), followed by harvesting (25.0%), planting (13.9%), land preparation (9.0%), threshing (8.6%), agrochemical applications (7.7%), and a combination of other activities such as cleaning, watering and winnowing (1.8%) (Table 4.6.1.4).

For modern farmers, the largest share of total labor cost/ha was for manual weeding (35.8%), followed by land preparation (15.0%), harvesting (14.9%), agrochemical applications (10.0%), threshing (9.2%), and a combination of other activities (2.9%) (Table 4.6.1.5).

For traditional farmers, hired labor cost accounted for 52.2% of the average total labor cost per hectare, compared to 50.7% for modern farmers.

[37] Family Labor is valued at the wage rate (i.e. US$2.55/day) for *primera 1998*.

Table 4.6.1.4 Sum and Percentage of Traditional Farmers (N = 6) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Primera* 1999, *El Paraiso*.

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	67.1	7.2	17.0	1.8	84.0	9.0
Planting	85.8	9.2	44.4	4.8	130.2	13.9
App. Fertilizer	12.8	1.4	12.5	1.3	25.3	2.7
App. Herbicide	6.1	0.7	32.5	3.5	38.6	4.1
App. Insecticide	8.7	0.9	0.0	0.0	8.7	0.9
App. Fungicide	0.0	0.0	0.0	0.0	0.0	0.0
Manual Weeding	135.2	14.5	180.5	19.3	315.7	33.8
Harvesting	90.9	9.7	142.4	15.3	233.3	25.0
Threshing	22.9	2.4	57.8	6.2	80.7	8.6
Others	17.0	1.8	0.0	0.0	17.0	1.8
Total Labor Cost	446.4	47.8	487.1	52.2	933.5	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
b/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
c/ Is the sum of family and hired labor cost per hectare.

Table 4.6.1.5 Sum and Percentage of Modern Farmers (N = 14) Family, Hired and Total Labor Cost (US$/ha) by Operation, *Primera* 1998, *El Paraiso*.

Type of Operation	Family Labor[a] (US$/ha)	% of TLC[b]	Hired Labor[a] (US$/ha)	% of TLC[b]	Total Labor[c] (US$/ha)	% of TLC
Land Preparation	414.9	12.9	66.8	2.1	481.7	15.0
Planting	193.4	6.0	196.2	6.1	389.6	12.1
App. Fertilizer	96.9	3.0	27.7	0.9	124.6	3.9
App. Herbicide	0.0	0.0	19.8	0.6	19.8	0.6
App. Insecticide	110.4	3.4	61.2	1.9	171.6	5.3
App. Fungicide	2.4	0.1	5.3	0.2	7.7	0.2
Manual Weeding	496.1	15.4	652.4	20.3	1148.5	35.8
Harvesting	143.4	4.5	334.1	10.4	477.5	14.9
Threshing	80.5	2.5	216.2	6.7	296.7	9.2
Others	46.0	1.4	48.2	1.5	94.2	2.9
Total Labor Cost	1584.0	49.3	1627.9	50.7	3211.9	100.0

a/ It represents the sum of labor cost/ha by labor type used by all farmers in the sample for each operation, which is used to compute the percentage of the total labor cost/ha by type of labor and operation.
b/ Represents the percentage of the total labor cost/ha, used by the farmers in the sample, by type of labor to carry out the each operations in bean production.
% of TLC = (Family or hired Labor cost per hectare / Total sum of all Labor cost per hectare)*100.
c/ Is the sum of family and hired labor cost per hectare by operation.

4.6.2 Patterns and Costs of Input Use

Seed: All the farmers in the sample planted seed saved from previous harvest. From the sample of twenty farmers, six farmers planted traditional varieties and 14 farmers planted modern varieties. The average seed rate for traditional farmers was 70.7kg/ha at an average

cost of US$59.6/ha, while the seed rate for modern farmers was 51.3kg/ha at an average cost of US$40.8/ha (Table 4.6.2.1). Traditional varieties planted were *Paraisito*, *Cuarent*, *Seda*, and *Chile*, and the modern varieties planted were *Dorado*, *Dicta 113*, *Dicta 122* and *TC-75*.

Fertilizer: Eighteen farmers in the sample applied fertilizer, out of which six were traditional farmers and 12 were modern farmers. Traditional farmers applied an average of 121.7kg/ha at an average cost of US$37.0/ha, while the modern farmers applied an average of 130.4kg/ha at an average cost of US$42.2/ha. The majority of the farmers used *12-24-12*, and *Foliar Fertilizer*.

Herbicide: Seven farmer in the sample used herbicide, out of which three were traditional farmers and four were modern farmers. Traditional farmers used an average of 1.2 liters/ha at an average cost of US$6.6/ha, while the modern farmers used an average of 1.9 liters/ha at an average cost of US$22.1/ha (Table 4.6.2.1). The majority of the farmers used *Paraquat* and a few used *Fluziflop*.

Insecticide: Seventeen farmers used insecticide, out of which five were traditional farmers and 12 were modern farmers. Traditional farmers applied an average of 0.8 liters/ha at an average cost of US$7.8/ha, while the modern farmers applied 1.7 liters/ha at an average cost of US$18.9/ha (Table 4.6.2.1). The types of insecticide used were *Methyl Parathion*, *Methamidafos,* and *Endosulfan*.

Fungicide: None of the traditional farmers used fungicide, while six modern farmers applied an average of 2.6g/ha at an average cost of US$14.5/ha (Table 4.6.2.1). The type of fungicide used was *Mancozeb*.

Traction Contract: Seventeen farmers in the sample used either a tractor or animal traction for primary land tillage, out of which six were traditional farmers and 11 were

modern farmers. Traditional farmer used animal traction equal to 6.2 man-days/ha at an average cost of US$51.7/ha, while the modern farmers used tractor/animal traction for 2.3 days/ha at an average cost of US$89.6/ha (Table 4.6.2.1). The difference in the days and cost between modern and the traditional farmers was because the six of the farmers who used tractors were all modern farmers. Thus, their average for days was relatively low while the cost was higher.

Table 4.6.2.1. Average Quantity and Cost of Input Use Per Hectare by Type of Farmer, *Primera 1998, El Paraiso,* Honduras.

Item	Traditional (N=6)			Modern (N=14)			Total (N=20)		
	n[a]	Qtty[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)	n[a]	Qtty.[b]	Cost (US$/ha)
Seed (Kg/ha)	6	70.7	59.6	14	51.3	40.8	20	57.1	46.4
Fertilizer (Kg/ha)	6	121.7	37.0	12	130.4	42.2	18	127.5	40.5
Herbicide (l/ha)	3	1.2	6.6	4	1.9	22.1	7	1.6	15.5
Insecticide (l/ha)	5	0.8	7.8	12	1.7	18.9	17	1.4	15.7
Fungicide (g/ha)	0	NA	NA	6	2.6	14.5	6	2.6	14.5
Traction Contract[c] (days/ha)	6	6.2	51.7	11	2.3	89.6	17	3.6	76.2

a/ Number farmers under each category using the particular item.
b/ Mean quantity
c/ Cost per hectare of tractor and oxen hired/used for land preparation.

4.6.3 Profitability Analysis

Various measures of costs and returns are reported in the Table 4.6.3.1 and presented below.

Revenue:

Yield, Price and Gross Income (GI): On average, traditional farmers obtained 955.7kg/ha (S.D.= 590) and the modern farmers obtained 1,265.4kg/ha (S.D. = 695). Traditional farmers received an average price of US$0.18/kg, while the modern farmers received an average price of US$0.11/ha. GI for traditional farmers averaged US$172.0/ha, while it averaged US$139.2/ha for modern farmers.

Costs:

Total Enterprise Cost (TEC): For traditional farmers, TEC averaged US$387.5/ha, which consists of hired labor cost (31.4%), input cost (27.4%), opportunity cost of family labor (19.2%), traction contract cost (13.3%), and the opportunity cost of equity capital (8.7%) (Table4.6.3.2). Operating cost, excluding opportunity cost of equity capital and family labor, was US$279.5/ha (Table 4.6.3.1).

For modern farmers, TEC averaged US$488.3/ha, which consists of hired labor cost (27.8%), opportunity cost of family labor (23.2%), input cost (22.5%), traction contract cost (18.4%), and opportunity cost of equity capital (8.2%) (Table 4.6.3.2). Operating cost, excluding the opportunity cost of equity capital and family labor, averaged US$334.9/ha (Table 4.6.3.1).

Per unit Cost of Production (*i.e.* total enterprise cost divided by the average yield) for traditional farmers was US$0.41/ha compared to US$0.39/ha for modern farmers.

Returns:

Enterprise Gross Margin (EGM) EGM (*i.e.*GI less operating cost) for traditional farmers averaged *minus* US$107.5/ha, while it averaged *minus* US$195.7/ha for modern farmers.

Return to Family Land, Labor and Management (RFLLM) (*i.e.* EGM less the opportunity cost of equity capital) for traditional farmers averaged *minus* US$141.0/ha, while it averaged *minus* US$235.9/ha for modern farmers.

Returns to Family Land, Labor and Management per Day (*i.e.* RFLLM divided by the number of family labor days) for traditional farmers averaged *minus* US$4.8/day, while that of modern farmers averaged *minus* US$5.3/day.

Return to Family Land and Management (*i.e.* TEC deducted from GI) for traditional farmers averaged *minus* US$215.4/ha, while it averaged *minus* US$349.1/ha for the modern farmers.

Table 4.6.3.1 Average Yields, Prices, Costs and Returns by Type of Farmers, *Primera* 1998, *El Paraiso*, Honduras.

Items	Traditional (N=6)	Modern (N=14)	Sig. (t-test)[a]
Revenue:			
Average Yield (Kg./ha)	955.7	1265.4	0.34
Adjusted Price (US$/Kg)	0.2	0.1	0.21
(1) Gross Income (US$/ha)	172.0	139.2	0.54
Costs:			
Input Cost[b] (US$/ha)	106.1	109.7	0.88
Traction Contract Cost (US$/ha)	51.7	89.6	0.14
Hired Labor Cost (US$/ha)	121.8	135.7	0.44
(2) Total Operating Cost (US$/ha)	279.5	334.9	
(3) Opportunity Cost of Equity Capital[c] (US$/ha)	33.5	40.2	
(4) Family Labor			
(4.1) Number of Family Labor Days/ha	29.2	44.4	0.39
(4.2) Family Labor Cost[d] (US$/ha)	74.4	113.1	0.39
(5) Total Enterprise Cost (US$/ha) [*2+3+4.2*]	387.5	488.3	
(6) Per Unit Cost[e] (US$/kg)	0.4	0.4	
Profitability Measures			
(7) Enterprise Gross Margin (US$/ha) [*1-2*]	-107.5	-195.7	0.46
(8) Return to Family Land, Labor and Management (US$/ha) [*7-3*]	-141.0	-235.9	
(9) Returns to Family Land, Labor and Management per Day (US$/day) [*8/4.1*]	-4.8	-5.3	
(10) Return to Land and Management (US$/ha) [*8-4.2 or 1-5*]	-215.4	-349.1	

a/ T-test for equality of means:

* Significant at 5% significance level.

** Significant at 10% significant level.

b/ Mean of the aggregated total cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).

c/ Opportunity cost of equity capital was valued at 12% of Operating Cost.

d/ Opportunity cost family labor was valued at the wage rate of US$2.55/Day.

e/ Computed by dividing total enterprise cost by average yield.

Table 4.6.3.1. Average Total Enterprise Cost (US$/ha), *Primera* 1998, *El Paraiso*, Honduras.

Item	Traditional (N=6)		Modern (N=14)		Total (N=20)	
	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC	Cost (US$/ha)	% of TEC
Input Cost[a]	106.1	27.4	109.7	22.5	108.5	23.8
Traction Contract Cost[b]	51.7	13.3	89.6	18.4	76.2	16.7
Family Labor Cost	74.4	19.2	113.1	23.2	101.5	22.2
Hired Labor Cost	121.8	31.4	135.7	27.8	132.2	29.0
Equity Capital Cost	33.5	8.7	40.2	8.2	38.0	8.3
Total Enterprise Cost (TEC)	387.5	100.0	488.3	100.0	456.5	100.0

a/ Total aggregate mean of the cost of inputs (seeds, fertilizers, insecticides, fungicides and herbicides).
b/ Cost per hectare of tractor and oxen hired/used for land preparation.

4.6.4 Sensitivity Analysis[38]:

The results of the sensitivity analysis are reported for traditional (Table 4.6.4.1) and modern (Table 4.6.4.2) farmers with respect to a ± 50 percent change of bean price and yield, holding operating cost[39] constant.

For traditional farmers (Table 4.6.4.1), holding operating cost (US$279.5/ha) and one of either yield (955.7kg/ha) or price (US$0.18/kg) constant, EGM remained *minus* with a 50% increase in price or yields. Holding operating cost constant, EGM became positive at 30% increase in price and yield.

For modern farmers (Table 4.6.4.2), EGM remained negative, even if the price and the yield increased by 50%.

[38] Operating cost (input and hired labor cost) are held constant, assuming that yield changes are due to weather related risk.
[39] The operating costs do not include the opportunity cost of family labor and equity capital. Thus, the scenario will worse if we included these cost.

Table 4.6.4.1 Traditional Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Primera 1998, El Paraiso, Honduras.

	Bean Price (US$/Kg)											
		0.09	0.11	0.13	0.14	0.16	0.18	0.2	0.22	0.23	0.25	0.27
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
477.87	-50%	-236.5	-227.9	-219.3	-210.7	-202.1	-193.5	-184.9	-176.3	-167.7	-159.1	-150.5
573.44	-40%	-227.9	-217.6	-207.3	-196.9	-186.6	-176.3	-166	-155.7	-145.3	-135	-124.7
669.01	-30%	-219.3	-207.3	-195.2	-183.2	-171.1	-159.1	-147.1	-135	-123	-110.9	-98.88
764.58	-20%	-210.7	-196.9	-183.2	-169.4	-155.7	-141.9	-128.1	-114.4	-100.6	-86.83	-73.07
860.16	-10%	-202.1	-186.6	-171.1	-155.7	-140.2	-124.7	-109.2	-93.72	-78.23	-62.75	-47.27
955.73	0%	-193.5	-176.3	-159.1	-141.9	-124.7	-107.5	-90.28	-73.07	-55.87	-38.67	-21.46
1051.3	10%	-184.9	-166	-147.1	-128.1	-109.2	-90.28	-71.35	-52.43	-33.51	-14.58	4.34
1146.9	20%	-176.3	-155.7	-135	-114.4	-93.72	-73.07	-52.43	-31.78	-11.14	9.5	30.15
1242.5	30%	-167.7	-145.3	-123	-100.6	-78.23	-55.87	-33.51	-11.14	11.22	33.59	55.95
1338	40%	-159.1	-135	-110.9	-86.83	-62.75	-38.67	-14.58	9.5	33.59	57.67	81.76
1433.6	50%	-150.5	-124.7	-98.88	-73.07	-47.27	-21.46	4.34	30.15	55.95	81.76	107.56

Table 4.6.4.2 Modern Farmers: Sensitivity Analysis on Enterprise Gross Margin with Changing Bean Yield and Price, Primera 1998, El Paraiso, Honduras.

	Bean Price (US$/Kg)											
		0.06	0.07	0.08	0.09	0.1	0.11	0.12	0.13	0.14	0.15	0.17
Yield (Kg/ha)	**% Change**	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%	40%	50%
632.72	-50%	-300.1	-293.2	-286.2	-279.3	-272.3	-265.3	-258.4	-251.4	-244.5	-237.5	-230.5
759.26	-40%	-293.2	-284.8	-276.5	-268.1	-259.8	-251.4	-243.1	-234.7	-226.4	-218	-209.7
885.8	-30%	-286.2	-276.5	-266.7	-257	-247.3	-237.5	-227.8	-218	-208.3	-198.5	-188.8
1012.34	-20%	-279.3	-268.1	-257	-245.9	-234.7	-223.6	-212.5	-201.3	-190.2	-179	-167.9
1138.89	-10%	-272.3	-259.8	-247.3	-234.7	-222.2	-209.7	-197.1	-184.6	-172.1	-159.6	-147
1265.43	0%	-265.3	-251.4	-237.5	-223.6	-209.7	-195.7	-181.8	-167.9	-154	-140.1	-126.1
1391.97	10%	-258.4	-243.1	-227.8	-212.5	-197.1	-181.8	-166.5	-151.2	-135.9	-120.6	-105.3
1518.52	20%	-251.4	-234.7	-218	-201.3	-184.6	-167.9	-151.2	-134.5	-117.8	-101.1	-84.38
1645.06	30%	-244.5	-226.4	-208.3	-190.2	-172.1	-154	-135.9	-117.8	-99.7	-81.6	-63.51
1771.6	40%	-237.5	-218	-198.5	-179	-159.6	-140.1	-120.6	-101.1	-81.6	-62.11	-42.63
1898.15	50%	-230.5	-209.7	-188.8	-167.9	-147	-126.1	-105.3	-84.38	-63.51	-42.63	-21.75

4.7 Summary of Empirical Results

4.7.1 Yield and Prices

- The yields for modern farmers were higher than that of traditional farmers for all the data sets (Appendix 2). The mean yield difference between traditional and modern farmers ranged from 55.2kg/ha (*Yoro, primera* 2000) to 382.4kg/ha (*Olancho, Primera* 1999).
- Among the traditional and modern farmers of the three sites (*Yoro, Olancho* and *El Paraiso*), modern farmers of *El Paraiso* (1,265kg/ha in *Primera* 1998) had the highest average yield, while the traditional farmers of *Yoro* (249kg/ha in *Primera* 2000) had the lowest yield (Appendix 2).
- Traditional farmers received higher prices for the beans sold than modern farmers did during *primera* 1998 (*El Paraiso*) and *postrera* 1999 (*Olancho*). The modern farmers received higher prices than traditional farmers during *primera* 1999 (*El Paraiso*), *postrera* 2000 (*Yoro*), and *primera* 2000 (*Yoro*).

4.7.2 Cost of Production:

- The Per unit Cost (US$/kg) of bean production was higher for traditional farmers than for modern farmers across all data sets (Appendix 3). This is due to the lower yield that traditional farmers obtained, compared to the modern farmers yields.
- Cost of labor (hired and family labor) constituted the highest share of total enterprise cost/ha across all data sets (Appendix 4).

4.7.3 Labor Use and Cost:

- Average total number of man-days/ha (average for traditional and modern farmers) for bean production ranged from 34.6man-days/ha (Traditional farmers during *Postrera* 1999, *Olancho*) to 105man-days/ha (Modern farmers during *Primera* 1998, *El Paraiso*). The number of days used were higher in the hilly areas than those in the plains.
- Across all data sets, modern farmers used more labor days than the traditional farmers, except during *primera* 2000 (*Yoro*), where the traditional farmers used more labor days than the modern farmers did.
- In general, both traditional and modern farmers used more hired labor than family labor, except for the traditional farmers of *Yoro* (*Primera* and *Postrera* 2000), where they used more family labor than hired labor.
- When family labor was valued at its opportunity cost, cost of labor represented greater than 50% of the total enterprise cost for both traditional and modern farmers across all data sets, except for traditional farmers (47.8%) in *Olancho* (*Postrera* 1999).
- The share of total labor used for each operation varied greatly across data sets. For example, in data sets where yields were highest, harvest labor accounted for a larger share of labor, compared to other activities.

4.7.4 Use of Inputs and Cost:

- None of the farmers in any of the data sets (N = 96) strictly followed the recommended bean production practices[40].
- Out of the sample (N=96), 57% of the farmers applied herbicide, followed by insecticide (52%), fertilizer (28%), and fungicide (8%). However, input use varied greatly by location. For example, 90% of the farmers in *El Paraiso* applied both fertilizer and insecticides, while only nine farmers from *Yoro* and *Olancho* combined applied fertilizer.
- Input costs (seeds, fertilizer, herbicide, insecticide and fungicide) constituted the second largest (after labor cost) share of total enterprise cost (16% to 27% of TEC) across all data sets, except for traditional farmers during *postrera* 1999 (*Olancho*).

4.7.5 Revenue and Returns:

- All the data sets showed that modern farmers earned higher enterprise gross margins, and returns to land and management than the traditional farmers.
- Enterprise gross margin (*i.e.* operating cost deducted from gross income) was negative for both traditional and modern farmers during *primera* 1998 (*El Paraiso*) and for traditional farmers during *primera* 2000 (*Yoro*) (Appendix 5 & 6). This could be because they spent a substantial amount for hired labor, which consist of greater than 40% of the total operating cost in the both cases.
- Returns to land and management was negative (ranging from US$2.50/ha to US$349/ha) for farmers (both traditional and modern farmers) in *Yoro* (*Primera*

[40] See table 5.3.1 in section 5.3 for recommended practices.

1998) and *El Paraiso* (*Primera* and *Postrera* 2000), and for traditional farmers of *Olancho* (*Primera* 1999) (Appendix 5 & 6).

- The traditional farmers (*Postrera* 1999) and modern farmers (*Primera* and *Postrera* 1999) in *Olancho* had *positive* returns to land and management because they used relatively less labor man-days/ha. The majority of the sample farmers/farms was located in the plain areas and they used oxen for primary land tillage.
- Returns to Family Land, Labor and Management per Day across all data sets for both traditional and modern farmers ranged from *minus* US$5.3/day (modern farmers of *El Paraiso, Primera* 1998) to US$24.2/day (modern farmers of *Olancho, Postrera* 1999).

4.7.6 Sensitivity Analysis:

- Sensitivity Analysis on enterprise gross margin showed that traditional farmers' gross margins were more sensitive to yield and price changes than the gross margins of modern farmers. This may be due to higher yield obtained by the modern farmers.

4.7.7 Modern versus Traditional Farmers:

A major objective of carrying out these record-keeping studies was to compare the profitability of farmers who used modern bean technology, compared to those who used traditional technology. It was assumed that farmers who used traditional varieties applied few other cash inputs (fertilizers, insecticides, herbicides, fungicides) and that farmers who used modern varieties applied relatively more cash inputs and at higher levels. However, this

analysis demonstrates that there was considerable variability in types and amounts of inputs applied within the group of traditional and modern farmers, across all sites/seasons. In addition, in some of the data sets, a greater percentage of the traditional farmers applied modern inputs like fertilizers and insecticides, than did the modern farmers. For example, during *postrera* 2000 (*Yoro*), seven traditional farmers used herbicide (average of 1.9 liters/ha), while only one modern farmer used herbicide (1.4 liters/ha). Similarly, during the same season, six traditional farmers used insecticide at an average rate of 1.2 liters/ha, while five modern farmers only used at an average rate of 0.9 liters/ha (which is lower than the rate used by traditional farmers). This suggests, the variety planted is a weak indicator of whether or not a farmer uses only traditional inputs, versus those who uses modern inputs, broadly defined as fertilizer, herbicide, insecticide and fungicide.

CHAPTER V

IMPLICATIONS FOR FUTURE RECORD KEEPING ANALYSIS

The analysis in Chapter 4 provides numerous detailed insights regarding the nature of the bean production system in selected sites/years in Honduras. However, in most cases the observed differences in yields (and other data values) of traditional versus modern farmers were not statistically significant.

This chapter analyzes the potential causes of the significance problem and possible solutions. In addition, given the time and cost required to collect record keeping data, the chapter explores options for using a single interview survey plus standard labor parameters for estimating the cost and returns to bean production in Honduras. Finally, the chapter contrasts the existing bean production recommendation with the farmers' current practices.

5.1 Yield Difference, Significance and the Sample Size

The average yields across different data sets/locations were highly variable. In general, the traditional farmers of *Yoro* (*Primera*, 2000) had the lowest average yield (284.5kg/ha), while the modern farmers in *El Paraiso* (*Primera*, 1998) reported the highest (1,167.6kg/ha). These high yield variability is likely due to the location of the farms (hillside versus valleys), types/quantities of inputs (agro-chemicals) used by the farmers (which is evident from the data set), and varying soil and weather conditions and disease pressure.

As shown in Table 5.1.1, the average yields of modern farmers were higher than the yields of traditional farmers. The difference between traditional and modern farmers' average yield ranged from 55.2kg/ha (*Primera*, 2000) to 382.4kg/ha (*Primera*, 1999). However, upon

doing *t-test* for equality of means, only the difference in average yield (traditional versus modern farmers) for *Olancho* (*Primera* and *Postrera* 1999) were statistically significant at the 5% significance level. The failure of the significance test for other data sets is likely due to the small sample size for each group (traditional versus modern) and unequal sample size between groups, which is evident for *primera* 1998, *primera* 2000 and *postrera* 2000 data sets (Table 5.1.1).

Table 5.1.1. Average Yield and Significance by Type of Farmer, Season/Year and Location.

Season, Year and Location	n	Traditional Farmers	n	Modern Farmers	Mean Difference	Sig. (t-test)	N	Total	Standard Deviation
Primera 1998, El Paraiso	6	955.7	14	1265.4	309.7	0.336	20	1167.6	663.6
Postrera 1999, Olancho	9	361.4	11	641.7	280.1	0.018*	20	515.5	281.8
Primera 1999, Olancho	10	325.1	9	707.4	382.4	0.037*	19	516.2	387.6
Postrera 2000, Yoro	6	288.0	12	423.3	135.3	0.233	18	330.7	222.0
Primera 2000, Yoro	13	248.7	6	303.9	55.2	0.499	19	284.4	225.2

*The means are statistically significant at 5% significance level.

Sample sizes required for the data sets, which did not show statistical difference in yields, were estimated using the following formula:

$$N = (Z_{a/2} + Z_{ß})^2 (s / d)^2$$

Where by;

- a is the significance level or the risk of rejecting the null hypothesis when it is true.
- ß is the risk of accepting a false null hypothesis when a particular value of the alternative hypothesis is true.
- s is the value of the population standard deviation, and

- d is the minimum difference in yield between traditional variety and the modern variety that we want to detect.

The values used for each variable were; a = 5%, ß = 10%, and the values for d and s were the population standard deviations and the actual difference between mean yields of traditional farmer and the modern farmers, respectively. The quantities of the $Z_{0.025}$ (1.960) and $Z_{0.10}$ (1.282) are the upper critical values from the normal distribution.

The sample size that would have been required for the mean yield difference to be statistically significant at the 5% significance level varied by site/season. The required sample size for *primera* 1998, *primera* 2000 and *postrera* 2000, using the actual mean difference (d) and their respective pooled (traditional and modern farmers) standard deviation (s) for each site were 48, 29 and 175 farmers respectively (Table 5.1.2).

Table 5.1.2. Sample Size Required Using the Actual Mean Difference and the Population Standard Deviation.

Season, Year and Location	Traditional Farmers	Modern Farmers	Mean Difference	Population Standard Deviation	Sample Size Required
Primera 1998, El Paraiso	955.73	1265.43	309.70	663.57	48
Postrera 2000, Yoro	287.97	423.29	135.32	224.96	29
Primera 2000, Yoro	248.72	303.94	55.22	225.19	175

Sample sizes required (Table 5.1.2) are highly variable since the mean difference and the standard deviation vary greatly between data sets. As such, the hypothetical sample size that would be required for the yield difference to be statistically significant was estimated, assuming different levels of standard deviations, while using the same values for a (5%), ß (10%), and d (100kgs/ha). The following were the results:

Standard Deviation	Sample Size Required
140	21
160	27
180	34
200	42
220	***51***
260	71
300	95

From the results above, a sample size of 20 would detect a minimum mean yield difference of 100kgs/ha, between the traditional and modern farmers, if 95% of the samples mean yields fall within the range of " 280kgs/ha (2 standard deviation) from the mean yield. On the other hand, a sample size of 95 farmers would be required to detect a minimum mean yield difference of 100kgs/ha, if 95% of the sample's mean yields fall within the range of " 600kg/ha (2 standard deviations) from the mean yield. The results indicate that a larger sample is required to detect the difference between the mean yield, if the standard deviations were higher. All the results are computed assuming a normal distribution in the sample.

Assuming that the expected standard deviation will be around 225 (which is the average standard deviation for *postrera* and *primera* 2000) in future data sets, the sample size required to identify a 100 kg yield difference as statistically significant (at 5% significance level) would be approximately 52 farmers (26 traditional and 26 modern farmers). Standard deviation of the yield of *Primera* 1998 was dropped from including in the computation of expected average standard deviation, as it was very high (S.D.=664). Thus, for future record keeping survey, 52 farmers are required to detect a 100kg difference in the mean yield of traditional and modern farmers at 5% significance level with the assumption that their pooled standard deviation was approximately 225.

However, causes of high standard deviation in this particular study may be due to the presence of high heterogeneity in the samples of farmers (*e.g.* with respect to input used, topography, *etc*.) and very large differences in the size of each group (traditional and modern). Thus, in the future, the sample of farmers in each group (Traditional versus Modern) must be carefully stratified, each group must be equal in size, and they must be selected to reduce heterogeneity in terms of their farming environment (hill versus valley) and input use.

5.2 Standard Labor Parameters by Operation

Standard labor parameters (mean and the median) for labor use by type of operation were estimated from the pooled data set (N=96). Table 5.2.1 shows the mean and the median of standard parameters, assumptions made, and the transformation required to compute labor cost for each operation.

Table 5.2.1. Estimated Standard Parameters of Labor Use (**Mean and the Median**) Per Hectare Bean Farm, for Labor Cost Calculation, by Type of Operation.

Type of Operation	Standard Parameters				Transformation Required
	Median	Mean	Units	Assumptions	
1. Land Preparation[a]					
With labor only	15.654	16.571	Man-days/ha		Standard*wage rate* area (ha)
If with traction power was used for primary tillage	7.156	8.120	Man-days/ha		
2. Planting	0.186	0.232	Man-days/kg of seeds used	Man-days needed for planting is the function of quantities of seed used.	Standard*wage rate *quantity of seed used (Kg)
3. Application of fertilizer	2.147	2.417	Man-days per application for 1ha bean farm.		Standard*wage rate*number of applications
4. Application of herbicide	2.147	2.478	Man-days per application for 1ha bean farm.		Standard*wage rate*number of applications
5. Application of insecticide	2.505	2.618	Man-days per application for 1ha bean farm.		Standard*wage rate*number of application
6. Application of fungicide	1.789	1.849	Man-days per application for 1ha bean farm.		Standard*wage rate*number of applications
7. Manual weeding	10.730	17.927	Man-days/ha		Standard*wage rate*area (ha)
8. Harvesting	0.027	0.046	Man-days/kg of harvest (yield).	Man-days needed for harvesting is the function of yield.	Standard*wage rate*yield (Kg)
9. Threshing	0.011	0.022	Man-days/kg of harvest (yield).	Man-days needed for planting is the function of yield.	Standard*wage rate*yield (Kg)
10. Other activities	5.009	5.416	Man-days/ha		Standard*wage rate

a/ If the operation is carried out without using traction power (for primary land tillage) use the standard parameter with labor only, if otherwise use the lower standard parameter.

Standard parameter for planting was based on quantity of seed used, and threshing and harvesting was based on the yield.

Standard parameters for agrochemical applications represent the average number of man-days used per application per hectare.

The parameters (mean and the median) obtained were validated for each data set using the actual yield, price, seed rate, aggregated input cost, traction contract cost, wage rate, and average number of agrochemical (fertilizer, herbicide, insecticide and fungicide)

applications. The results showed that return to land and labor, using median values deviated less from the actual, which was computed in profitability analysis, than by using mean values (Appendix 7 & 8).

From the results, we assume that median is more reliable parameter to use than mean for computing labor days used and labor cost by operation in bean production. The use of the median is justified by the high standard deviation observed in labor use values for each farming operation. We assume that this is largely due to measurement error, including farmers' inaccurate estimates of their bean area (*i.e.* over/under reporting of planted area biases per hectare estimates of labor use/ha) and/or recall error regarding the amount of labor that they actually used. When data are highly skewed, the median is a more reliable estimate of central tendency than the mean.

However, as shown in Appendix 7 and 8, the estimate of returns to land and management (Gross Income minus total enterprise cost) when estimated using these labor parameters varies from the values estimated directly from the record keeping data. Using the median as the standard labor parameter (Appendix 7), the estimate of return to land and management was lower than the actual estimate for both traditional and modern farmers in *Olancho* (*Postrera* & *Pirmera* 1999) and *El Paraiso* (*Primera* 1998), and it was higher than actual for both traditional and modern farmers of *Yoro* (*Primera* & *Postrera* 2000). The difference between the estimate and the actual return to land and management of traditional and modern farmers, using median, for all the data sets ranged from US$0.88 to US$130.97. It is worth mentioning that the second highest difference was US$84.97 or the difference for rest of the cases was below US$100.

When using the mean as the standard parameter (Appendix 8), the estimate of return to land and management was lower than actual for both traditional and modern farmers of all the data sets with the exception of traditional farmers of *Yoro* (*Primera,* 2000). The difference between the estimate and the actual return to land and management of traditional and modern farmers, using mean, for all the data sets ranged from US$1.32 to US$177.20. The majority of the difference between the actual and the estimate of returns to land and management was greater than US$100.

5.3. Farmers' Actual Practices and the Recommended Practices

For most of the inputs, farmers' practices diverged greatly from the recommendations, as reported by Juan Carlos Rosas (Table 5.3.1).

Seeds: The average seed rate for the whole sample (N=96) was 51.0kg/ha. However, only 15% of the farmers followed the recommended seed rate of 50 to 60kg/ha. Fifty-three percent of the farmers used less than 50kg/ha, while 32% used more than 60kg/ha.

Fertilizers: Only 27 farmers out of the sample (N=96) applied fertilizer. Out of the 27 farmers, nine were traditional farmers and 18 were modern farmers. The type of fertilizer used were 18-46-0, 12-24-12, 40-0-0, *Foliar Fertilizer*, and micronutrients.

Sixty-four percent of the farmers who applied fertilizer came from *El Paraiso* (*Primera,* 1998). The majority of the farmers, who used fertilizer, applied either 18-46-0 or 12-24-12 during planting time. Few farmers applied *Foliar Fertilizer* or urea, 4 to 5 weeks after planting, as is recommended.

Herbicides: Fifty-seven percent (55 farmers) of the farmers in the sample (N=96) used herbicides, out of which 49% were traditional farmers and 51% were modern farmers.

The majority of the farmers used *Paraquat* and the others used *Fluziflop*. Farmers, who used herbicides, applied it once within the range of three to four days before and after planting.

Insecticides: Fifty-two percent (49 farmers) of the farmers in the sample (N=96) used insecticides, out of which 39% were traditional farmers and 61% were modern farmers. The types of insecticides used were *Methyl Parathion*, *Methamidifos*, *Endosulfan*, and *Cialotrina*. The majority of the farmers used *Methyl Parathion*. Most farmers applied insecticides only once. The application was done either during planting or four to five weeks after planting.

Fungicides: Only seven farmers out of 96 used fungicide, out of which one was traditional farmer and six were modern farmers. Six of these farmers came from *El Paraiso*. *Mancozeb* is the type of fungicide used by all seven farmers.

Table 5.3.1. The Mean and the Range of Input Quantities and the Recommended Quantities and Applications (N=96).

Inputs	**n**	**Observations**		**Recommended Practices for Central America and the Caribbean**[41]
		Mean	**Range**	
Seeds	96	50.97 kg/ha	8.82 - 140.00 kg/ha	50-60kg/ha
Fertilizers	27	96.77kg/ha	0.54 – 261.64kg/ha	80-120kg/ha of 18-46-0 or 12-24-12 at planting plus 20-30kg/ha of urea after four to five weeks of planting.
Herbicides	55	1.95 liters/ha	0.24 – 4.29 liters/ha	One application during pre planting or pre emergence stage.
Insecticides	49	1.04 liters/ha	0.01 – 9.45 liters/ha	Two applications to control bean pod borer at flowering and a week after flowering.
Fungicides	7	2.306 gm/ha	0.36 - 11.42 gm/ha	

[41] Source: Dr. Juan Carlos Rosas, Director, Programa de Investigaciones en Frijol, Escuela Agricola Panamericana, Zamorano, Honduras.

CHAPTER VI

SUMMARY, RECOMMENDATIONS FOR FUTURE RECORD KEEPING AND FUTURE RESEARCH

6.1 Summary

The analysis showed that among the sample of farmers included in the record keeping surveys, farmers growing modern varieties had higher average yields and earned higher profits or suffered less loss than the farmers growing traditional varieties. This held true for all of the five data sets analyzed in this study. Sensitivity analyses on enterprise gross margin showed that traditional farmers, gross margins were more sensitive to yield and price changes than for modern farmers. This may be due to higher yields obtained by the modern farmers.

However, yields and profitability varied greatly from data set to data set. The sample farmers in *El Paraiso* (*Primera* 1998), in comparison to sample farmers in *Olancho (Postrera and Primera 1999)* and *Yoro (Postrera and Primera 2000)*, reported the highest average yield for both traditional and modern farmers. This difference in yields may be attributed to their greater access to information and various inputs (seeds, agrochemicals and credit), as they are located closer to Tegucigalpa, the capital of Honduras. Ninety percent of the farmers in *El Paraiso* (*Primera,* 1998) applied both fertilizer and insecticides, 30% applied herbicides and it was in *El Paraiso* that the highest number of farmers applied fungicides. In contrast, very few sample farmers in the departments of *Olancho* and *Yoro* used fertilizer. Thus, it is possible that sample farmers in *Olancho* and *Yoro* had limited access to information about the various technologies,

and/or did not have access to inputs (seeds, agrochemicals and credit) at affordable prices.

6.2 Recommendations for Future Record Keeping

Due to the time and cost required to collect record keeping data, it has been necessary to limit the sample size. As a result, in only two (out of five) data sets, were the yield differences between traditional and modern farmers statistically significant at the 5% significance level.

Rather than continuing to collect record keeping data every alternate week during the production season, future efforts to assess the profitability of bean production should utilize a single round (post-harvest) or a two round (mid-season and post-harvest) survey to collect data on the following:

a) Bean area.
b) Type of traction (oxen or tractor) power used and their associated cost and number of days.
c) Type and amount of inputs (seed, fertilizer, insecticide, herbicide and fungicide) applied and their associated cost.
d) Number of applications, by type of agrochemicals.
e) Wage rate for hired labor.
f) Total production
g) Prices received for beans sold and associated marketing cost.

Subsequently, these data--along with the standardized parameters for estimating labor costs--should be used to estimate the profitability of traditional versus modern farmers.

Second, in addition to the small sample size, the non-significance of the yield differences is likely due to the extreme heterogeneity within each group, with respect to the types and amounts of inputs used. Thus, in the future, possible farmers to be included in the survey should be pre-screened to insure that all “traditional” and all “modern” farmers are relatively homogenous with respect to inputs used. To do this it would first be necessary to specify the two groups, in terms of the desired characteristics of each group, and then purposively sample (quota sampling) to select respondents who meet the desired criteria.

Third, the variability in farmers’ yield may also be because some farmers experienced yield losses due to pest and diseases. Thus, in the future, the survey questionnaire should include question that ask farmers to describe the type and level of pest and disease problems that they faced during the growing season.

Fourth, in most sites the number of farmers in the sample of traditional and modern farmers varied greatly. The selection of an unbalanced sample increases the difficulty of identifying significant yield difference between the two groups. Thus, in the future, an equal number of farmers should be included in each group.

Fifth, many of the farmers (38%) in the sample planted only a very small bean area (less than 0.50 ha). Thus, some of the high variability in yields and input use may be due to converting data reported by these farmers to per hectare equivalents. Thus, in the future, the sample should include only farmers with a bean area of 0.50 hectare or more.

Finally, with respect to sample size, in the future a minimum sample of 26 farmers should be included in each group in order to be able to identify yield differences of 100kg/ha that are statistically significant.

6.3 Future Research

This analysis clearly indicates that none of the farmers in the sample adopted the recommended practices completely and most traditional and modern farmers adopted only a few of the recommended practices. It is likely that greater adoption contributed to higher yields in *El Paraiso (Primera 1998)*, compared to *Olancho (Postrera and Primera 1999)* and *Yoro (Postrera and Primera 2000)*. Thus, future research should focus on gaining a better understanding of why most farmers do not follow the recommended practices. Is this because they are not aware of the recommendation, cannot afford to adopt them, or do not have access to these inputs? However, the fact that few farmers follow the recommended practices may suggests that these general recommendations are not appropriate for the bean farming system of farmers with limited resources and who cultivate marginal land. Thus, there is a need to carry out research to validate the recommended practices and determine if these recommendations--or another package of recommendations--are more appropriate.

Second, in future surveys, it would be highly desirable to ask the farmers who applied fertilizers, herbicides, insecticides, and fungicides when they did these applications and why they carry them out at this time. Similarly, it would be highly desirable to ask farmers who don't follow the recommended practices, why they don't follow them. For example, some farmers may plant at a higher seed rate than is recommended because of poor germination. Insights gained from farmers' responses to these questions may contribute to identifying why they do/do not follow the recommended practices.

Third, the share of labor cost in total enterprise cost (Appendix 4), for traditional and modern farmers, ranged from 48% to 78%--depending on the data set. Furthermore, total labor man-days, as reported by the sample farmers, appeared to be extremely high for some

data sets (ranged from 35 man-days/ha during *Primera* 1999, *Olancho* to 105 man-days/ha during *Primera* 1998, *El Paraiso*). Thus, there may be an opportunity to minimize total enterprise cost, in order to maximize profits (or minimize loss), by carrying out research to identify labor-saving technologies, which are appropriate and affordable for small farmers.

Fourth, given the high variability in observed yields, there is a need to carry out research to identify the causes of this variability, including the possible contribution of poor seed germination and/or stand establishment.

Finally, This analysis confirms that farmers who plant improved bean varieties earn higher profits or suffer lower losses than farmers who plant traditional varieties. However, in most sites/seasons, yields and profits were quite low. This suggests that while varietal improvement has the potential to increase farmers' yields and profits, variety alone has a limited impact on increasing farmers' yields and profits. Rather a broader research agenda is required, which focuses on gaining a better understanding of the causes of the high yield variability and identifying recommended practices that will both increase yield (and profits) and reduce yield variability. Similarly, research that focuses on reducing labor requirements has the potential to reduce production costs and increase farmers' profits.

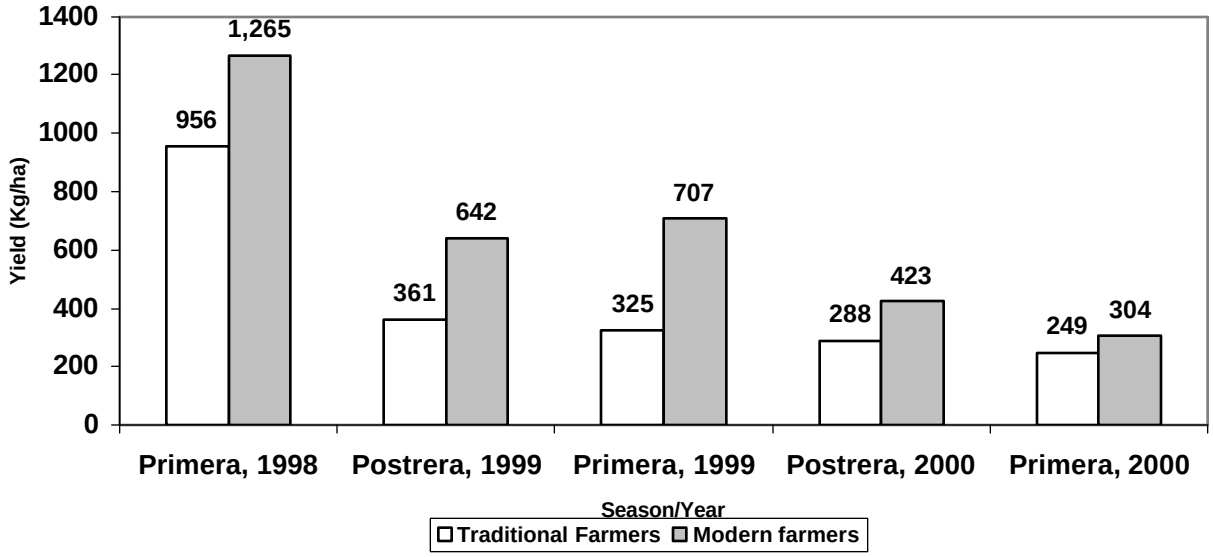
Appendix 1. Information on Topography, Rainfall and Distance from the Nearest City.

Season/Year	Department	Municipality	Locality	Topography	Avg. Annual Rainfall (mm)	Distance from the nearest city (Km)
Primera 1998	El Paraiso	Danlí	El Barro	Plain	800-1000	28 - Danlí
	El Paraiso	Danlí	Araulí	Plain	800-1000	20 - Danlí
	El Paraiso	San Matías	Robledal	Plain	1200-1400	16 - Danlí
	El Paraiso	Moroceli	Limones	Hilly	800-1000	70 - Teg.[1]
	El Paraiso	Guinope	Lavanderos	Hilly	1200-1400	45 - Teg.
Primera 1999	Olancho	Silca	Silca	Plain	1200-1400	93 - Jutic.[2]
	Olancho	Silca	Zuntul	Plain, Hilly	1200-1400	93 - Jutic.
	Olancho	Silca	Quilinchuch	Plain, Hilly	1200-1400	93 - Jutic.
	Olancho	El Rosario	El Ocotal	Plain, Hilly	1600-2000	120 - Jutic.
	Olancho	El Rosario	El Rosario	Plain	1600-2000	115 - Jutic.
	Olancho	El Rosario	El Pino	Plain	1600-2000	117 - Jutic.
	Olancho	El Rosario	Yupite	Hilly	1600-2000	122 - Jutic.
Postrera 1999	Olancho	Silca	Silca	Plain	1200-1400	93 -Jutic.
	Olancho	Silca	Zuntul	Plain, Hilly	1200-1400	93 - Jutic.
	Olancho	El Rosario	El Ocotal	Plain, Hilly	1600-2000	120 - Jutic.
	Olancho	El Rosario	El Rosario	Plain	1600-2000	115 - Jutic.
	Olancho	El Rosario	El Pino	Plain	1600-2000	117 - Jutic.
	Olancho	El Rosario	Yupite	Hilly	1600-2000	122 - Jutic.
Primera 2000	Yoro	Yorito	Santa Cruz	Hilly	1600-2000	35 - Yoro
	Yoro	Yorito	La Ladera	Hilly	1600-2000	8 - Yoro
	Yoro	Yorito	Pueblo Viejo	Hilly	1600-2000	8 - Yoro
	Yoro	Yorito	Mina Honda	Hilly	1600-2000	12 -Yoro
Postrera 2000	Yoro	Yorito	Santa Cruz	Hilly	1600-2000	35 - Yoro
	Yoro	Yorito	La Ladera	Hilly	1600-2000	8 - Yoro
	Yoro	Yorito	Pueblo Viejo	Hilly	1600-2000	8 - Yoro
	Yoro	Yorito	Mina Honda	Hilly	1600-2000	12 -Yoro

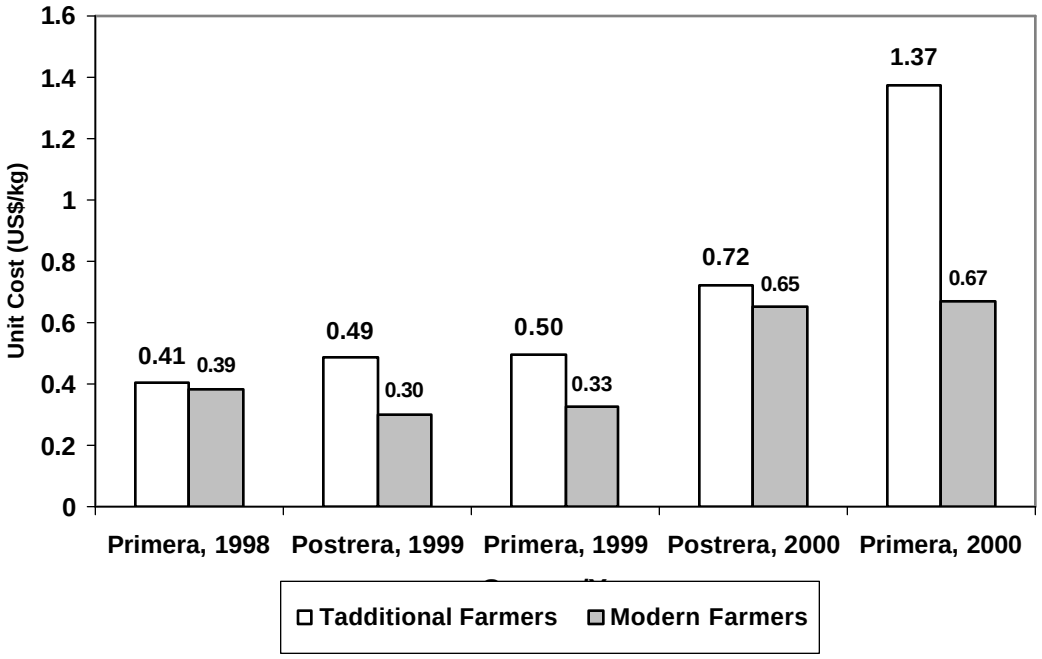
[1] Tegucigalpa
[2] Juticalpa
NOTE : Juticalpa is the largest city of Olancho
Yoro is the largest city of Yoro
Danlí is the largest city of El Paraíso
Tegucigalpa is the largest city and the capitalof Honduas

Source: Dr. Juan Carlos Rosas, Director, Programa de Investigaciones en Frijol, Escuela Agricola Panamericana, Zamorano, Honduras.

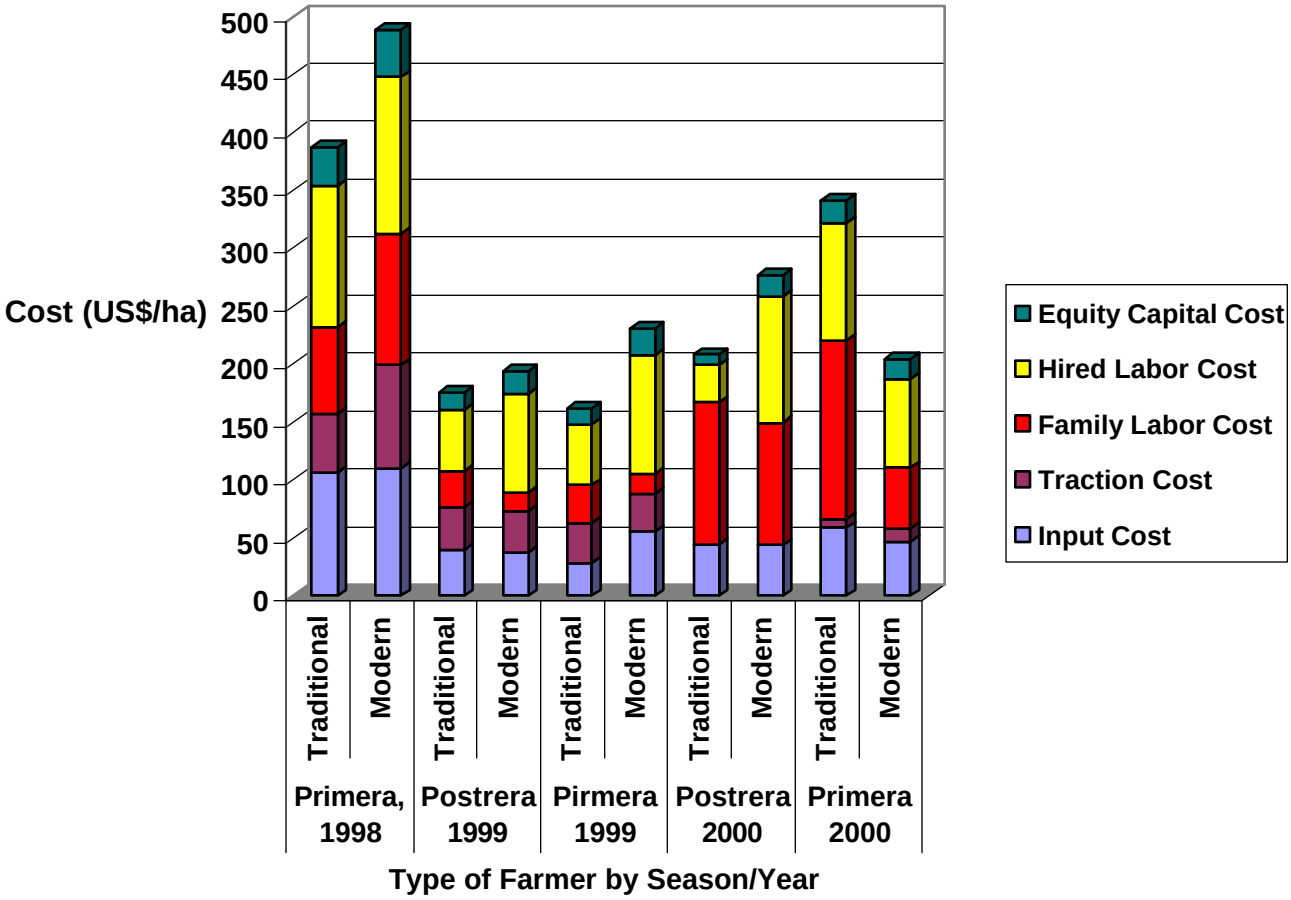
Appendix 2. Average Yield Difference between Traditional and Modern Farmers by Season/Year, Honduras.



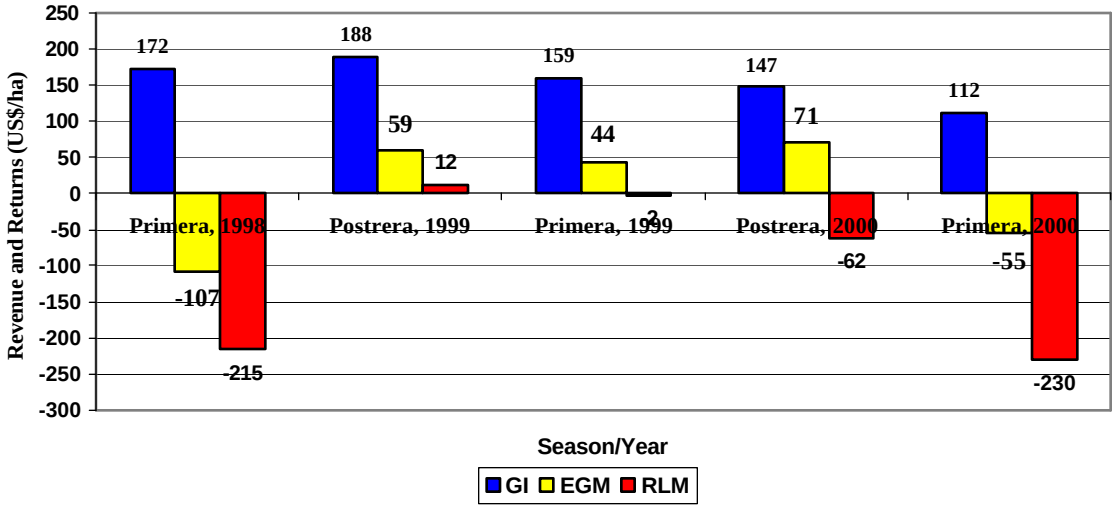
Appendix 3. Per Unit Cost of Production for Traditional and Modern Farmers by Season/Year, Honduras.



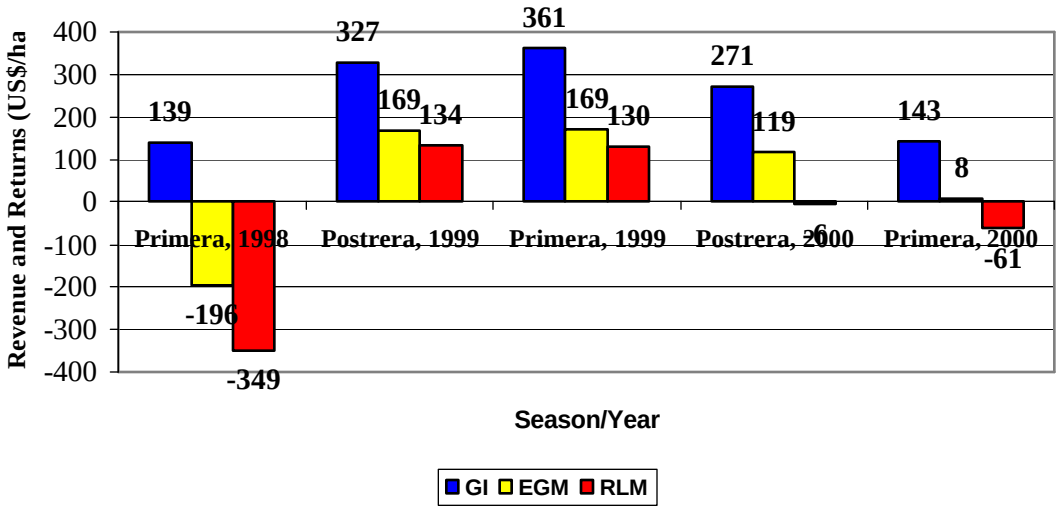
Appendix 4. Total Enterprise Cost and its Components for All the Data sets by Type of Farmer, Honduras.



Appendix 5. Traditional Farmers' Gross Income (GI), Enterprise Gross Margin (EGM), and Return to Land and Management (RLM) by Season/Year, Honduras.



Appendix 6. Modern Farmers Gross Income (GI), Enterprise Gross Margin (EGM), and Retruns to Land and Management (RLM) by Season/Year, Honduras.



Appendix 7 . Validation of Bean Production Profitability Using Standard Labor Parameters (using median from the pooled data set).																	
Basic Information collected from the survey			**Postrera 2000**			**Primera 2000**			**Postrera 1999**			**Primera 1999**			**Primera 1998**		
			TF (N=13)	MF (N=6)	All (N=19)	TF (N=13)	MF (N=6)	All (N=19)	TF (N=13)	MF (N=6)	All (N=19)	TF (N=13)	MF (N=6)	All (N=19)	TF (N=6)	MF (N=14)	All (N=20)
Yield (Kg/ha)			287.97	423.29	330.7	248.72	303.94	284.45	361.37	641.68	515.53	325.05	707.43	516.24	955.73	1265.43	1167.63
Price (US$/ha)			0.51	0.64	0.55	0.45	0.47	0.46	0.52	0.51	0.51	0.49	0.51	0.5	0.18	0.11	0.13
Input Cost (US$/ha)			44.18	43.74	44.04	58.73	47.15	51.01	40.03	37.49	38.63	27.97	55.46	41.72	106.07	109.67	108.53
Traction contract cost (US$/ha)			0	0	0	7.68	11.13	10.27	36.27	36.14	36.19	35.03	32.76	34.02	51.67	89.61	76.22
Area (ha)			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wage Rate (US$/man-days)			2.22	2.22	2.22	2.17	2.17	2.17	2.63	2.63	2.63	2.69	2.69	2.69	2.55	2.55	2.55
Quantity of seed used (kg/ha)			53.31	54.26	53.61	49.51	46.37	47.42	46.67	51.42	49.37	41.82	53.06	46.45	70.68	51.3	57.11
Quantity of fertilizer used (kg/ha)			2.86	59.02	26.44	16.11	18.39	17.25	0	0.75	0.75	0	97.41	97.41	121.66	130.44	127.51
Quantity of Herbicide used (l/ha)			1.91	1.43	1.85	2.06	2.49	2.32	1.67	1.43	1.53	2.17	2.19	2.18	1.16	1.91	1.59
Quantity of Insecticide (l/ha)			1.21	0.91	1.07	1.42	0.4	0.74	0.57	0.75	0.69	0.9	0.65	0.75	0.79	1.68	1.42
Quantity of fungicide (gm/ha)			0	0	0	1.43	0	1.43	0	1.43	1.43	0	0	0	0	2.6	2.6
Average number Fertilizer Applications				1.31													
Average number if Herbicide Applications				1.16													
Average number of Insecticide Applications				1.3													
Average number of Fungicide Applications				1													
Synthetic Budget																	
Variables	**Standard Parameters**																
Revenue:	**Qtty.**	**unit**															
Yield (kg/ha)			287.97	423.29	330.70	248.72	303.94	284.45	361.37	641.68	515.53	325.05	707.43	516.24	955.73	1265.43	1167.63
Price (US$/kg)			0.51	0.64	0.55	0.45	0.47	0.46	0.52	0.51	0.51	0.49	0.51	0.50	0.18	0.11	0.13
Gross Enterprise Income			**146.86**	**270.91**	**181.89**	**111.92**	**142.85**	**130.85**	**187.91**	**327.26**	**262.92**	**159.27**	**360.79**	**258.12**	**172.03**	**139.20**	**151.79**
Cost:																	
Input Cost (US$/ha)			44.18	43.74	44.04	58.73	47.15	51.01	40.03	37.49	38.63	27.97	55.46	41.72	106.07	109.67	108.53
Traction Cost (US$/ha)			0.00	0.00	0.00	7.68	11.13	10.27	36.27	36.14	36.19	35.03	32.76	34.02	51.67	89.61	76.22
Partial Operation cost			44.18	43.74	44.04	66.41	58.28	61.28	76.30	73.63	74.82	63.00	88.22	75.74	157.74	199.28	184.75
Labor cost:																	
land Preparation																	
with labor only	**15.654**	man-days/ha	34.75	34.75	34.75												
oxen used for primary tillage	**7.156**	man-days/ha				15.53	15.53	15.53	18.82	18.82	18.82	19.25	19.25	19.25	18.25	18.25	18.25
Planting	**0.186**	man-days/kg (seed)	22.01	22.41	22.14	19.98	18.72	19.14	22.83	25.15	24.15	20.92	26.55	23.24	33.52	24.33	27.09
Application of Fertilizer	**2.147**	man-days/applications	6.24	6.24	6.24	6.10	6.10	6.10	7.40	7.40	7.40	7.57	7.57	7.57	7.17	7.17	7.17
Application of Herbicide	**2.147**	man-days/applications	5.53	5.53	5.53	5.40	5.40	5.40	6.55	6.55	6.55	6.70	6.70	6.70	6.35	6.35	6.35
Application of Insecticide	**2.505**	man-days/applications	7.23	7.23	7.23	7.07	7.07	7.07	8.56	8.56	8.56	8.76	8.76	8.76	8.30	8.30	8.30
Application of Fungicide	**1.789**	man-days/applications	3.97	3.97	3.97	3.88	3.88	3.88	4.71	4.71	4.71	4.81	4.81	4.81	4.56	4.56	4.56
Manual Weeding	**10.730**	man-days/ha	23.82	23.82	23.82	23.28	23.28	23.28	28.22	28.22	28.22	28.86	28.86	28.86	27.36	27.36	27.36
Harvesting	**0.027**	man-days/kg (yield)	17.26	25.37	19.82	14.57	17.81	16.67	25.66	45.57	36.61	23.61	51.38	37.49	65.80	87.12	80.39
Threshing	**0.011**	man-days/kg (yield)	7.03	10.34	8.08	5.94	7.26	6.79	10.45	18.56	14.91	9.62	20.93	15.28	26.81	35.50	32.75
Other activities	**5.009**	man-days/ha	11.12	11.12	11.12	10.87	10.87	10.87	13.17	13.17	13.17	13.47	13.47	13.47	12.77	12.77	12.77
Labor Cost			138.97	150.78	142.70	112.63	115.92	114.73	146.38	176.71	163.10	143.58	188.29	165.44	210.90	231.72	225.00
Opportunity cost of Equity capital			9.80	10.13	9.91	12.83	14.51	13.41	20.75	26.86	23.46	19.28	29.79	24.77	32.09	38.93	36.75
Total Enterprise Cost			**192.96**	**204.65**	**196.65**	**191.88**	**188.70**	**189.43**	**243.42**	**277.20**	**261.39**	**225.85**	**306.30**	**265.95**	**400.73**	**469.93**	**446.50**
Return to Land and Management			**-46.09**	**66.25**	**-14.76**	**-79.95**	**-45.85**	**-58.58**	**-55.51**	**50.05**	**1.53**	**-66.58**	**54.49**	**-7.83**	**-228.70**	**-330.73**	**-294.71**
Comparison with actual.																	
Return to Land & Management (actual)			-53.23	14.6	-35.95	-210.92	-46.73	-103.47	11.93	135.02	78.01	0.77	133.34	66.08	-169.96	-327.37	-275.09
Difference			7.14	51.65	21.19	130.97	0.88	44.89	-67.44	-84.97	-76.48	-67.35	-78.85	-73.91	-58.74	-3.36	-19.62

TF = Traditional Farmers, MF = Modern Farmers, and All = Traditional and Modern Farmers .

Appendix 8. Validation of Bean Production Profitability Using Standard Labor Parameters (using mean from the pooled data set).																	
Basic Information collected from the survey			**Postrera 2000**			**Primera 2000**			**Postrera 1999**			**Primera 1999**			**Primera 1998**		
			TF (N=13)	MF (N=6)	All (N=19)	TF (N=13)	MF (N=6)	All (N=18)	TF (N=13)	MF (N=6)	All (N=20)	TF (N=13)	MF (N=6)	All (N=18)	TF (N=6)	MF (N=14)	All (N=19)
Yield (Kg/ha)			287.97	423.29	330.7	248.72	303.94	284.45	361.37	641.68	515.53	325.05	707.43	516.24	955.73	1265.43	1167.63
Price (US$/ha)			0.51	0.64	0.55	0.45	0.47	0.46	0.52	0.51	0.51	0.49	0.51	0.5	0.18	0.11	0.13
Input Cost (US$/ha)			44.18	43.74	44.04	58.73	47.15	51.01	40.03	37.49	38.63	27.97	55.46	41.72	106.07	109.67	108.53
Traction contract cost (US$/ha)			0	0	0	7.68	11.13	10.27	36.27	36.14	36.19	35.03	32.76	34.02	51.67	89.61	76.22
Area (ha)			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wage Rate (US$/man-days)			2.22	2.22	2.22	2.17	2.17	2.17	2.63	2.63	2.63	2.69	2.69	2.69	2.55	2.55	2.55
Quantity of seed used (kg/ha)			53.31	54.26	53.61	49.51	46.37	47.42	46.67	51.42	49.37	41.82	53.06	46.45	70.68	51.3	57.11
Quantity of fertilizer used (kg/ha)			2.86	59.02	26.44	16.11	18.39	17.25	0	0.75	0.75	0	97.41	97.41	121.66	130.44	127.51
Quantity of Herbicide used (l/ha)			1.91	1.43	1.85	2.06	2.49	2.32	1.67	1.43	1.53	2.17	2.19	2.18	1.16	1.91	1.59
Quantity of Insecticide (l/ha)			1.21	0.91	1.07	1.42	0.4	0.74	0.57	0.75	0.69	0.9	0.65	0.75	0.79	1.68	1.42
Quantity of fungicide (gm/ha)			0	0	0	1.43	0	1.43	0	1.43	1.43	0	0	0	0	2.6	2.6
Average number Fertilizer Applications				1.31													
Average number if Herbicide applications				1.16													
Average number of Insecticide Applications				1.3													
Average number of Fungicide Applications				1													
Synthetic Budget																	
Variables	**Standard Parameters**																
Revenue:	**Qtty.**	**unit**															
Yield (kg/ha)			287.97	423.29	330.70	248.72	303.94	284.45	361.37	641.68	515.53	325.05	707.43	516.24	955.73	1265.43	1167.63
Price (US$/kg)			0.51	0.64	0.55	0.45	0.47	0.46	0.52	0.51	0.51	0.49	0.51	0.50	0.18	0.11	0.13
Gross Enterprise Income			**146.86**	**270.91**	**181.89**	**111.92**	**142.85**	**130.85**	**187.91**	**327.26**	**262.92**	**159.27**	**360.79**	**258.12**	**172.03**	**139.20**	**151.79**
Cost:																	
Input Cost (US$/ha)			44.18	43.74	44.04	58.73	47.15	51.01	40.03	37.49	38.63	27.97	55.46	41.72	106.07	109.67	108.53
Traction Cost (US$/ha)			0.00	0.00	0.00	7.68	11.13	10.27	36.27	36.14	36.19	35.03	32.76	34.02	51.67	89.61	76.22
Partial Operation cost			44.18	43.74	44.04	66.41	58.28	61.28	76.30	73.63	74.82	63.00	88.22	75.74	157.74	199.28	184.75
Labor cost:																	
land Preparation																	
with labor only	**16.571**	man-days/ha	36.79	36.79	36.79												
oxen used for primary tillage	**8.120**	man-days/ha				17.62	17.62	17.62	21.36	21.36	21.36	21.84	21.84	21.84	20.71	20.71	20.71
Planting	**0.232**	man-days/kg (seed)	27.46	27.95	27.61	24.93	23.34	23.87	28.48	31.37	30.12	26.10	33.11	28.99	41.81	30.35	33.79
Application of Fertilizer	**2.417**	man-days/Application	7.03	7.03	7.03	6.87	6.87	6.87	8.33	8.33	8.33	8.52	8.52	8.52	8.07	8.07	8.07
Application of Herbicide	**2.478**	man-days/Applications	6.38	6.38	6.38	6.24	6.24	6.24	7.56	7.56	7.56	7.73	7.73	7.73	7.33	7.33	7.33
Application of Insecticide	**2.618**	man-days/Applications	7.56	7.56	7.56	7.39	7.39	7.39	8.95	8.95	8.95	9.16	9.16	9.16	8.68	8.68	8.68
Application of Fungicide	**1.849**	man-days/Applications	4.10	4.10	4.10	4.01	4.01	4.01	4.86	4.86	4.86	4.97	4.97	4.97	4.71	4.71	4.71
Manual Weeding	**17.927**	man-days/ha	39.80	39.80	39.80	38.90	38.90	38.90	47.15	47.15	47.15	48.22	48.22	48.22	45.71	45.71	45.71
Harvesting	**0.046**	man-days/kg (yield)	29.41	43.23	33.77	24.83	30.34	28.39	43.72	77.63	62.37	40.22	87.54	63.88	112.11	148.43	136.96
Threshing	**0.022**	man-days/kg (yield)	14.06	20.67	16.15	11.87	14.51	13.58	20.91	37.13	29.83	19.24	41.87	30.55	53.62	70.99	65.50
Other activities	**5.416**	man-days/ha	12.02	12.02	12.02	11.75	11.75	11.75	14.24	14.24	14.24	14.57	14.57	14.57	13.81	13.81	13.81
Labor Cost			184.61	205.53	191.21	154.41	160.97	158.63	205.55	258.58	234.77	200.57	277.53	238.43	316.57	358.80	345.28
Opportunity cost of Equity capital			11.28	11.91	11.48	14.64	17.42	15.73	25.44	35.21	29.83	23.93	38.89	31.69	38.68	47.16	44.54
Total Enterprise Cost			**240.07**	**261.17**	**246.73**	**235.46**	**236.68**	**235.64**	**307.29**	**367.42**	**339.42**	**287.50**	**404.65**	**345.87**	**512.99**	**605.25**	**574.58**
Return to Land and Management			**-93.21**	**9.73**	**-64.85**	**-123.53**	**-93.83**	**-104.79**	**-119.38**	**-40.17**	**-76.50**	**-128.22**	**-43.86**	**-87.75**	**-340.96**	**-466.05**	**-422.78**
Comparison with actual.																	
Return to Land & Management (actual)			-53.23	14.6	-35.95	-210.92	-46.73	-103.47	11.93	135.02	78.01	0.77	133.34	66.08	-169.96	-327.37	-275.09
Difference			-39.98	-4.87	-28.90	87.39	-47.10	-1.32	-131.31	-175.19	-154.51	-128.99	-177.20	-153.83	-171.00	-138.68	-147.69

Appendix 9. Average Bean Yield, Price, Gross Income and Returns, Honduras.

Items	***Primera* 1998** *(El Paraiso)*		***Primera* 1999** *(Olancho)*		***Postrera* 1999** *(Olancho)*		***Primera* 2000** *(Yoro)*		***Postrera* 2000** *(Yoro)*	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Yield (Kg/ha):										
Traditional	955.73	590.07	325.05	207.50	361.37	152.50	248.72	238.01	287.97	159.02
Modern	1265.43	694.70	707.43	440.32	641.68	305.55	303.94	227.22	423.29	326.28
Total	1167.63	663.57	516.24	387.56	515.53	281.78	284.45	225.19	330.70	224.96
Significance level (t-test)[a]	*0.336*		*0.037*[*]		*0.018*[*]		*0.499*		*0.233*	
Price (US$/Kg):										
Traditional	0.18	0.10	0.49	0.04	0.52	0.04	0.45	0.04	0.51	0.07
Modern	0.11	0.05	0.51	0.06	0.51	0.05	0.47	0.10	0.64	0.13
Total	0.13	0.07	0.50	0.05	0.51	0.04	0.46	0.08	0.55	0.11
Significance level (t-test)[a]	*0.211*		*0.373*		*0.486*		*0.498*		*0.011*[*]	
Gross Income (US$/ha):										
Traditional	172.03	38.66	159.27	101.27	187.91	86.61	111.92	90.95	146.86	73.90
Modern	139.20	127.25	360.79	201.58	327.26	179.30	142.85	104.22	270.90	205.22
Total	151.79	106.51	258.12	182.92	262.92	159.01	130.85	98.25	181.89	137.98
Significance level (t-test)[a]	*0.538*		*0.027*[*]		*0.036*[*]		*0.499*		*0.059*[**]	
Enterprise Gross Margin										
Traditional	-107.48		43.97		58.92		-55.38		70.67	
Modern	-195.74		169.49		168.78		7.69		118.54	
Total	-165.15		106.03		114.72		-1.16		92.42	
Return to Family Land and Management										
Traditional	-215.42		-2.49		11.93		-229.76		-61.50	
Modern	-349.08		129.57		133.55		-61.08		-5.68	
Total	-304.70		62.01		73.48		-103.47		-35.95	

a/ T-test for equality of means of number of days:

[*] Significant at 5% significance level.

[**] Significant at 10% significant level.

[***] Significant at 15% significant level.

Appendix 10. Average Bean Seed Rate, Prices and Total Seed Costs by Type of Farmer, Honduras.

Items	***Primera* 1998** *(El Paraiso)*		***Primera* 1999** *(Olancho)*		***Postrera* 1999** *(Olancho)*		***Primera* 2000** *(Yoro)*		***Postrera* 2000** *(Yoro)*	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Qtty. Seed Used (Kg/ha):										
Traditional	70.68	26.43	41.82	15.79	46.87	14.67	49.51	21.78	53.31	18.96
Modern	51.30	31.76	53.06	17.95	51.42	8.76	46.37	15.33	54.26	23.19
Total	57.11	30.94	46.45	17.14	49.37	11.68	47.42	17.14	53.61	19.73
Significance level (t-test)[a]	*0.185*		*0.207*		*0.428*		*0.761*		*0.932*	
Price (US$/Kg):										
Traditional	0.84		0.55		0.59		0.70		0.62	
Modern	0.79		0.80		0.55		0.63		0.57	
Total	0.81		0.68		0.56		0.66		0.60	
Total Seed Cost (US$/ha):										
Traditional	59.60	20.43	22.86	15.55	27.53	7.53	34.73	13.61	33.11	17.45
Modern	40.78	23.86	42.69	14.68	28.52	4.49	29.46	12.36	30.87	9.45
Total	46.42	24.04	31.67	17.87	27.73	5.99	31.22	12.64	32.40	15.13

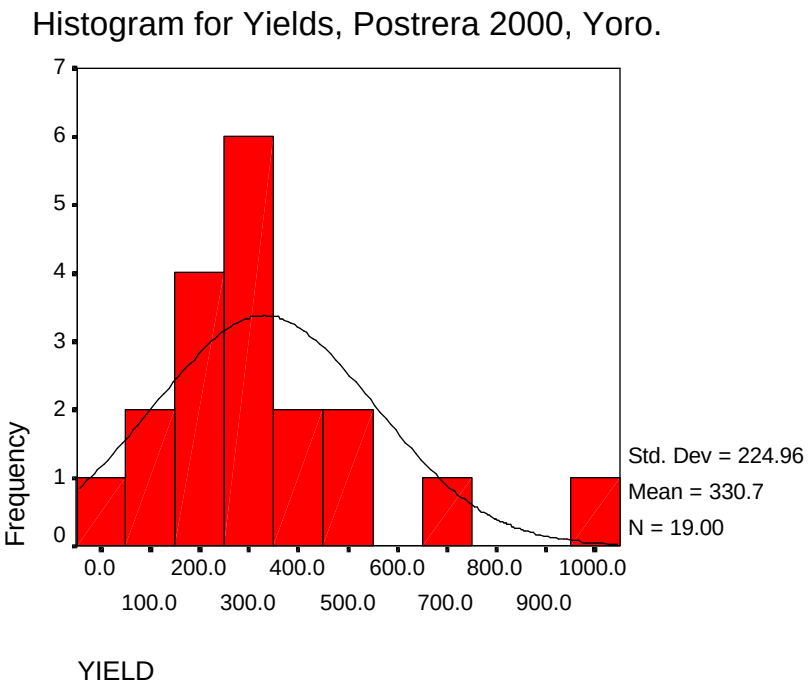
a/ T-test for equality of means of number of days:

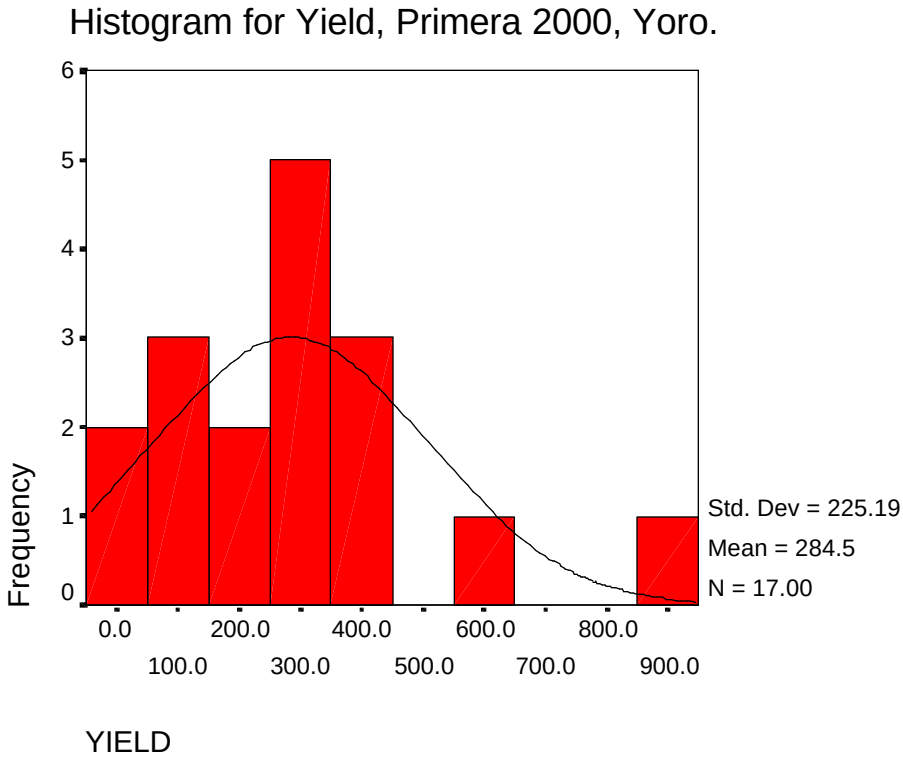
* Significant at 5% significance level.

** Significant at 10% significant level.

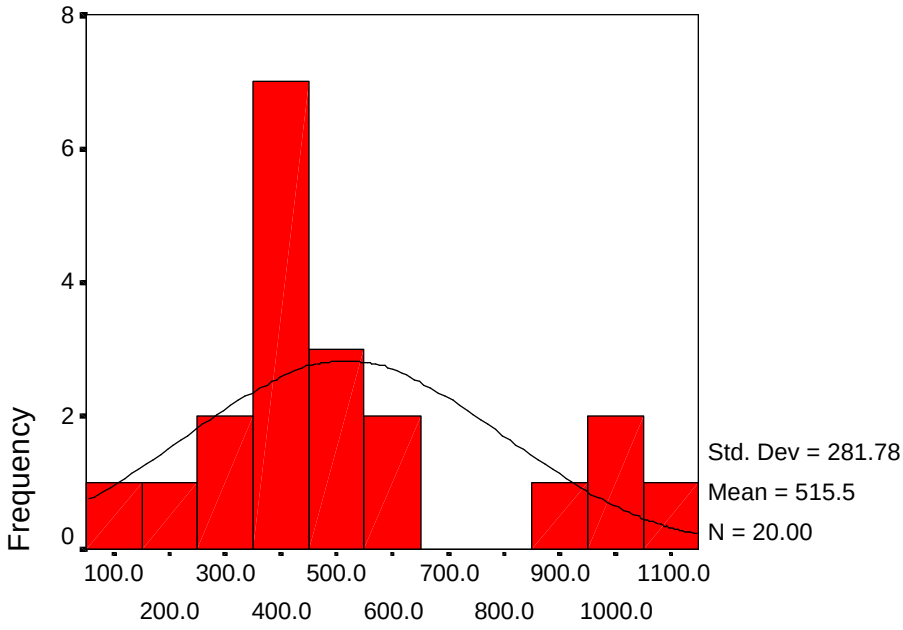
*** Significant at 15% significant level.

Appendix 11. Yield Distribution (for both traditional and modern farmers) by Season/Year.

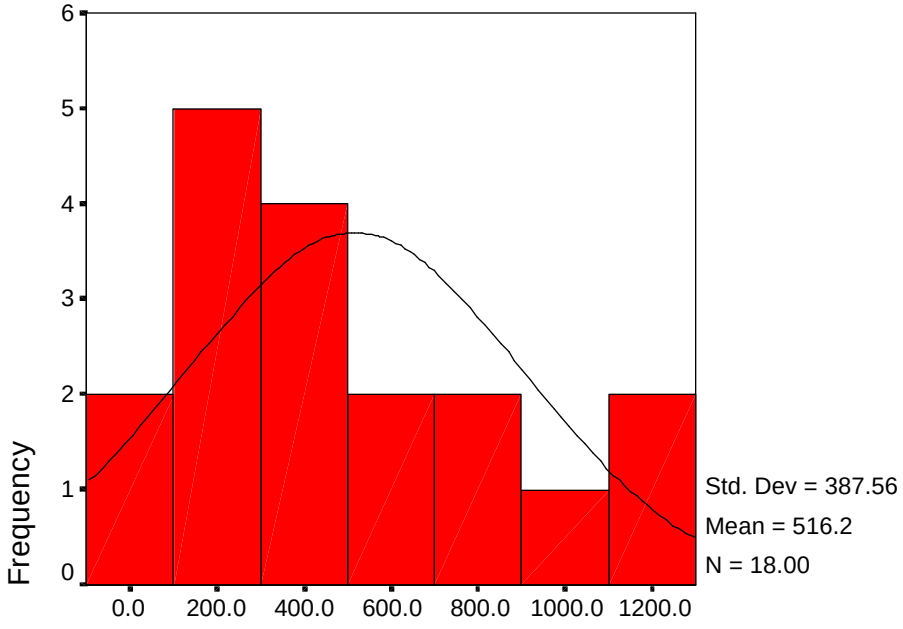




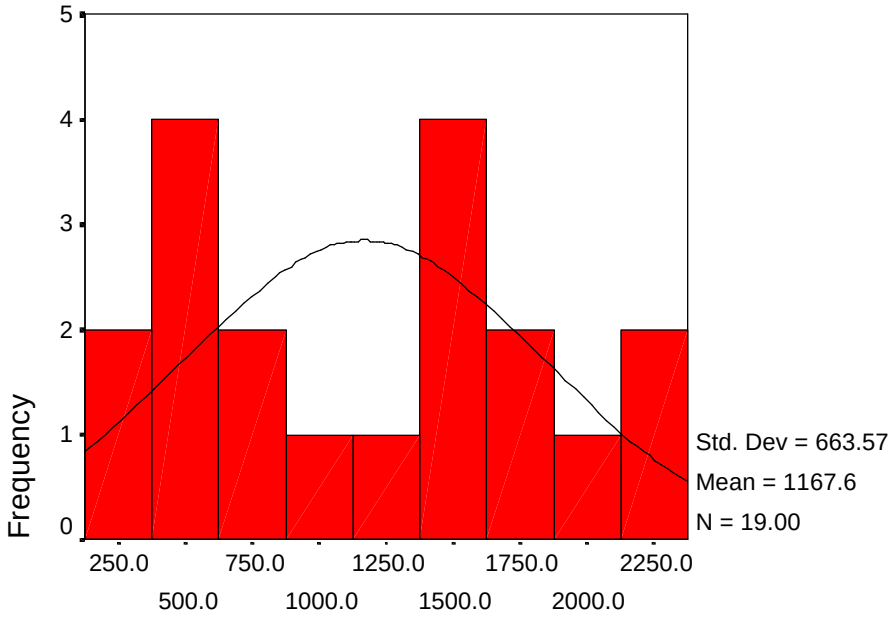
Histogram for Yields, Postrera 1999, Olancho.



Histogram for Yields, Primera 1999, Olancho.



Histogram for Yields, Primera 1998, El Paraiso.



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BIBLOGRAPHY

Bernsten, R.H., D. Mather, D. Mainville, H. Gonzales, and J. Estrada-Valle (2000). *Dry Beans in Mexico, Central America, and the Caribbean: Impacts and Constraints to Increasing Consumption, Production, and Trade*. Bean/Cowpea CRSP Project, East Lansing, Michigan State University.

Bernsten, R.H. and D. Mainville (1998). *Smallholder Seed Schemes in Developing Countries: Lessons Learned & Implications for Designing More Effective Seed Schemes.* Paper presented at the Workshop on the Production & Distribution of Bean Seed, Zamorano, Honduras.

Casley D.J. and K. Kumar (1998). *The Collection, Analysis, and Use of Monitoring and Evaluation Data*. World Bank Publication. The Johns Hopkins University Press, Baltimore, Maryland, USA.

Dillon, J.L. and J.B. Hardaker (1980). *Farm Management Research of Small Farmer Development*. Agricultural Services Bulletin. FAO, Rome.

Gerloff, D.C. and R. W. Holland Jr. (1995). *Establishing and Using a Farm Financial Record-Keeping System.* Agricultural Extension Services, University of Tennessee.

Harsh, S.B., L. J. Connor and G.D. Schwab (1981). *Managing the Farm Business*. New Jersey: Prentice-Hall, Inc., Englewood Cliffs.

Food and Agriculture Organization (FAO), On-line Agricultural Statistics, 2002.

Inter-American Development Bank (April 1999), *Problems and Opportunities for Developing the Rural Economy*, Working Paper, Washington, D.C.

Ishikawa, Yuki (1999). *The Profitability Analysis of Bean Production in Nicaragua*. East Lansing, Master Plan B Research Paper, Department of Agricultural Economics, Michigan State University.

McConnell, D.J. and J.L. Dillon (1997). *Farm management for Asia: a systems approach.* Food and Agriculture of the United Nations, Rome.

Mainville, Denise Y. (2000). Relief and Development: *Bean Seed Markets in Honduras After Hurricane Mitch*. East Lansing, Master Plan B Research Paper, Department of Agricultural Economics, Michigan State University.

Martel-Lagos, P.V. (1995). *A Socio-economic Study of the Honduran Bean Subsector: Production Characteristics, Adoption of Improved Varieties, And Policy Implications*. East Lansing, Doctoral Dissertation, Department of Agricultural economics, Michigan State University.

Martel-Lagos, P.V. and R. Bernsten (1994). *The Bean Subsector in Honduras: Historical Developments, Current Status, and Policy Issues.* Bean/Cowpea CRSP Socioeconomics Working Paper 94-2, Michigan State University.

World Bank, World Development Report 1998/1999, 2000 and 2002, Washington D.C.

World Bank, World Development Indicators, Washington D.C. 2002.

Websites referred

http:/www.hondurasag.org/background/

http://www.internationalspecialreports.com/theamericas/00/hondutas/agriculture/

http://www.countryreports.org/content/honduras.htm

http://www.immigartion-usa.com/wfb/honduras_economy.html

http://photius.com/wfb1999/honduras/honduras_economy.html

http://www.fao.org

www.latinsynergy.org/hondurasinfo.htm

www.culturegrams.com/country/premium/honduras/background/land.htm