ECONOMIC ASSESSMENT OF BEAN RESEARCH IN THE DOMINICAN REPUBLIC

By

David Len Mather

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Agricultural Economics

2001

ABSTRACT

ECONOMIC ASSESSMENT OF BEAN RESEARCH IN THE DOMINICAN REPUBLIC

By

David Len Mather

This study estimates the economic impact of two technologies developed by the USAID Bean/Cowpea CRSP in the Dominican Republic: PC-50, an improved red bean variety, and the fallow period in the San Juan Valley (SJV). Subsector analysis is used to document the policy and institutional factors which have led to widespread adoption of PC-50, and assesses the future competitiveness of domestic production.

While bean production in the SJV is financially profitable, it is unviable under economic valuation. While both the financial and economic *ex post* rate of return to PC-50 adoption in the DR during the period 1984-2002 indicate that B/C CRSP research attributed to screening, promotion, and multiplication of PC-50 was profitable. Although bean is uneconomic in the SJV, PC-50 adoption decreased the magnitude of economic loss that would have occurred without PC-50, thus generating a positive incremental benefit. However, the welfare benefits from PC-50 adopters have gone almost exclusively to irrigated producers, while consumers have not benefitted from this technology. When the SJV fallow period is considered an output of the CRSP, joint analysis of PC-50 and the fallow period lead to the result that the CRSP research in the DR is not profitable in economic terms.

ACKNOWLEDGMENTS

I express my sincere gratitude to Dr. Richard Bernsten, my major professor, for the opportunity to work on the Bean/Cowpea CRSP, and for his attentive, supportive, and critically constructive comments and suggestions during the thesis process. I also thank the other members of my committee, Drs. Eric Crawford and Russell Freed, for their timely and constructive comments. I especially thank Dr. Crawford and Dr. James Oehmke for their help with the benefit-cost analysis.

This research would have been virtually impossible without the logistical and research support of Dr. Eladio Arnaud Santana, the DR CRSP PI at the Centro de Investigación Agrícola del Suroeste (CIAS, Arroyo Loro). Special thanks to my team of enumerators: Segundo Nova and Ana Mateo. Their long hours of work were essential to the completion of this thesis.

I also thank the USAID/Bean Cowpea CRSP and the Department of Agricultural Economics at MSU for financial support during my M.Sc. program, and logistical support during my field work.

In the Dominican Republic, useful suggestions and comments were made by Dr. Cesar Paniagua (PRODAS), Dr. Jesus de los Santos (JAD), and Dr. Ruben Nunez (IICA). I thank Wagner Mendez for help in collecting secondary data in Santo Domingo, and for his hospitality.

I cherish the time I have spent with so many friends in the MSU community. Special thanks for support and friendship to Brady Deaton, Matt Schaefer, Jim Sterns, Allen Kannapel at EMMSU, and the soccer team.

I am especially grateful for the support of my family. I would not be here if it were not for the sacrifice, love, and inspiration provided by my mother, father, and brother.

I dedicate this work and my life to Jesus Christ, my Lord and Saviour.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE: INTRODUCTION

1.1 Problem Statement

Beans and rice are two of the most important staple foods in the Dominican Republic. Rice is the principle source of calories, and dry beans are the principle source of vegetable protein for the majority of Dominicans, especially the poor. Together, the traditional staples -- rice and beans -- account for 35% of calories and 27% of protein in the Dominican diet (Rogers, 1987). In addition to being an important staple food crop for consumers, beans are also an important cash crop for both commercial and subsistence farmers throughout the country. The financial importance of this crop to commercial farmers, combined with high farmer participation in farm commodity organizations and heavy government involvement in the direct marketing of beans in the DR since the mid-1970s, makes beans one of the most political crops in the country. In addition to the importance of beans to both consumers (as a staple food) and to producers (as a cash crop), consumption of beans is an integral part of the country's culture. The most common midday meal for the majority of Dominicans is *arroz con habichuelas* (rice and beans).

Compared to many developing countries, Dominican bean yields are relatively high, averaging 765 kg/ha over the last twenty years (SEA, 1998). However, during this period, yields have ranged from 565 to 1,021 kg/ha due to erratic growing conditions. Agronomic constraints to increasing yields include heat stress and the widespread threat of yield-reducing diseases, including bean golden mosaic virus (BGMV), common blight, rust, and web blight.

In light of the nutritional, economic, political, and cultural importance of beans, and the realization that the country's producers were not keeping pace with consumer demand, in 1981, the Dominican Ministry of Agriculture (SEA) joined together with the USAID-funded Bean Cowpea Collaborative Research Support Project (CRSP) to undertake research designed to increase bean production and stabilize bean yields in the DR. Major research objectives of this initiative have included developing new higher-yielding, disease-tolerant varieties and identifying improved management practices to reduce disease incidence.

This collaboration on varietal improvement led to the release of "PC-50" in 1989, a red molted variety chosen from among 250 selections of the widely grown local land race "Pompador Checa." PC-50 is high-yielding, has uniform seed size and maturity, good cooking attributes, and is tolerant to rust and to both common and web blight. Since 1990, the Seed Department of SEA (the Dominican Ministry of Agriculture) has contracted farmers to grow "seed of good quality" for subsequent sale to commercial producers.

In addition to developing improved seed, the project identified "fallowing" as a strategy for reducing the incidence of BGMV in the San Juan Valley (SJV), the leading bean-producing area in the country. Based on this research, in 1991, the project recommended that SJV farmers incorporate a "fallow" period for beans into their cropping pattern from August to November, followed by a planting period from 15 November to 10 January. The Southwest regional government made this fallow and planting period recommendation into law for the 1991/92 season. As a result of subsequent research on optimal planting dates in the San Juan Valley, in 1993, the Southwest regional government adjusted the mandated planting period to 5 November to 15 December. Anecdotal evidence suggests that the fallowing and optimal planting strategy have contributed to a much lower level of BGMV than seen in the 1989-91 period, and has reduced farmers' dependence (and expenditures) on insecticides used to control the white fly, the vector of BGMV.

The widespread adoption of both PC-50 and the fallow period in the SJV suggests that the Bean/Cowpea CRSP research program has had a major impact on bean production in the DR. While previous studies have documented the widespread adoption of this technology package (Heikes 1993, Arnaud 1997), the role of institutional arrangements and the policy environment that contributed to its widespread adoption has not been documented, nor has an analysis of the economic rate of return to CRSP bean research in the DR been conducted.

1.2 Research Objectives

The general objective of this study is to assess the impact of PC-50 and the SJV fallow period and to describe the policy factors that facilitated PC-50 adoption. The policy framework that delineates the opportunities and constraints facing all bean subsector agents also defines the distribution of the impact benefits among them. This study thus documents the policy framework as an integral part of the impact assessment.

The specific objectives of this research are to:

1) Assess the financial and economic costs of bean production in the SJV;

2) Determine the incremental benefits associated with farmer adoption of PC-50; the

adoption of the SJV fallow period; and the economic rate of return (ROR) to CRSP investments;

3) Assess the sensitivity of this ROR to key assumptions of bean area, yield, and farm-level bean price;

4) Identify the policy and institutional factors that account for widespread adoption of PC-50 and associated management practices in the SJV and other principal production areas, including: the roles of the CRSP, the government, and farmer associations in promoting seed variety development, production, distribution, and adoption; CRSP field days and other extension efforts; and government price supports;

5) Describe the bean subsector, focusing on the seed and grain price negotiation process, input/output marketing channels, and price differentials between domestic and imported beans and between beans grown for seed and consumption.

6) Document farm-level constraints to increased production and profitability; farmers' perceptions of the advantages/disadvantages of PC-50 and the planting dates; and farmer responses to various hypothetical bean price scenarios.

1.3 Hypotheses

This study tests the hypothesis that investments in agricultural research have positive returns. Specifically, it will determine if the economic rate of return (ROR) to investment in bean research in the DR is greater than the opportunity cost of capital. Many ROR studies in Latin America report a high rate of return to agricultural research (Daniels *et al.*, 1992), and previous studies indicate that project-developed technologies have been widely adopted, have improved bean yields, and have brought BGMV under control in the San Juan Valley, the primary bean grain and seed-producing region in the DR. While CRSP documents report that CRSP bean research in the Dominican Republic has been a resounding success, this is not clear from an economic perspective. This guarded pessimism is due to the high production costs of domestic beans relative to imports, and the high domestic retail bean prices (relative to other countries and to protein substitutes) that result from import restrictions.

Subsector analysis will describe how policy and institutional arrangements facilitate the adoption of agricultural technologies and thus the economic rate of return. It will also describe the distribution of the benefits of technology adoption, which are hypothesized to be significant for larger, resource-abundant farmers, small for smaller, resource-poor farmers, and potentially negligible for consumers. Because domestic production rarely meets demand, and because imports are restricted based upon annual projections of domestic production, real domestic retail bean prices have not fallen, meaning that benefits from increased yields are captured almost entirely by producers.

1.4 Organization of Thesis

This thesis is divided into seven chapters. Chapter 2 briefly reviews the rate of return literature and presents the research design and methodology. Chapter 3 gives an overview of macroeconomic and demographic conditions in the DR, including a general overview of the agricultural sector. Chapter 4 presents an overview of the Dominican bean subsector. Chapter 5 presents a detailed view of bean production in the San Juan Valley. Chapter 6 reports results of the rate of return analysis and the distribution of the project impact, given the institutional framework described in the subsector analysis.

Chapter 7 summarizes the findings of the study and draws policy implications.

CHAPTER TWO: LITERATURE REVIEW AND METHODS

2.1 Introduction

This chapter first presents literature relevant to determining the economic impact of bean research in the DR, and documenting the institutions and policies which account for the magnitude and distribution of this impact. The choice of benefit-cost methodology is then discussed, followed by a discussion of the data collection methodologies and instruments.

2.2 Literature Review

2.2.1 Benefit-Cost Analysis

2.2.1.1 Technical Innovations and Resource Productivity

The challenge of increasing agricultural production requires continuous investment in the development and extension of productive agricultural technology. Since the early 1960s, developing countries, assisted by foreign donors, have invested resources to strengthen their agricultural research systems to generate technologies to increase agricultural productivity. Agricultural economists have long supported this strategy, arguing that technical innovations in agricultural production drive the development of the agricultural sector, whose growth is viewed as a precondition to the sustainable and broad-based growth of the general economy (Mellor, 1966). Because such investment is costly and competes for scare public and donor resources, socioeconomic impact studies of such investments can help policymakers to assess the value of these past investments and prioritize alternative future research investments to enable improved allocation of scarce resources to meet their economic, political, and social interests. Numerous studies that have assessed the impact of research on agricultural productivity growth, particularly in the US, Latin America, and Asia, indicate a high rate of return to investment in agricultural research (Daniels *et al*, 1992).

2.2.1.2 Benefit-Cost Methodologies

Most published impact assessments attempt to quantify benefits as economic or financial returns to expenditures for agricultural research. Three extensive reviews of such impact methodologies include Schuh and Tollini (1979), Norton and Davis (1981), and Echeverria (1990). Impact methodologies can be grouped into two main categories: *ex post* and *ex ante* approaches. The *ex post* approach is used to determine the impact of past research expenditures while the *ex ante* approach is typically used to estimate expected rates of return for proposed projects.

Echeverria (1990) groups quantitative benefit-cost methods into two general classes, the economic surplus approach (consumer-producer surplus, benefit-cost, and index number methods) and the econometric approach (production, profit and supply functions and their derivations). Economic surplus approaches "estimate returns on investment (an average rate of return) by measuring the change in consumer and producer surplus from a shift to the right in the supply curve due to technological change (*ibid*, 1990)." Econometric approaches "treat research as a variable and allow a marginal rate of return on investment to be calculated (*ibid*, 1990)." The average rate of return over some time period is considered appropriate for *ex post* analysis as an indicator of the financial and economic profitability of past investments. The marginal rate of return is considered more appropriate for situations in which research expenditures related to the technology in question are ongoing.

Several different indicators or measures of the return of the investment may be employed. The internal rate of return (IRR) is once such measure, defined as follows: The IRR is the interest rate that equates the net present value of cash flows to zero, as calculated by the equation:

$$\sum_{t=1}^{n} \frac{B_t - C_t}{(1+r)^t} = 0$$

where "B_t" and "C_t" are the values of the benefit and cost streams in each time period from *t = 1 to n*, and "*r*" is the interest rate that solves the equality (the IRR).

The IRR is the "rate of return on capital outstanding per period while it is invested in the project (Gittinger, 1982);" in other words, the return to the money invested in the project. For example, an IRR of 18 percent means that project returns are large enough to cover all operating costs, pay back the principal on the capital invested in the project, and return an average 18 percent annually for the use of the money in the meantime. A project with an IRR that exceeds the average real market interest rate during the project life is deemed "profitable."

Economists make further distinctions when measuring profitability, primarily between "financial" and "economic" valuation. The financial ROR is an IRR where benefits and costs are valued in terms of market prices and domestic currency, unadjusted for "distortions" in the prices of inputs or outputs in question. Thus, financial values are the actual and unadjusted prices faced by producers and consumers over the time period in question. The economic ROR is an IRR where the benefits and costs are valued in terms of their economic opportunity costs. Economic opportunity costs are "financial" prices adjusted to reflect the "economic values" of the inputs and outputs in question. For example, the *financial* farmgate price of beans in the DR is the actual reported price per unit at any given point in time. On the other hand, the *economic* farmgate price of a metric ton of Dominican beans is the sum of the total cost (of production, marketing, and transport) necessary to bring a metric ton of imported beans (assumed to be a perfect substitute for the domestic product) to the same physical location in the DR at which the farmgate price was recorded. This study will present rate of return indicators reflecting both financial and economic valuation of benefits and costs.

Many of the pioneering efforts to measure the impact of agricultural technology adoption assumed closed-economy scenarios and reported aggregate benefits to society or benefits disaggregated between producers and consumers of the commodity in question. More recent methodological developments have focused on incorporating distributional issues, social costs, and the effects of government trade and price policy regimes into the impact analysis.

The consumer-producer surplus approach generally assumes that producers who adopt new technologies enjoy higher productivity (lower production costs per unit of output), while consumers enjoy the lower relative product prices that result from an increased product supply. An advantage of this approach is that it is relatively flexible and can be modified to account for the effect of trade and price policy on the distribution of benefits between consumers and producers. This is only feasible when the technology in question can be associated with a particular research program. The empirical information required is knowledge of how much the technical change shifted the supply curve and estimates of the elasticities of supply and demand for the commodity.

Consumer-producer surplus approaches need not limit impact analysis to the aggregate benefit to society or to consumer and producers in the aggregate. In fact, the effect of technological change on the structure of input and output markets for the commodity affected by technological change can influence the distribution of income within a society and the relative productivity of factors of production. For example, when technology adoption leads to increased production of a staple commodity (and assuming that increased production leads to lower retail prices of that commodity), low-income groups benefit relatively more than high income groups from lower output prices. However, lower output prices may reduce the profitability of late or non-adopters of new production technologies.

If the technology package requires such complimentary inputs such as irrigation or fertilizer, small rainfed producers lacking these resources would either not adopt the technology or not enjoy the full benefits of its yield-augmenting potential. Therefore, lower product prices could therefore have a detrimental effect on producers not able to adopt said cost-diminishing or yield-augmenting production technologies, assuming said producers are net sellers of the commodity. With that in mind, Scobie and Posada (1978) note that "frequently it is the well-being of only the rural poor (both small farmer and landless worker) that is the focus of attention. The presence of large concentrations of urban poor who are potential beneficiaries of expanded production of basic food stuffs is sometimes neglected when castigating (new technologies)." Their influential study of the impact of improved rice varieties in Colombia demonstrated that the benefits of lower food prices for the urban poor in Colombia far outweighed the costs to rural rice producers in the form of lower farmgate prices. Their work thus demonstrated the value of investigating the distribution of both benefits and costs - not just the distribution between consumers and producers, but the distribution between subgroups within consumer and producers in the aggregate.

In their assessment of the impact of mechanical tomato harvester adoption in the U.S., Schmitz and Seckler (1970) argued that an increase in productivity due to technical change can lead to a release of resources from the sector, depending on the demand conditions for the product. If alternative employment possibilities are not available, the resources released may be unemployed. They argue that in such cases, the income lost by these unemployed resources has to be deducted from the benefits of the technical change to determine the net benefits. Their research thus contends that adjustment costs faced by displaced labor should not be assumed away. The work of Hirschman (   ) and Williamson (1985) show that this reasoning also applies to capital; assets highly specific to a given transaction that suddenly become unemployed may in fact face substantial adjustment costs.

Other variations on more standard consumer-surplus approaches include Capalbo and Antle's (1989) framework to include social costs such as environmental damage and human health risk in the impact analysis. Oehmke (1988) demonstrated that the interaction between successful research and other government interventions in the same commodity market can increase the cost of those interventions, thus decreasing the return to the research. For example, a government commodity procurement or price support payments program may suddenly incur greater costs if domestic production is increased. These incremental commodity program costs to the government would be considered indirect economic costs to be included along with the research costs. Not including such indirect economic costs in the benefit-cost analysis would therefore bias the IRR upward. He also noted that many studies in the literature - often those reporting high returns - assume that the only relevant government intervention was the research, and thus neglected this bias that unambiguously increases the calculated rate of return. Various practitioners suggest that high returns among *ex ante* evaluations may also be due to selection bias, in that successful projects are more likely to be the focus of impact evaluation (Echeverria, 1990).

2.2.1.3 Appropriate Benefit-Cost Methodology

The choice of impact assessment method employed depends on several factors including the availability of data, the objectives of the research, and the timing of the study. As noted above, the average rate of return (from economic surplus approaches) is considered appropriate for *ex post* analysis as an indicator of the financial and economic profitability of past investments, while the marginal rate of return (from econometric approaches) is considered more appropriate for situations in which research expenditures related to the technology in question are ongoing. The econometric approaches are not appropriate for estimating the ROR to bean research in the DR because the expenditures in question are not ongoing, and because these methods require highly accurate and detailed time-series data on inputs, outputs, and research expenditures which are not available. While CRSP-funded bean research in the DR is fact on-going, this analysis is only focusing on the impact of a technology which developed between 1985 to 1990 and subsequently released in 1990.

An economic surplus method is therefore more appropriate for this analysis because all relevant expenditures of the project under review occurred in the past. The objective of the analysis is limited to estimating the average rate of return over the sum of these historical expenditures. While there are no known estimates of the bean supply and demand elasticities in the DR, the consumer-producer surplus method is nevertheless used, and sensitivity analysis of assumed elasticities is presented. The benefit-cost method is also presented here in the sense that one elasticity scenario within the consumer-producer supply method sensitivity analysis is the same calculation as that of the benefit-cost method (in which elasticity of supply =1 and elasticity of demand=0). Therefore, this study will calculate a cost stream that includes research costs of PC-50 from 1985 to 1990, as well as economic costs of government input subsidies from 1990 to 2004. The benefit stream is calculated as the adopted area (hectares) from 1989 to 2004 times the incremental yield from of adopted area (kg/ha) times the unit value of beans (US$/kg). These cost and benefit streams are used along with assumed supply and demand elasticities to estimate a financial and an economic average internal rate of return to CRSP-funded bean research in the DR related to the development of the variety PC-50.

2.2.1.4 Relevance of Benefit-Cost Literature

Beginning in 1989, the variety PC-50 was adopted nationwide primarily by farmers who were already using irrigation and fertilizer with the previous variety Pompadour Checa. While increased fertilizer usage was not promoted as part of a technology package including PC-50, sensitivity analysis in Chapter 6 nevertheless includes a scenario in which fertilizer usage is assumed to have increased with adoption, thus augmenting production costs per hectare. Though bean yields in the DR have increased since 1989, bean area and total production have declined. This fact, coupled with price stability stemming from the government's supply control policy (import restrictions), implies that producers have captured all the gains to incremental yields. All economic surplus is thus assumed to have accrued to producers. The issue of incremental environmental damage is not entertained here, because costs of production per hectare is assumed to be the same in both the with- and without-project scenarios, and because area planted has not increased. While areas of the SJV have recently experienced soil degradation due to impaction and over-salinization, these problems cannot be attributed to PC-50 adoption, as mechanical land preparation and irrigation were employed in the SJV long before 1990, and bean area has not increased.

The technology "package" embodied by PC-50 is assumed to be factor neutral (with respect to labor versus mechanization) yet scale-biased. There is nothing inherent in PC-50 adoption that implies labor savings. In fact, increased yields could increase harvest and post-harvest costs, 80 percent of which is labor (CRSP, 1998). Though it is true that farmers with better (i.e. mechanized) land preparation and fertilization rates have higher yields with PC-50 relative to resource-poor farmers, the larger farmers enjoyed higher yields with Pompadour Checa. However, PC-50 is still scale-biased in the sense that it is assumed here that incremental yields to rainfed producers are negligible. [1] Oehmke's concern for the interaction between increased yields from research and the costs of government intervention in the seed and grain markets is not relevant in the DR case. Because the government's bean seed and grain purchasing programs existed almost a decade prior to PC-50 adoption (see Chapter 3), and because government purchases for neither the bean seed multiplication nor the bean grain purchasing programs are tied in any way to the size of a given harvest (to yields), it is assumed that the costs of government intervention in seed and grain markets did not increase due to PC-50 adoption.

2.2.2 Institutional Analysis

In the absence of consumer-producer surplus techniques, qualitative institutional analysis can help identify not only *how* gains are distributed among different groups in society but also *why* a given research expenditure had a high, low, or negative rate of return. This analysis is also relevant because it includes a review of economic policy, which can largely determine whether or not new technologies are adopted at the farm level, which farmers may adopt them, and whether or not consumers share in the incremental benefits.

Schmid broadly defines institutions as "sets of ordered relationships among people that define their rights, their exposure to the rights of others, their privileges, and their

---

[1] It is possible that rainfed farmers have benefitted from the improved uniformity of PC-50, assuming improved uniformity has resulted in receipt of higher grades for their marketed beans (and thus higher prices paid by intermediaries).

responsibilities" (Schmid, 1987). In the DR, institutions that heavily influenced the adoption and profitability of CRSP-developed technologies included farmer organizations, the government's bean seed and grain marketing programs, and its trade and price policies. "In effect, (the policy and institutional framework) can provide the means whereby the biological and physical research program will be quite productive for the society, or it can cancel it out almost in its entirety" (Schuh and Tollini, 1979). Thus, the Dominican government's marketing and trade policies may therefore be as vital to the continuing profitability of bean production in the DR as it was for the adoption of PC-50.

2.2.3 On the Rapid Appraisal/Subsector Method of Analysis

The subsector approach has been used effectively as a tool to conduct research on a country's food system, including the United States as under the NC-117 project. The subsector paradigm was first proposed by Shaffer (1973) as the study of "the vertical set of economic activities in the production and distribution of a closely related set of commodities." This vertical set of activities is composed of horizontal levels such as input provision, farm-level production, assembly, processing, storage, transportation, wholesaling, retailing, and consumption. Each horizontal level, or industry, represents a transformation of inputs to produce a commodity with increasing value of time, space, and form. As noted by Byerlee (1993), the subsector approach generates information especially useful to policy makers and scientists when "a commodity or a region is undergoing rapid changes due to demand and supply factors or policy changes."

Because long term subsector research can be prohibitively costly and since the research findings are typically demanded by policy makers within a short time frame, rapid appraisal techniques have been merged with the subsector analysis paradigm (Holtzman, 1986). A rapid appraisal survey is characterized as a broad and preliminary overview of the organization, operation, and performance of a food system or components thereof, designed to identify key system constraints and opportunities (*ibid*, 1986). These techniques thus enable a researcher to synthesize data collected from secondary sources and key informants to generate an overview of the historical and current status of the subsector.

2.3 Instruments and Methods of Analysis

2.3.1 Rapid Appraisal

In implementing this study, a rapid appraisal was conducted during the initial two weeks of field work in June 1998. The primary objective of this rapid reconnaissance was to identify important constraints to increasing profitability of bean production, as well as factors that have accounted for the widespread adoption of the PC-50 bean variety in the San Juan Valley. The rapid appraisal also provided a clearer understanding of the current state of the bean subsector in the SJV which was required to design the questionnaire design and identify an appropriate sampling strategy. The rapid appraisal included a review of secondary documents, as well as interviews with key informants including CRSP scientists, government officials, non-governmental researchers, and farmer associations. Additional appraisal work was conducted at various intervals during and after implementation of the farmer survey. This activity involved continued review of secondary documents and interviews with key informants at various levels of the subsector, including input suppliers, researchers, merchants and traders at rural and urban markets and supermarkets, bean importers, and government officials from various programs active in the bean subsector.

2.3.2 Record-Keeping Data

The CRSP DR scientists implemented a cost of production record-keeping (RK) study in the San Juan Valley (SJV) during the 1997-98 winter bean season. A total of 29 bean farmers were selected from among of the valley's farmer associations. Dr. Eladio Arnaud-Santana, the CRSP-Principal Investigator in the DR, and Ana Mateo, one of the two enumerators, selected the sample. The sample farmers were visited once a week throughout the bean season by two enumerators under the direction of Dr. Arnaud-Santana. This RK study was undertaken in order to generate accurate data to assess the farm-level profitability of irrigated bean production in the DR, and to compare levels of input use among irrigated farmers of various resource endowments. The study was repeated with a new sample of 30 farmers during the 1998-99 winter bean season, although the results from this study are not used here.

While the RK farmer sample was not selected strictly at random, the distribution of sample farmers among each of the valley's bean farmer associations approximates the sampling quotas used in the larger producer survey (discussed below) undertaken in July-August 1998. Allocating the sample among the various farmer associations resulted in a sample that was representative of the diversity of socioeconomic, educational, technical, and resource endowment characteristics of the bean farmer population in the SJV.

2.3.3 Farm-level Adoption and Production Survey

2.3.3.1 Survey Objectives

A survey of 100 bean producers in the San Juan Valley was conducted from early July 1998 through early August 1998. The study focused primarily on collecting data required to assess the impact of bean research in the SJV, a region that accounts for 40 percent of national production, 80 percent of seed production, and has been the area targeted by the CRSP research. The survey was designed to collect retrospective data required to estimate farmers' bean yields (yields of PC-50 and varieties grown prior to adopting PC-50), inputs used, farmers' opinions concerning the advantages and disadvantages of PC-50 (compared to their previous variety), and their knowledge of the sources of disease problems common to the SJV and appropriate chemical and non-chemical remedies to said problems.

Adoption research typically focuses on estimating the overall adoption level and the characteristics that distinguish adopters from non-adopters. However, as non-adopters in the SJV account for less than 5 percent of all irrigated producers, the survey instead focused on collecting data to document the historical pattern of adoption (*i.e.* the year farmers adopted PC-50) and the physical, institutional, and household characteristics that accounted for this pattern.

2.3.3.2 Population and Sampling Method

The target population for the study was all farmers in the San Juan Valley who planted beans in the 1997-98 growing season. An estimated 95 percent of the estimated population of 1,001 SJV farmers (see Appendix A-1) are members of farmer organizations, and each organization is required by law to register information on the number and addresses of its members.[2] Thus, while the farmers included in these membership lists approximates the target population, they include farmers who did not grow beans.

A multistage sampling procedure was used to select a random sample of 100 farmers who planted beans in 1997-98. First, a membership list was obtained from each farmer organization, and a leader of each organization was asked to identify which of its members grew beans in 1997-98[3]. Second, the number of bean farmers across associations was summed to estimate the total population of bean farmers in the SJV. Third, each organization's share of the SJV farmer population was estimated to determine the percent of respondents to be selected (the quota) from each organization's membership list. Fourth, 27 of the 29 RK farmers were then assigned to their respective organizations. Fifth, from each organization's membership list, a random sample of farmers (excluding those who participated in the RK study) was selected to fill the quota assigned to that organization. Finally, at the beginning of the interview with the selected farmers, a screening question ("Did you plant beans in 1997-98?") was asked to determine if they planted beans during the previous growing season. If the farmer didn't grow beans,

---

[2] Please see Appendix A for a discussion of the validity of the sample frame.

[3] Firstly, a few associations were organized with respect to crops other than beans, though some of the farmers in said organizations grow beans. Secondly, some farmers within bean-dominated associations may choose not to grow beans a given year. Thirdly, some association members may be traders who have never grown beans before but simply use association membership in order to sell beans to the government (to obtain higher prices).

he/she was replaced with another randomly selected member of the same farmer organization.

While bean farmers with relatively large bean plantings account for a relatively small proportion of all bean farmers, they account for a large share of the bean area. Thus, in order to insure that the sample included a sufficient number of large farmers to obtain reliable estimates of their characteristics, the quota for large farmers was set higher than their actual percentage in the population (i.e. their sampling rate was higher than that for the small and medium size farmers). Similarly, the quota for small farmers was set at a lower percentage than their actual percentage in the population (i.e. the sampling rate of small farmers was lower than their incidence in the population). For example, although land reform farmers (i.e. all small farmers) make up 27.5 percent of the estimated SJV bean farmer population (N=1,001), the land reform quota was set at 19 farmers (19 percent of the sample, N=100). On the other hand, the sampling rate for the three associations that contain many of the larger farmers in the valley was increased slightly in order to ensure a sizeable number of large farmers in the sample. However, in the analysis section (Chapter 5), these data were weighted to reflect the actual percent of farmers in each bean farm size class (i.e. the weights enable accurate extrapolation of sub-sample statistics to the population). The actual sampling weights and their respective calculations are included in Appendix A-2.

2.3.4 Varietal Trials

As part of the process of selecting PC-50 from among various local, foreign, and crossed materials, CRSP scientists carried out experimental and semi-commercial varietal trials from 1985 to 1990. This experimental yield data serves as an upper bound to the incremental yields of PC-50 assumed in the benefit-cost analysis.

2.3.5 Related Research

In 1992, the Bean/Cowpea CRSP funded a nationwide study to document the adoption rate of PC-50, compare the characteristics of adopters versus non-adopters, and collect more general information about bean production and the constraints facing bean producers in the DR (Heikes, 1993). In addition to updating findings from the 1992 research, the 1998 research (which includes the RK survey, the Producer Survey, and the Rapid Appraisal) documents the institutional arrangements and government policies that contributed to widespread adoption of PC-50 and provides more accurate estimates of the costs of production and the benefits of adoption, which is used to assess the competitiveness of Dominican beans and to calculate financial and economic rates of return to CRSP investments in the DR. In addition to recall data from the Producer survey, this study uses the RK data to estimate costs of production and yields.

In recent years, Dr. Arnaud has implemented several SJV producer surveys which collected data on farmers' yields, input use, planting dates, and production constraints (Arnaud *et al*, 1994, 1996, 1997). While the sample sizes of these surveys ranged from 48 to 105 farmers and included information relevant to the planned benefit-cost analysis, these samples were not randomly selected. Therefore, while this data was not used directly for the benefit-cost or profitability analysis, it was nevertheless reviewed and used to confirm/supplement data collected in 1998 via the RK and Producer surveys.

2.3.6 Questionnaire design

A draft bean producer survey for use in the SJV of the DR was designed by David Mather, Bean/Cowpea CRSP Research Associate/MSU Agricultural Economics Graduate Student, and Dr. Richard Bernsten, CRSP Economist, prior to travel to the DR. Upon arrival in the SJV, Mr. Mather and Dr. Bernsten solicited advice from Dr. Arnaud, Segundo Nova (also of the CRSP-DR), and Ana Mateo (a SJV bean farmer who served as an enumerator for both the 1998 RK and 1998 Producer surveys), who all helped revise the draft into a pilot survey. Thus, Dr. Arnaud, Mr. Nova, and Mrs. Mateo played a vital role in revising the questionnaire as well as in formulating additional survey research questions. In addition, rapid appraisal interviews during the first week in-country also influenced the questionnaire design. Mr. Nova and Mrs. Mateo, the 1998 Producer survey enumerators, and Mr. Mather, the survey director, pre-tested the pilot survey on small, medium, and large farmers before completing the final questionnaire.

2.4 Chapter Summary

The impact analysis undertaken in this study uses benefit-cost, institutional, and rapid appraisal/subsector methods in order to not only assess the aggregate economic impact of bean research in the DR but to also describe the distribution of the benefits of adopting technology developed by the CRSP project, as well as the policies and institutions which underpin the incentives to adoption. Thus, this chapter reviews relevant literature in these methodologies and describes the research instruments developed and implemented in 1998 to collect the quantitative and qualitative data necessary to assess and document the profitability of bean production in the DR, the aggregate economic impact of PC-50 adoption, the distribution of said benefits, and the institutions that facilitated adoption and influenced the distribution of benefits.

CHAPTER THREE: THE DOMINICAN REPUBLIC

3.1 Physical and Socioeconomic Characteristics

3.1.1 Geography and Agroecology

The Dominican Republic is located in the Caribbean and together with Haiti forms the second largest Antillean island of Hispanola. The country occupies 48,442 square kilometers (4.8 million hectares). The climate is subtropical and topographically quite variable, consisting of fertile valleys, high and partly deforested and eroded mountains, and desert-like plains (FAS, 1997).

The mean temperature varies between 22 and 28 degrees centigrade (72 and 82 degrees Fahrenheit), rarely exceeding 32 or falling below 15 degrees - except at the high elevations. Precipitation patterns are very complex, due to the influence of the mountain and prevailing winds from the Caribbean and the Atlantic Ocean. In some regions, rainfall is evenly distributed throughout the year, while in other regions two distinct rainy seasons occur. The Northeast and East sections of the country receive the most rainfall (1500-2750 mm/year) while the Southwest and Northwest are much drier (350-1000 mm/year) (JICA, 1998).

3.1.2 Population Growth

The Dominican Republic's population was estimated at 8.1 million in 1997, yielding a population density of 167 persons/km^2. Population growth in the DR has increased at an average rate of 1.9 percent annually in the 1990s, decreasing from 2.6 percent in the 1970s and 2.3 percent in the 1980s (IDB, 1998). Although population growth rates have declined, two additional demographic factors pose a challenge for

Dominican food security. First, almost 50 percent of the population is less than 14 years of age. Second, migration from the countryside to the cities has dramatically increased the percentage of the population living in urban areas from 30 percent in 1960 to 51 percent in 1980 to 63 percent in 1997. During the 1990s, the growth in urban population has averaged 3 percent annually, while that of the rural areas has averaged 0.08 percent during the same period. While population growth and urbanization are not inherently detrimental to economic growth and poverty alleviation, in an environment of stagnate domestic food production and unbalanced macroeconomic growth, these trends can lead to decreased per capita food supplies and diminished nutritional status for the poorer segments of society.

3.2 The Economy

3.2.1 Macroeconomy

Macroeconomic indicators of the performance of the Dominican economy have been very positive over the last few years. Real GDP growth averaged 5.4 percent from 1992-97, with growth at levels above 7 percent in 1996 and 1997 (Banco Central, 1997). While inflation averaged 16.9 percent annually from 1991-95, it fell to 4 percent in 1996 and stood at 8.6 percent in 1997. For 1998 and 1999, inflation has been at or below 10 percent (EIU, 1997).

However, several structural weaknesses in the Dominican economy belie the optimism of these figures. Firstly, the DR has recorded a trade deficit in every year since 1976, which has been financed by receipts from tourism, remittances, and free zone exports. In 1996, tourism contributed US$ 1.7 billion, remittances $1.1 billion, and free zone exports $520 million (EIU, 1997). Family remittances, at an estimated 6.5 percent of GDP, are quite high compared to the 4 percent average for Central America, but remain below the 12 percent level which the IDB considers to be a problem (IDB, 1997). Though remittances may increase consumption, imports, and voluntary unemployment (at the expense of savings, domestic purchases and participation in labor markets), they may also increase investment in real estate and family-run small businesses, thus contributing to broadening the economic base *(ibid,* p.4 1997).

Secondly, although inflation has been brought under control in recent years, interest rates have remained high (around or above 25 percent). There are several explanations for these high rates. First, the central bank has maintained a tight monetary policy to keep inflation in check, to attract foreign capital, and to keep domestic capital within the country. Second, large government expenditures often crowd out private investment because of the payment and financing of government projects. Using the example of several recent construction projects, private contractors hired by the government are usually paid long after services have been rendered. These contractors must borrow from private banks to finance their operations, thus crowding out other investments (Nuñez, 1999). Finally, costs of intermediation are quite high. A new foreign investment law, effective September 1997, opened up the banking sector to further foreign participation, and may eventually lead to lower interest rates. Rates are clearly segmented by sector, however, with more productive sectors enjoying lower rates than those available for agriculture (Libre, 1998).

3.2.2 Income Distribution

The third structural weakness of the Dominican economy is its highly skewed income distribution. In 1997, the poorest 20 percent of Dominicans received 4.5 percent of national income and the wealthiest 20 percent received 60 percent (IDB, 1997). Therefore, while increasing per capita income is encouraging, this type of aggregate indicator hides growing income inequality. Income redistribution is minimal as no welfare or social security system exists, and the so-called land redistribution program of the government has granted very few titles to land reform recipients, keeping them dependent on the state. In addition, distribution of use rights to land alone has moved extremely slowly.

3.2.3 Poverty

The final structural weakness of the Dominican economy is the persistence of poverty. According to standards constructed on the basis of a 1992 national income and expenditure survey, more than one in four Dominicans lives in poverty, and almost one in ten in extreme poverty (World Bank, 1995). Rural poverty is three times greater than in urban areas and extreme poverty is twice as prevalent. A factor which exacerbates poverty, especially rural poverty, is stagnant growth of the agricultural sector.

3.2.4 Structure of the Economy

Manufacturing[1] and Agriculture are the two largest economic sectors, contributing 17 percent and 12.7 percent respectively to GDP in 1997 (Banco Central, 1998), and

---

[1] Manufacturing consists primarily of the processing of sugar, rice, beer, and tobacco.

accounting for 18.3 percent and 14.6 percent of formal sector employment. However, the largest share of the work force is employed in Other Services (27.2 percent) and Commerce (23.4 percent). Growth in Manufacturing and Agriculture has lagged that of the rest of the economy; from 1992-1997, agricultural GDP growth averaged 4.1 percent while manufacturing averaged 3.1 percent. The fastest growing sectors during this period were Hotels, Bar and Restaurants at 14.9 percent and Communications at 14.8 percent (Banco Central, 1998).

The Dominican economy is dualistic in nature, wherein those sectors relatively open to foreign investment and with close ties to international markets have grown rapidly (free trade zones (FTZs), telecommunications, and tourism), while domestically-oriented sectors have exhibited slow and often stagnate growth. To stimulate their expansion, the government has provided the FTZs total exemption from taxes for 15-20 years and from import duty on inputs. Thus this growth comes at the cost that direct revenue generation for the government does not exist for 20 years and though FTZ's, especially tourism, generate foreign exchange and employment, these enterprises have few other linkages to the domestic economy (IDB, 1997).

In 1996, 434 firms operated in 34 industrial FTZs, about one-half privately financed and operated. Most of the enterprises in these areas are involved in assembly and light manufacturing (textiles, shoes and leather goods, electronics, pharmaceuticals, and cigar manufacturing). From 1983-93, FTZ output expanded at an average of 26 percent per year and tourism grew by 17 percent annually (World Bank, 1995). In contrast, the rest of the economy grew at an average 1.8 percent per year. The implications of this growth for employment is clear: FTZ employment rose from 1,000 workers in 1970 to 165,000 in 1993, or 7 percent of the total labor force, with 70 percent of FTZ workers female.

However, this success is qualified. Furthermore, many FTZ products have benefitted from preferential access to the U.S. Market via the Caribbean Basin Initiative and the Generalized System of Preferences, and to the European Market through the Lome Convention. FTZ growth in 1996 fell to 5.9 percent, and productivity has fallen among many FTZ firms, suggesting diminished competitiveness. As a result of recent trade liberalization, government officials and FTZ business leaders are concerned about the potential impact of NAFTA on FTZ textile firms. However, the amount of trade that may be displaced by Mexico's new preferential access to the US textile, sugar, and other markets is not yet clear, as Mexico does not yet export significant quantities of many of the goods on which US tariffs were eliminated (IBRD, 1995).

3.3 Agricultural Sector

3.3.1 Agricultural Price and Trade Policy

In September 1990, the government initiated a major economic reform program that included trade, tax, financial, and exchange rate reforms. As a result, foreign exchange taxes were eliminated, the number of different tariff rates was reduced from 140 to 7 and the range of tariffs was reduced from 5 to 226 percent to 5 to 40 percent, all specific tariffs were converted to *ad valorem* rates, direct export taxes were removed, and use of non-tariff barriers decreased (World Bank, 1995).

The DR joined the GATT in 1994, which requires the replacement of existing licensing and quota systems with the tariff-rate-quota system. However, the implementation of WTO commitments remains unfinished. Although the agreement bound all agricultural imports to an across-the-board 40 percent maximum duty, the government proposed a "technical ratification" in 1995 to the original tariff schedule, modifying initial tariff and quota levels for eight commodities deemed politically sensitive (rice, beans, poultry, sugar, maize, onions, garlic, and milk). Perhaps more significant is the continued use of import licenses by the government to control the timing and quantity of imports of these sensitive commodities. The continuation of the import licensing regime maintains a nontransparent license acquisition process that, according to numerous accounts, generates enormous rents for government officials and importers while increasing price uncertainty over time for commodity wholesalers.

The government's assistance to the agricultural sector since the mid-1970s has primarily taken the form of input and output subsidies. For certain areas and crops, the government provides a limited amount of subsidized inputs (seed, irrigation, credit, tractor services, and land), as well as support prices for several commodities (some product is purchased directly by the government at supported prices). The goal of this assistance is to increase farm-level net income and commodity production, though long-term productivity-enhancing activities such as agricultural research and extension receive marginal funding. In June 1997, the government implemented several additional measures to assist agricultural producers, including eliminating import taxes on agricultural inputs (notably corn, soybean meal, fertilizers and pesticides) and abolishing the official exchange rate (below open market) for traditional agricultural export products (sugar, coffee, cocoa, and tobacco). For years, the differential between the official and market exchange rates had served as an indirect tax on cash crop exports (Valdes, 1997).

3.3.2 Land Use and Ownership

Of the country's 48,000 square kilometers (4.8 million ha), approximately 1.35 million hectares are arable -- about 28 percent of the country's total area. Of this arable land, approximately 29 percent is planted in permanent crops, 71 percent is planted in annual crops, and 16 percent (222,000 has) is irrigated (FAOSTAT, 1999). Permanent pasture occupies approximately 42 percent of total area, while forests and woodlands occupy 12 percent. Since 1965, the growth of arable and permanent crop area has averaged 1.5 percent annually, while the forest and woodland area has decreased during the 1980s by an average of 2.9 percent annually. However, the permanent pasture area has remained constant during the 1980s (World Bank, 1997).

While the average farm size is 7 hectares, land ownership is highly skewed. According to the 1981 census, farms with less than 5 hectares represented 82 percent of landed properties, but accounted for only 12 percent of cultivable land. In contrast, farms with 50 or more hectares represented less than 2 percent of landed properties while accounting for 55 percent of cultivable land. Furthermore, holdings with less than 5 hectares are characteristically marginal lands, of steep or rugged topography with no irrigation (Heikes, 1995).

3.3.3 Domestic Food and Cash Crop Production in 1997

The eight food crops with the largest area harvested in the Dominican Republic are: rice (97,400 has), beans (33,300 has), plantains (34,000 has), maize (28,700 has), cassava (16,000 has), pigeon peas (15,500 has), sorghum (8,500 has), and sweet potatoes (5,900 has). While maize and sorghum rank fourth and seventh, these two crops are generally used for feeding animals and not for direct consumption. As measured by total area planted, the five most important export crops are: sugar (194,000), cacao (141,000), coffee (125,700), bananas (33,000), and tobacco (18,800 mt) (Table 3.1).

Table 3.1 Major Food and Export Crops, DR, 1997

MAJOR FOOD CROPS	1997 Total Area Harvested (has)	percent change in area harvested from average of 1988-92 period to that of 1993-97
Rice	97,400	-3.1
Beans	33,345	-21.7
Maize	28,783	-1.2
Cassava	16,321	-0.6
Pigeon Peas	15,500	-14.8
Plantains	34,000	-28.1
Sorghum	8,541	-36.9
Sweet Potatoes	5,890	18
MAJOR EXPORT CROPS		
Sugar	194,986	3.2
Cacao	141,521	10.8
Coffee	125,786	0
Bananas	33,000	3.7
Tobacco	18,824	-11.9

Source: FAS, 1997

3.3.4 Food Security

Over the last thirty years, the agricultural sector has failed to keep pace with the food needs of the country's growing population. While daily per capita calorie supply averaged 2,310 in 1995 (UNDP, 1999), thereby meeting the recommended supply of daily calories, these data disguise the fact that because income distribution is highly skewed, food insecurity was likely widespread among the rural and urban poor. Furthermore, this requirement is met only through increased food imports. For example, imports of cereals, primarily wheat for processing and maize for the poultry industry, has increased from 48 percent of domestic supply during the 1970s to 70 percent in the 1990s. Wheat is not produced in the DR due to climatic constraints, and although maize is grown, approximately 95 percent of the DR's maize consumption is imported. The ratio of bean imports to consumption has similarly risen from an average 17 percent annually in the 1970s to 32 percent in the 1990s. On the other hand, the ratio of imports to consumption for rice has fallen from an average of 14 percent annually in 1970s to 7.3 percent in the 1990s. This "success" might be tempered by the fact that rice receives the lion's share of government credit assistance and is grown almost entirely under irrigation.

Rice, beans, vegetables and chicken have been staple foods in most Dominican households for over fifty years. Yet rice and bean production has not been able to keep up with population growth, mirroring the performance of the agricultural sector in general, which has consistently lagged most other sectors in the economy. Because retail prices of rice and beans have been supported through import restrictions that limit domestic supply, these prices have increased during recent years, relative to alternative carbohydrate sources such as bread, pasta, and other staples like plantain, cassava, sweet potato and dasheen. The result has been falling per capita consumption of rice and beans during the 1990s.

Food price inflation in general has been an average 3 percent greater than the overall average CPI since 1970 (Banco Central, 1998). The consequence of the DR's increasing food import dependency is decreased foreign exchange availability, while the result of government supply control policies is often food insecurity for the poor. This situation leads to malnutrition and severe economic hardship for the rural and urban poor for whom such primary agricultural commodities constitute a large portion of their household expenditures. Production of staple food crops and their marketing environments remain a serious challenge to poverty alleviation in the DR, for food insecurity in this context remains a threat regardless of glowing macroeconomic performance indicators.

3.4 Conclusion

The DR has recently enjoyed very high economic growth rates and slowing population growth, yet highly skewed income distribution and poverty persists. Agricultural growth rates have lagged those of other sectors in the economy, contributing to continued high rural poverty rates. This trend will not likely change until the government changes the nature of its assistance to the agricultural sector from subsidization and protection to investment in the development and diffusion of new technology and improved land distribution.

CHAPTER FOUR: AN OVERVIEW OF THE DOMINICAN BEAN SUBSECTOR

4.1 Introduction

This research is primarily concerned with using subsector analysis to help identify factors that contributed to the adoption of CRSP-developed bean production technologies and associated management practices, and to identify *how* the benefits of these yield-augmenting technologies are distributed among different groups in society. An understanding of the policy and institutional framework is required to explain *why* the research expenditure had a high, low, or negative financial or economic return, and the level of dependence of this return (profitability at the aggregate and at the individual farm level) on the continuation of the existing institutional and policy framework.

4.2 Demand Analysis

4.2.1 Beans in the Dominican Diet

Rice and beans are the major staple food crops in the Dominican Republic, with beans the principal source of vegetable protein for the majority of Dominicans, especially the poor. Two combinations of these staples are consumed daily by the majority of Dominicans. *Arroz con habichuelas* refers to a separate portion of rice served with a bowl of beans that has been cooked in its own sauce. The beans and sauce are then placed over the rice and eaten. *El moro* refers to a dish comprised principally of rice, but containing a few beans which are cooked with the rice and served as one dish. *El moro* is the typical form of beans consumed by lower income households (Heikes, 1993).

4.2.2 Consumer Preferences

Although various market classes of beans are consumed in the DR, Dominican consumers have historically preferred large red varieties – the domestically produced *Pompadour Checa* in particular – over black, white, cranberry and imported red varieties. However, as importation of pinto beans increased in the 1990s due to falling domestic production, consumers began to be increasingly exposed to this new market class. Because Dominican consumers classify beans by much more than simply price and color (as throughout the Caribbean and Central America), differences in bean size, texture, freshness, cooking time, and culinary traditions can result in significant price differentials between market classes.

Conventional wisdom in the DR asserts that pintos are primarily purchased by poorer Dominicans, who are attracted by their lower price (normally 10-20 percent lower, depending on the season). Thus, thus assuming that the domestic red's culinary attributes are preferred to those of the pinto, a price differential may exist whereby Dominicans will pay a premium for the preferred attributes of the domestic red. Since SEA has only recently begun collecting weekly and monthly retail prices for both domestic reds and pintos (before they were treated as the same commodity by SEA and INESPRE), it is difficult to empirically determine price elasticities of demand for the two bean classes at this time.

However, rapid appraisal interviews with bean traders in San Juan and wholesalers and supermarket managers in Santo Domingo in July/August 1998 strongly suggested that the dynamics of consumer preferences, regarding imported pinto beans *vis a vis* traditional domestic red beans, may be changing. In San Juan, several traders said that pintos were actually preferred by some consumers because they were "fresher" and "cooked faster." This is surprising, considering that at that time (July 1998), pinto prices in the market were a bit higher than those for domestic reds (US$1.82/kg for pinto versus US$1.37/kg for domestic red). This price differential was likely a seasonal effect in that February and March production was still depressing domestic red prices, whereas pinto imports in the spring through mid-summer are typically light. Interviews with three supermarket managers in Santo Domingo revealed that among middle- to upper-income consumers, pintos were in fact becoming popular due to their perceived freshness and faster cooking time relative to domestic red beans. One manager observed that some consumers were simply using tomato paste with pintos to reproduce the red sauce that comes from cooking the domestic red.

If consumer preferences are changing from domestic reds towards pintos, such a change may play a very important role in determining the future of bean production in the DR. If pinto imports increase in the future, due to either falling domestic production or a more liberal import policy, or if current pinto imports are no longer restricted to late summer/fall entry, then whether or not domestic reds can command price differentials based on consumer preference may significantly affect the future of the Dominican bean industry.

4.2.3 Domestic Consumption

Available data indicates that annual per capita Dominican bean consumption has varied considerably over the last three decades. Annual per capita dry bean consumption averaged 7.5 kg during the 1970s, 8.9 kg during the 1980s, and 5.5 kg from 1990-98 (SEA, 1999; FAOSTAT, 1999). Thus, average per capita dry bean consumption in the 1990s has fallen 38 percent from that of the previous decade. However, it should be noted that the large imports of 1997 and 1998 increased per capita bean consumption from a low of 4.6 kg/capita in 1996, to 5.7 kg/capita in 1997, and to 7.2 kg/capita in 1998 (as production/capita fell in 1998 to a low of 2.6 kg/capita). While the decline in consumption per capita from 1990-96 can be partially explained by sustained economic growth during this period, it would be hard to argue that the macroeconomic growth in this period stimulated an income effect among enough consumers to have such a large aggregate effect on bean consumption per capita. More likely, as a result of high bean prices during this period due to supply control (import restrictions), consumers substituted other protein sources for beans. However, now that bean supplies have increased due to larger import volumes, consumption per capita is again increasing.

The Dominican Republic's 1981 national food and nutrition plan established a recommended level of red bean consumption at 27 grams/day. Comparing this recommendation to actual daily consumption with actual consumption per capita for the 1981 to 1997 period indicates an average daily deficit of 30 percent from 1981-89 and 43 percent from 1990-97 (SEA, 1998). Only in 1988 did average daily consumption meet the recommended level.

4.2.4 Imports

As Table 4.1 demonstrates, Dominican bean production per capita has declined in the 1990s, leading to increasing dependence on imports to meet domestic demand for dry beans. Imports[1] increased dramatically in the late 1990s, accounting for half of domestic consumption, and as much as 67 percent of consumption in 1998.

Table 4.1 Per Capita Bean Production, Consumption, and Imports in the DR

Indicators	1970s	1980s	1990-1998[1]
Bean Production per capita (kg/year)	7.2	8.7	3.9
Bean Consumption per capita (kg/year)	7.5	8.9	5.5
Bean Imports (MT/year)	6,078	6,291	14,404
% Consumption Imported	17%	10%	32%

[1] 1990-98 consumption and imports estimated using SEA/INESPRE data. Data for 1970-89 is from FAO. Consumption is defined as food consumption, estimated to be 95% of total annual production plus imports.
Source: SEA, 1999; FAOSTAT, 1999

4.3 Production Analysis

4.3.1 Bean Classes and Varieties

While red, black, and white beans are grown in the DR, 88 percent of the bean area is planted to red molten bean varieties. The most common reds are strong and erect shrub types, particularly Pompadour Checa, PC-50 (a selection of the Pompador Checa land race), Constanza I, Jose Beta, and JB-178 (a cross between Jose Beta and C1308). Black varieties account for 8.1 percent of bean area planted, and white varieties 3.6 percent.

[1] Bean imports are controlled by the Secretaria de Estado de Agricultura (SEA), the Dominican Ministry of Agriculture, which defines the quantity, market class, timing, and importer for all bean imports. Importing agents include INESPRE, the government food marketing parastatal, and various private sector importers who must acquire an import license from SEA for each shipment (discussed in greater detail below).

4.3.2 Bean Production Location and Seasons

Planting and harvesting dates vary greatly within and between regions because the Dominican Republic is an island where rainfall patterns are influenced by location (leeward versus windward side) and topography. In addition, producers with access to irrigation have additional flexibility with respect to planting dates. While beans are planted practically year-round in the Dominican Republic, the three principal bean seasons are: *spring, fall and winter.* Vegetative cycles vary between seventy-five and one hundred five days, depending on bean variety and elevation.

The *spring* crop (March through June), which accounted for an average 17.6 percent of total annual red bean production (1994-97), is *mostly* grown in high altitude areas (500 to 1300 meters above sea level). The *fall* crop (July through October), which accounted for an average 23.5 percent of total red bean production during this period, is generally grown between 400 and 500 meters above sea level. Finally, the *winter* bean crop (November through early March), which accounted for 59 percent of total production (SEA Breve, 1990 and SEA/DEA, 1998) during this period, is grown below 400 meters above sea level (in valleys). The timing of these seasons and their respective shares of total red bean production have shifted considerably in recent years, due primarily to an increase in irrigated area as a percentage of total bean area planted, changes in the timing of bean production in the San Juan Valley (Southwest region), and an increase in that region's share of total production – which increased from 40 percent in the late 1980's to over 50 percent in recent years.

Data for area planted to red beans and red bean production are reported by the Ministry of Agriculture's administrative zones (Table 4.2). From 1994-97, the most important regions for red bean production were the Southwest (a four-year average of 52 percent), Northcentral (16 percent), North (8.3 percent, and East (7.8 percent). Notable changes in regional bean production from the 1985-89 to the 1994-97 period occurred in the South, which declined from period averages of 10.1 to 5.4 percent of national production, and the Northwest, which declined from 9.9 to 5.2 percent. Between these periods, average production shares increased in the Southwest from 41 to 52 percent, and in the East from 3.5 to 7.8 percent.

4.3.3 Recent Changes in Red Bean Area and Yields

Analysis of red bean production in the DR (Table 4.2) suggests several national and regional trends. Comparing the period 1985-89 to that of 1990-94, total average annual red bean area[2] fell 20 percent, production fell 11 percent, and yields increased 14 percent, from a period average of 719 to 821 kg/ha. Comparing the period 1990-94 to that of 1995-98, average annual red bean area fell 13 percent, production fell 14 percent, and yields fell 3 percent, from 821 kg/ha to 796 kg/ha. Comparing the 1985-89 period to that of 1995-98, yields increased 10.8 percent, while area declined 30 percent and production declined 24 percent. While a simple explanation for this trend could be an increase in the percentage of area under irrigation, the data shows otherwise.

During the 1985-89 period, irrigated land accounted for an average 35 percent of total red bean area and 47 percent of total production (SEA Breve, 1990). From 1990-94,

[2] Through this document, area refers to harvested area, unless otherwise noted.

Table 4.2 Regional Area, Production, and Yield of Red Beans in the DR

REGION	1985-89 Average			1990-93 Average			1994-97 Average		
	% Total Area	% Total Production	Yield (kg/ha)	% Total Area	% Total Production	Yield (kg/ha)	% Total Area	% Total Production	Yield (kg/ha)
Central	9.0	7.4	615	7.7	6.2	565	4.8	5.0	847
East	4.5	3.5	571	9.6	7.4	634	9.2	7.8	670
N.Central	12.3	14.0	854	11.8	15.4	956	12.7	15.5	960
N.East	1.7	1.7	775	1.2	1.0	603	1.1	1.2	878
N.West	8.9	9.9	819	6.2	6.6	777	5.2	5.2	789
North	10.8	12.5	863	10.4	12.9	882	6.7	8.3	973
South	13.0	10.1	571	14.2	10.4	522	10.8	5.4	407
S.West	40.0	40.9	756	44.1	46.0	786	49.6	51.5	827
Total[1]	**50,213**	**52,032**	**738**	**41,133**	**41,541**	**745**	**36,640**	**40,630**	**795**

[1] Total Area is in hectares; Total Production is in metric tons.
Source: SEA Breve (1990); SEA Departamento de Economia Agropecuaria (1998)

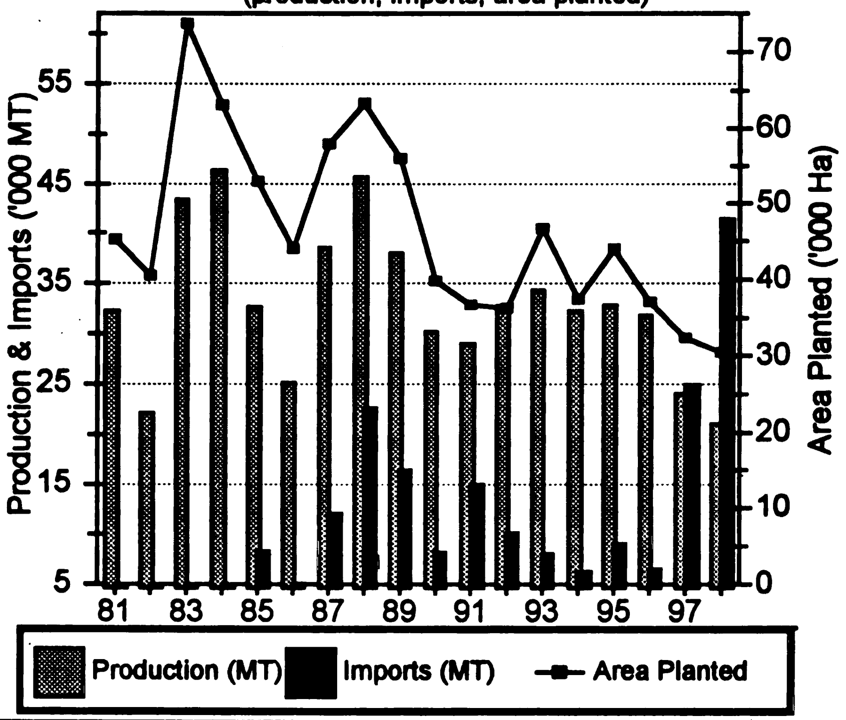
irrigated land accounted for an average 37 percent of *total bean area planted* and 49 percent of total bean production (red, black, and white varieties) (SEA, 1999). From 1995-1998, irrigated land accounted for 33 percent of total bean area planted and 42 percent of production (SEA, 1999). Thus, while irrigated area did increase in the 1990-94 period, it declined back to below the average for the 1985-89 period, while yields increased between these two periods by 10 percent.

Considering that the average differential between irrigated and rainfed bean yields was 66 percent during the 1985-89 period (989 kg/ha for irrigated vs. 595 kg/ha for rainfed areas), increases in the average national red bean yield from the 1985-89 to the 1990-94 periods are at least partially explained by an increasing share of total bean area under irrigation (from 35 to 37 percent). However, the yield improvement of 14 percent between these two periods cannot simply be explained by an increased proportion of area under irrigation, demonstrating that a change in technology (increased input use, increased technical or allocative efficiency, etc.) contributed to this increase. Annual data for area planted, domestic production, and import levels are reported in Figure 4.1.

4.3.4 Recent Changes in the Seasonality of Red Bean Production

Until 1990, bean farmers in the San Juan Valley grew beans during two seasons: one from August/September-November/December and then again from December/ January through March/April. After a devastating epidemic of bean golden mosaic virus (see 4.4.6.1) in the SJV during 1989-90, the Bean/Cowpea CRSP project convinced the regional government to restrict bean planting in the SJV to a period between 15 November and 10 January and to strictly enforce a fallow period from August

Figure 4.1: DR Red Bean Supply 1981-98
(production, imports, area planted)



through mid-November, during time which no hosts (beans, peppers, tomatoes, etc.) to the whitefly could be planted anywhere in the valley. Thus, beginning with the 1991-92 season, farmers in the SJV went from growing a fall (small) and a winter (large) crop to growing one large winter crop. A second planting period change in the SJV occurred in 1994-95, when the CRSP project presented research to the local government demonstrating the benefits of an earlier planting period, 5 November - 15 December. The regional government enacted this modified planting period into law for the SJV, which remains in force to the present.

These changes in the bean planting schedule in the San Juan Valley have resulted in a decrease in the fall season's share of annual national production and a substantial increase in the winter season's share. From 1985-89 to 1994-97, the October through December season's production share fell from an average of 23 to 14 percent, and the January and February season's share increased from 20 to 48 percent. In contrast, the March and April season's share, which used to include the end of the winter SJV harvest, fell from 39 to 15.8 percent. This change in production seasonality has several implications. Declining domestic bean production requires a greater level of bean imports. However, as an increasing share of domestic production occurs during January and February, the optimal timing of bean imports is late summer and fall, when bean prices begin to rise (as discussed below). Furthermore, if beans are imported during the first six months of the year, imports will further depress prices for the Southwest region producers, who are notably politically organized and active.

4.3.5 Land Tenure and Farm Size

According to the 1992 CRSP-funded nationwide survey of bean producers (Heikes, 1993), 61 percent of total bean area is owned, 16 percent is under the Agrarian Reform program, 13 percent is rented, and 9 percent is sharecropped (Heikes, 1993). As the last national agricultural census was in 1981, it is difficult to estimate with certainty the farm size of bean producers, although data from the 1998 producer survey in the San Juan Valley indicates that land distribution among bean farmers is similar to that of national agricultural land distribution averages (even since 1981; see Chapter 3.3.2), and also that smaller commercial producers are moving out of bean production and into other crops (Chapter 5.4.1). However, it is clear from national level data that irrigated land, as a share of total production, is increasing, and that bean yields have increased (unsurprisingly), as noted above (Chapter 4.3.3).

4.3.6 Constraints to Increasing Productivity

4.3.6.1 Bean Disease Prevalence, Frequency, and Severity

The four principal bean diseases in the DR are bean golden mosaic virus (BGMV; *Mosaico Dorado*), rust (*roya*), web blight (*Mustia Hilachosa*), and common blight (*Bacteriosis Comun*). In the 1992 nationwide survey, producers were shown pictures of these four diseases and asked if they had experienced any of them during the last five years. They were also asked to judge the severity of each with respect to yield reduction. The results (Table 4.4), demonstrated the prevalence, frequency, and severity of these four diseases for bean production across the DR in 1992. From the perspective of these farmers, rust and BGMV were the most prevalent, frequent, and severe bean diseases[3].

Table 4.3 Prevalence, Frequency, and Severity of Bean Diseases in the DR, 1992

Disease Name	Prevalence[1] (%)	Frequency[2] (# years out of last 5)	Severity[3] (%)
Bean Golden Mosaic Virus	73	2.6	73
Rust	77	n.a.	70
Web Blight	63	2.1	68
Common Blight	38	1.3	53

Source: 1992 CRSP Nationwide Producer Survey; N=219; table from Heikes, 1993.
[1] percentage of producers who experienced the disease at least once between 1988-1992
[2] number of years out of the last five that the producer experienced the disease.
[3] percentage of producers stating that the presence of the respective disease significantly reduces yield.

[3] Results from similar questions posed in the 1998 Producer Survey in the San Juan Valley are discussed in Chapter 5.

4.3.6.2 Other Production Constraints

When asked to rank their major production constraint, producers in 1992 cited insufficient rain (40 percent), insects (19 percent), too much rain (17 percent), disease (13), and other problems (11 percent). These results help to explain the recent decline in rainfed bean area as a share of total area, which has declined steadily over the last decade. Confirming these results, the government attributes low rainfall in the past few years as the main factor in decreased bean area (SEA, 1998).

4.3.7 Agricultural Organization Membership

Nearly two-thirds (63 percent) of respondents to the 1992 nationwide survey were members of an agricultural organization (Heikes, 1993). Since many organizations are primarily social clubs, respondents were asked if their given organizations were actually beneficial to the production of beans. Forty-seven percent said that their organization was "beneficial," with the benefits being better access to seeds (45 percent), credit (30 percent), and overall improved influence (25 percent). Other producers cited benefits such as better access to technical assistance, information, chemical inputs, and land preparation services/equipment. These responses are very similar to those of San Juan Valley farmers (Chapter 5.3.1), who rely on their association for quality seed, credit, and negotiation power with INESPRE regarding INESPRE's purchase price each season (as well as access to INESPRE's purchasing system in the first place).

4.4 Bean Price Analysis

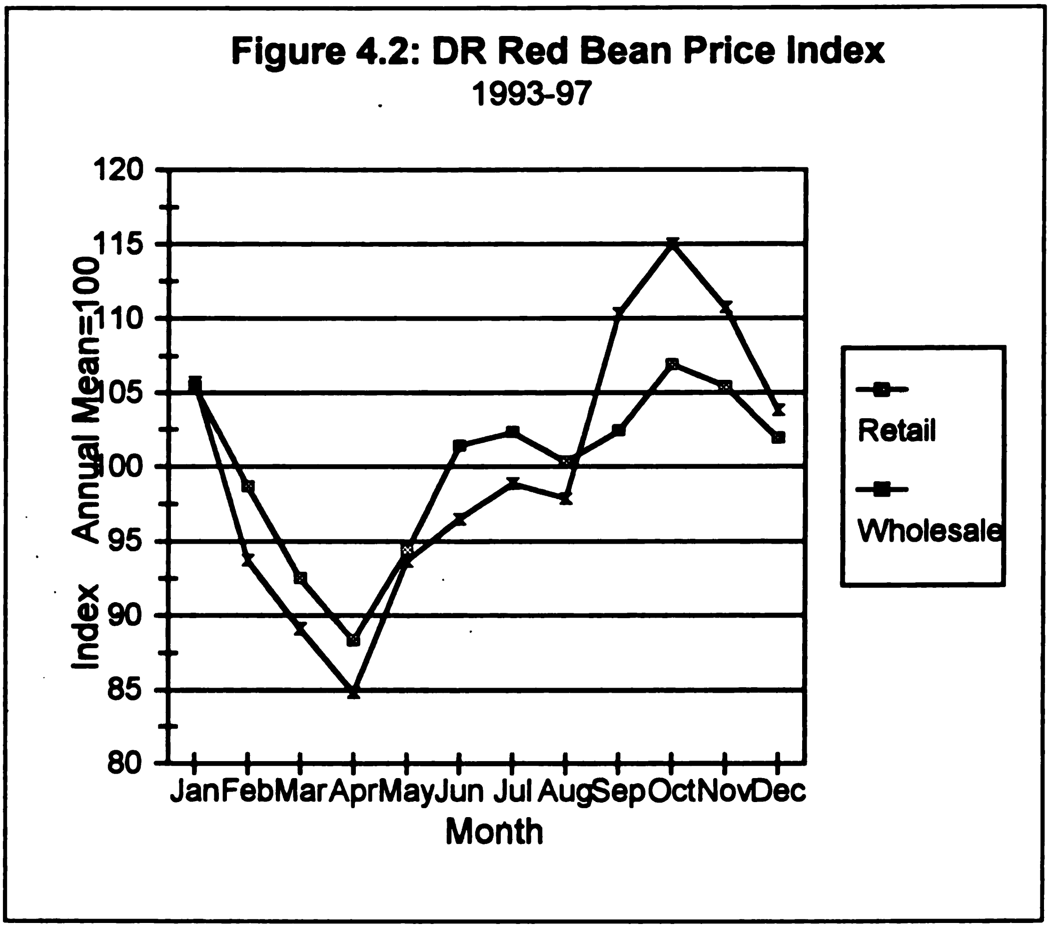
4.4.1 Bean Price Seasonality

Approximately 59 percent of bean production is from the *winter season,* with a corresponding February harvest period, 17.5 percent from the *spring season* with a June harvest period, and 23.5 percent from the *fall season* with an October harvest period (Section 4.3.2). Bean prices at the farmgate,[4] wholesale, and retail levels are affected by the timing and quantity of these harvests, suggesting that many producers sell their surpluses soon after harvest.

The seasonality of wholesale and retail bean prices (1993-97) is demonstrated in Figure 4.2. Although the average January wholesale price is 5 percent above the annual average price, wholesale prices begin a sharp decline after the February *winter season* harvest, falling to 15 percent below the in April. They gradually climb back to slightly below the retail price in April, and then they gradually increase to slightly below the average by July, as the June *spring season* harvest arrives. At this point, the domestic production from the winter season has reached the retail level (or has been consumed). Thus, prices increase dramatically and peak in October at 15 percent above annual average price. Following the October (fall season) harvest, prices fall back to the annual average by mid-December. The maximum spread between minimum (April) and maximum (October) wholesale prices averages 30 percent.

---

[4] Monthly farmgate prices were only available for 1997. The seasonality of farmgate prices is thus implied by wholesale price seasonality.



The retail price index follows a similar cycle, although price increases and declines are of smaller magnitude. The spread between minimum (April) and maximum (October) retail prices is 19 percent. Comparison of the monthly retail real price index average from the 1985-90 period to that of the 1993-97 period (Figure 4.3) clearly indicates that monthly retail price fluctuations have diminished considerably since the 1985-90 period.

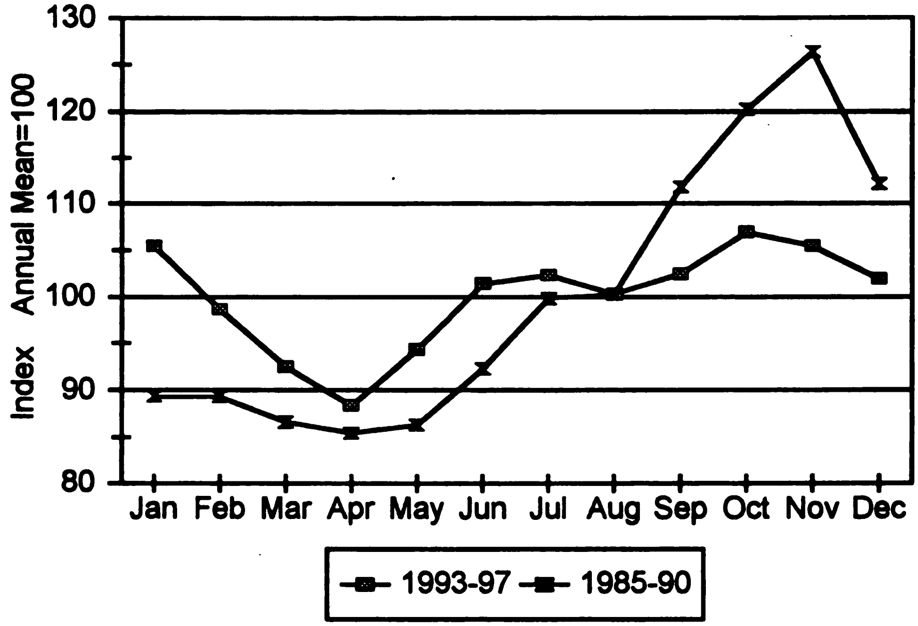
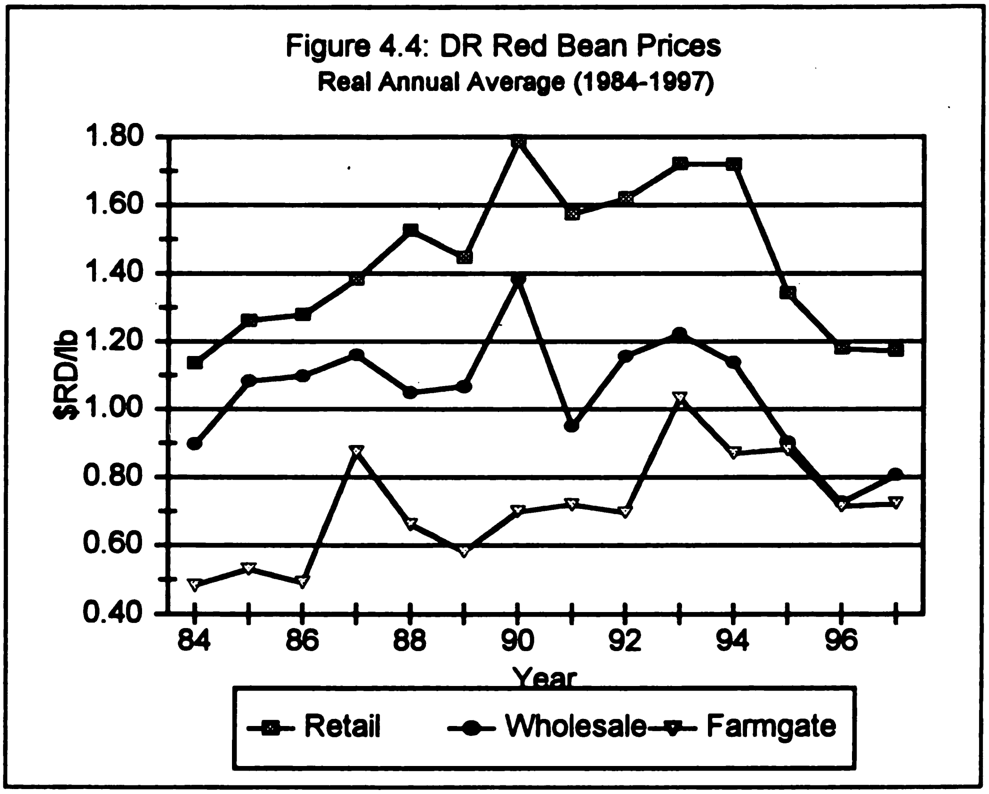


Figure 4.3 Red Bean Retail Price Index
1985-90 vs.1993-97

The coefficient of variation in monthly retail price from the 1993-97 period (8.2 percent) is in fact half that of the 1985-90 period (16.6 percent). Noting that this index was constructed with deflated monthly prices, one possible explanation for the decreased monthly retail price fluctuation is that increased bean imports in the 1990s (due to declining domestic production) have enabled wholesalers and retailers access to cheaper beans in the second half of the year, when domestic production is low. Decreased fluctuation from the annual mean during the first half of the year is likely due to the change in planting dates in the SJV (as discussed above), resulting in one large harvest in February, as opposed to a small one in December and another in March.

4.4.2 Trends in Real Prices

As shown in Figure 4.4, annual average farmgate red bean prices (real) over the 1984-97 period have been quite variable, although the trend since 1994 has been downward. This decline in the real bean price since 1994 helps to explain why the bean area has declined substantially since that year, reaching its lowest level coming in 1997.



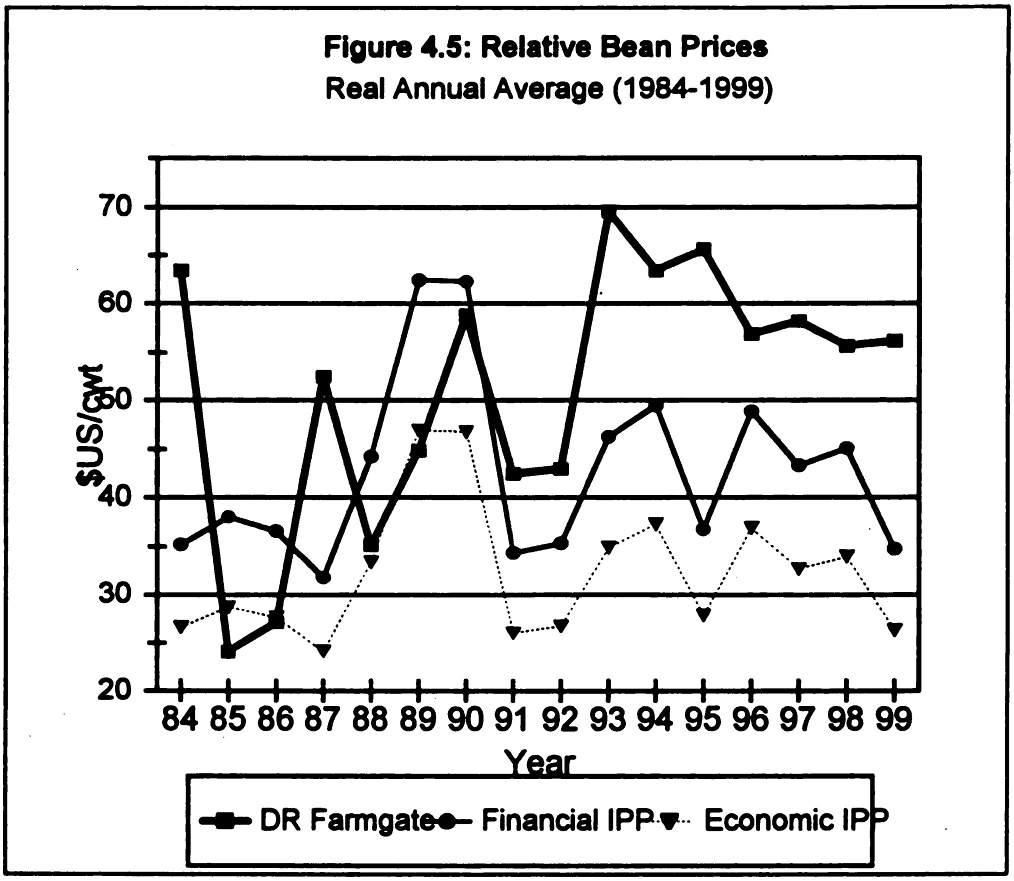
Real annual retail and wholesale prices have declined since 1994, although per capita consumption of beans has continued to decline throughout the 1990s. It should be noted that although national average real bean prices have been falling in recent years, the prices received by San Juan Valley farmers are on average higher than the national average, helping to explain why the bean area in this region has not fallen as much as it has in other areas. These higher prices are the result of bean purchases by SEA and INESPRE, as discussed in the following section.

4.4.3 Trends in Relative Prices

Relative prices are often used in subsector analysis as a measure of the efficiency of domestic production at a given level of the subsector. Figure 4.5 shows real farmgate prices for Dominican red beans, compared to relative international parity prices (the financial import parity price (US pintos), and the economic import parity price (US pintos))[5]. It is clear from this table that the DR is a highly inefficient producer of beans, compared to US pintos. These findings are further amplified at the wholesale and retail levels, due to the oligopsonistic/ oligopolistic wholesale bean markets for domestic and imported beans. Even in 1998-99, when DR real bean prices reached their lowest levels in decades, wholesale real red bean prices in the DR were still 20 to 25 percent higher than red bean prices across Central America (CORECA, 2000), and DR retail red bean prices were 30 to 35 percent higher than those of Central America.

---

[5] Chapter 6 includes a discussion of the calculation of financial and economic import parity prices (IPP) used in this study. Financial prices include all taxes and tariffs, while economic prices exclude them. The financial IPP in this table demonstrates what US pintos could sell for in San Juan using US price plus transport, shipping, insurance, port fees, tariffs, taxes, Dominican transport to San Juan, etc.



4.5 Government Policies Affecting the Bean Subsector

4.5.1 Introduction

4.5.1.1 Agricultural Sector

Several Dominican government policies directly and indirectly affect the bean subsector. In the bean grain market, INESPRE, the government food marketing parastatal, purchases an annually varying amount of domestic and imported beans and resells them through its consumer food subsidy program. With respect to inputs for farm-level bean production, SEA provides partial funding for bean research, subsidizes the multiplication and distribution of bean seeds, and provides technical assistance through extension services. Various government agencies also provide subsidized inputs as credit (Banco Agricola), land preparation services (PROSEMA), irrigation (INDRHI), technical assistance (SEA), and some chemical inputs (CVMA sales centers). SEA also oversees INESPRE's regulation of the quantity and timing of bean imports, and the Agrarian Reform Institute (IAD) guarantees use rights to agrarian reform land. In addition, in 1990, the government passed legislation prohibiting the distribution of inputs to bean producers intending to plant on steep sloping lands.

4.5.1.2 Import Restrictions

Perhaps the primary policy that shapes the opportunity and constraint sets of subsector agents is the government's import licensing regime which limits the timing and quantity of bean imports. Because the DR is not self-sufficient in beans, this means that SEA is able to support the annual bean prices by adjusting the quantity and timing of bean imports each year according to domestic production. The average nominal protection rate (NPR) for red beans in the DR over the 1985-89 period was 58, and 116 over the 1990-94 period (Valdes, 1995). It is therefore clear that consumers in the DR pay more for their beans than they would in the absence of import restrictions – even considering that domestic red beans may very well command some price differential over imported pintos, given preferred characteristics of the domestic red.

4.5.1.3 GATT Obligations

Although the Dominican Government signed the GATT treaty in 1994, soon thereafter it submitted a "technical ratification" (TR), whereby the government claimed exemption of certain commodities (rice, beans, sugar, corn, garlic, onion, milk, and poultry) from their original GATT agreement tariff schedules due to the political and economic importance of these commodities. After some negotiation, the U.S. agreed with this TR. Under the TR, the DR must allow the importation of up to 12,000 metric tons (MT) of beans a year at a within-quota tariff of 25 percent. For imports above 12,000 MT, the DR may impose an out-of-quota tariff of 99 percent. The initial quota will be increased over 10 years (from 1995-2004) to a final level of 18,000 MT, and the over-quota tariff will be reduced to 89 percent (FAS, 1998).

The effect of the import levels required by the GATT on the domestic production of beans is unclear, as the implementation of the agreement remains uncertain. Although the TR tariff rates and quotas are not in dispute (at least between the US and the DR), it is clear that the non-transparent distribution of import licenses for bean imports, as currently practiced, is against the letter and spirit of the GATT. While open tenders for the sale of these licenses (the timing and quantity determined by SEA) are the official policy, these do not occur in practice. However, in the short term, the import quota level itself should not be a large threat to domestic bean growers because the DR imported nearly 25,000 MT of beans in 1997 (all at the within quota tariff of 25 percent) and has approached or exceeded that level almost every year since 1987.

What may be more problematic for domestic growers is if consumers – especially middle or upper-income consumers -- become accustomed to and begin to prefer imported pintos. If this were to happen, as some supermarket managers and open market traders indicated is occurring to some degree, pintos may gain enough market share year round to dampen demand for domestic reds following the large winter harvest, thereby lowering farmgate prices for domestic reds.

There are two additional scenarios in which pintos, without a change in consumer preferences[6], could result in lower consumer demand for domestic reds (and thus lower farmgate prices). First, if bean importers are allowed unrestricted entry of imports with respect to seasonality, spring farmgate prices may fall if imports arrive then (currently very little is imported in the spring, although this is difficult to measure given the politically sensitive nature of these data). Second, if import licenses are distributed through a transparent tender system, a portion of the rents that are now reportedly captured by government officials will be passed on to consumers in the form of lower prices. Thus, lower-priced pintos would surely decrease demand for domestic reds. Modeling the potential effects of various combinations of import levels and timings is not attempted here, though this is necessary to more accurately predict the potential effects of these changes on domestic prices and production.

4.5.2 INESPRE

4.5.2.1 Institutional Background of INESPRE

Contemporary price controls and the legal and institutional structure needed to implement intervention in prices are a legacy from the Trujillo period (1930-61) (Greene and Roe, 1991). By the end of this era, his family and associates controlled a wide variety of manufacturing and industrial firms (Bell, 1981). After Trujillo's death in the mid-1960s, many of these firms became part of the Dominican Corporation of State-Owned

---

[6] Conventional wisdom holds that consumers prefer the color and culinary characteristics of domestic reds *vis a vis* imported pintos, although poorer Dominicans purchase pintos because they are usually cheaper.

Enterprises (CORDE), such as the state-owned sugar enterprise (CEA), which evolved from the process of nationalization of this conglomerate of private firms (Greene and Roe, 1991).

Control of food prices was first implemented in 1957 by the Bank of Agricultural and Industrial Credit, which was authorized to set rice prices for producers, wholesalers, and retailers. The 1969 reorganization of the public sector enterprises in agriculture led to the creation of the *Instituto de Estabilizacion de Precios* (INESPRE). INESPRE initially took over the government's rice marketing and price control activities and later became the principal parastatal for implementing the marketing and price policies for other foods such as dry beans, sugar, milk, eggs, garlic, onions, chicken, wheat and corn flour, soybean oil, pasta, and bread.

Implementation of these policies led to INESPRE involvement in activities such as commodity procurement (domestic and/or international), transportation, storage, and sales at the to wholesalers and retailers, as well as direct sales to consumers through food subsidy programs. The basis of the government's price control activities for many crops is SEA's import licensing regime, by which INESPRE maintains a measure of control over domestic commodity prices. As the Secretary of Agriculture (the head of SEA) is also the director of INESPRE, SEA effectively controls INESPRE's activities.

Since its inception, INESPRE's level of involvement in these various levels of the marketing system has fluctuated by commodity, by season, and by year – depending upon several factors including the financial situation of the government as a whole and of INESPRE individually, the government's expenditure priorities in a political economy context (the proximity of elections), etc. As its title suggests, the stated goal of INESPRE is to stabilize prices of politically sensitive commodities for both producers and consumers. The idea is to offer producers "fair" and "negotiated" prices for their product as well as import protection from typically lower world prices, while protecting consumers from seasonal price increases through timely public or private sector imports, as regulated by SEA's import licensing regime. However, a closer inspection of INESPRE's marketing activities in the bean subsector demonstrates a significant difference between publicly stated goals and actual performance outcomes of INESPRE involvement in commodity markets.

4.5.2.2 INESPRE's domestic bean purchases

INESPRE's authorization to participate in bean marketing was issued in August 1975, by Decree # 1194. INESPRE participates in the Dominican bean subsector by engaging in the procurement of domestic and imported beans, their transportation and storage, and the eventual sale of beans to wholesalers, retailers, and directly to the public through a consumer food subsidy program.

INESPRE purchases several varieties of domestic red beans for eventual resale to consumers, including Pompadour Checa, PC-50, Jose Beta, JB-178, and Yacomelo. Beans are typically only purchased by INESPRE in San Juan (Southwest Region) and Santiago (North Central), areas that from 1993-97 accounted for an average of 51 and 15 percent of total annual bean production, respectively. INESPRE's purchasing activities in San Juan demonstrate how the agency's commodity support activities actually serve to create the very price and income risk it is paradoxically intended to remove (from the market).

Although in some years INESPRE buys a significant amount of the production of these two regions (37 percent of bean production in the SJV in 1998) at a price consistently higher than that offered by private traders[7], INESPRE's price is not announced before or during the season, nor does the government even commit to a procurement quantity and/or timing prior to planting. Even more significantly, when a producer sells beans to INESPRE, he is paid anywhere from two weeks to five months later. Therefore, INESPRE's domestic procurement activity is not the predictable and transparent type of process usually associated with government attempts to stimulate supply response. Furthermore, INESPRE's procurement activity changes from year-to-year, seemingly driven by the current financial and political situation of the government.

As data from the 1998 Producer Survey in the SJV shows (CRSP, 1998), INESPRE's purchases do not actually result in much higher prices, the program primarily benefits larger farmers, and the supply response is questionable – given that SJV bean area has not declined as has the area in other regions, while DR bean production on aggregate *has* declined in the last decade. The implication of these findings is that the activities of INESPRE are too small, too unpredictable, and poorly targeted if supply response were the true goal of the endeavor.

For example, although INESPRE purchased beans at \$1.57/kg (RD\$1,035/qq) in 1998, it did not pay growers in full until an average 13.8 weeks after the sale (CRSP,

---

[7] The differential between the INESPRE and trader price was 15-22 percent in the past three years, although it averaged about 13 percent higher since 1992.

1998). This delayed payment resulted in financial losses to farmers for interest payments on outstanding loans, as well as for the loss of the interest on the difference between a farmer's total sale revenue less his total outstanding loans, valued over the waiting period. When INESPRE's "purchase price" was adjusted to account for these real costs to farmers[8], the INESPRE adjusted price for the sample was actually $1.47/kg (RD$964/qq), which represents a seven percent decrease in the "sale price" offered by INESPRE. Thus, instead of enjoying a price 18 percent higher than that of average trader price of $1.29/kg (RD$849/qq), farmers who sold to INESPRE in 1998 received an adjusted price 12 percent higher than the trader price. However, because larger farmers have access to much lower interest rates, their adjusted prices are higher than those of small farmers (see Chapter 5.11.4). Many of the smallest farmers in the SJV don't sell to INESPRE because they need cash at harvest to pay off their loans, which are usually made at high interest rates. Therefore, the case of INESPRE producer price support activities mirrors that of U.S. crop price supports in that the benefits of such programs typically accrue to the largest farmers (those most able to remain profitable without support), while claiming to protect the most vulnerable. These figures and INESPRE's purchasing and payment activities are discussed in more detail in Chapter 5.1.3 and 5.1.5.

[8] This calculation was made using information collected in the 1998 Producer Survey on each farmer's sale volumes and sources, average interest rates on outstanding loans, and how long the farmer waited for payment. It is assumed that outstanding loans are not resolved by each farmer until receipt of INESPRE payment. If they were resolved before this time, the farmer would have had to borrow the money from somewhere anyway, or transfer it from an alternative productive use. Farmers with loans from Banco Agricola were not charged interest on said loans once their beans were received by either INESPRE or SEA.

4.5.2.3 INESPRE's Imports

INESPRE was the only official importer of beans until 1988, when the private sector was also allowed to import beans, although only after obtaining an import license from SEA that restricts the timing, quantity, and market class of beans to be imported. However, the role of INESPRE as a bean importer itself has diminished considerably over the past decade, due to the organization's continuing financial difficulties (coming from the subsidies absorbed in the operation of its domestic purchase and sales programs). From 1988 to 1991, INESPRE itself accounted for 95 percent or more of bean imports; but during 1992-94, that share fell to between 33 to 67 percent, and then bottomed out from 1995-98 to between 0 to 10 percent.

According to every non-governmental source contacted, even a former customs official, the import licensing system is used by officials to extract rents both at SEA (distribution of import permits) and at customs (enforcement of permits). Though SEA claims that import permits are sold through an open bidding auction, the reality is that this never occurs. Thus, while there is surely "bidding" for these permits, the value of the bid is captured by an official – not by consumers in the form of price savings on imported goods. In addition, SEA's official policy is to only import beans in the fall, when domestic production is lowest. However, permits are still granted in the spring, thereby depressing prices at a time when the country produces the most beans. One additional problem is that while the permits specify a specific market class, timing, and quantity of the shipment permitted to enter the DR, customs officials at times do not enforce one or more of these conditions. Thus, the market class, timing, or quantity of what actually enters the country does not match the permit. The implication of this system is that imported beans are sold at higher prices than would otherwise be (given the "cost" of the permit captured by an official), and that rents are extracted in this manner from consumers by government officials.

Rents are not only captured by officials who sell import licenses, but also by importers who enjoy a markup of approximately 20 to 40 percent above the wholesale import parity price of US Colorado Pintos shipped to Santo Domingo[9]. Thus, conservatively assuming a 20 percent markup (about US$7.50/cwt) existed throughout 1998, during which time the DR imported 913,000 cwt of pintos, government officials and importers shared rents of approximately US$6.85 million. By 1999, a few of the more powerful SJV farmer organizations (not all of them) had negotiated with the government and importers and managed to share in these rents[10].

4.5.2.4 INESPRE Direct Sales to Consumers

Since 1979, INESPRE has implemented some version of a subsidized, targeted basic foods program. While these programs are renamed every 2-4 years, the program

---

[9] Calculation based upon monthly data from August 1998 to July 1999 from USDA AMS (US Pintos) and SEA (wholesale pinto prices in Santo Domingo), employing the import parity price calculations presented in Chapter 6.

[10] According to several key informants, in 1999, the government negotiated a deal in which several wholesalers would be given access to import licenses (in the fall) under the condition that they purchase beans from select SJV farmer associations at higher-than-market prices (in the previous spring). In this way, a few of the SJV farmer associations share in the rents associated with the import licensing regime. Reportedly, in 1998, a group of wholesalers purchased SJV beans under a similar arrangement only to later be denied access to import licenses as promised by the government. These events further highlight the politicized, erratic, and destabilizing nature of government involvement in bean marketing.

remains essentially the same. Under the current edition, *Programa de Alimentos para Todos* (program of food for all), direct sales are made from the backs of yellow program trucks or from program stores, which are located in urban areas and regional centers. In previous years, large numbers of program stores – financed by the government and stocked with INESPRE-purchased agricultural commodities – were scattered throughout urban and rural areas to "protect the consumer from middlemen." In the past, INESPRE has also sold domestically purchased or imported beans to wholesalers and retailers at given prices, and has then regulated those sellers to ensure their margins were not excessive.

According to INESPRE data, during the period from 1983-1991, INESPRE's direct and indirect sales to consumers accounted for an average of 24 percent of total domestic consumption (INESPRE, 1998). This was clearly the height of INESPRE's marketing activities, when domestic purchases, imports, and sales were at their highest levels. Eventual financial difficulties forced INESPRE to curtail their degree of activity. Thus, their direct and indirect sales from 1992-98 averaged 6.8 percent of total domestic consumption, with four of these years registering shares around 1 percent. It is not possible to accurately calculate the prices charged by INESPRE to wholesalers, retailers, and the general public as available data only reports aggregate quantities sold and the value received by year. Although data on aggregate value received and quantity sold for INESPRE sales is available, it is not possible to estimate the subsidy to consumers per year because information on how much was sold at the wholesale and retail levels is not available.

4.5.2.5 The Future of INESPRE

While INESPRE was supposedly within the sights of the Fernandez administration's reform agenda when he took office, the institution actually thrived in his tenure. By 1998, it was back to its pre-1990 levels in purchasing, importation, and sales. How long the government will be able to continue underwriting the losses incurred by these programs is unclear. However, it does seem clear that the most powerful lobby against reform will come from bean producer associations, given their low political mobilization costs vis a vis consumers. Importers who have access to import permits would also be expected to fight reforms.

4.5.3 SEA Seed Multiplication and Distribution Program

SEA has supported a seed multiplication and distribution program for many years because of the importance of disease-free seed for insuring high national bean yields, and due to the susceptibility of stored bean seeds to heat, moisture, and insects, especially under storage by small to medium size farmers. In recent years, the multiplication program has taken a form close to the following: the CRSP develops, tests, and selects varieties, multiplies the basic material, and gives this to SEA; SEA guarantees approximately 50 pre-approved growers in the San Juan Valley a premium price to multiply the seed and purchases their seed at harvest[11]; SEA cleans, treats, and stores the seed, which at this point is worth close to $RD 1,400-1,450/qq (Dept. Semillas/SEA,

---

[11] SEA purchases seed from contract farmers at about 35 percent above market prices and 14 percent above the INESPRE price, based on 1998 CSRP Producer Survey data. SJV contract growers are responsible for close to 80 percent of bean seed production for the SEA Seed Multiplication Program.

1998); SEA sells the seed the next season via CVMA outlets located in many parts of the country for $RD 900/qq. While not "certified," the seed is considered *semilla de buena calidad* (seed of good quality). Recently, the CRSP has given basic seed directly to farm associations in the SJV for their seed banks (in exchange for use of a member's land for basic seed multiplication).

The calculated price subsidy of this seed is approximately US$0.36/lb of seed[12]. Using data from the SEA Seed Department on total seed distributed per year, combined with the subsidy per pound of seed, the economic cost of this program is included in the cost-benefit analysis in Chapter 6. Also using data from the SEA Seed Department on seed sales by region, and dividing these amounts by an assumed seed rate of 15 lb/ta, estimated area planted to SEA-direct seed was calculated for each year. This calculation per region, combined with SEA data on annual area planted by region, shows that each year, approximately 30 percent of bean area is planted with seed purchased *that year* from SEA (according to SEA data). As approximately 33 percent of SJV farmers purchase seed direct from SEA in a given year (Arnaud, 1997), this percentage figure for the country as a whole seems reasonable.

Problems in recent years with the quality, consistency, and timing of SEA's seed sales have led several SJV farmer associations to set up seed banks and store their own seed. The Seed Department in San Juan allows associations to store seed in special cold-storage rooms for free; the only condition is that seed deposited at the department may not

---

[12] The subsidy is calculated as RD$1400/qq economic cost of the seed, less the RD$900/qq paid by farmers, thus leaving a RD$500/qq subsidy, or US$0.36/lb.

be removed until November. Thus, association members who lose their crop one year can often buy seed from their association's seed bank.

Private sector bean seed suppliers have a brief history in the DR. Semillas Surenas, Inc. was one of three companies that tried to enter the bean seed market in the early 1990s. They faced the challenge of competing with government subsidized seed distribution, as well as government subsidized free cold-storage (in SJV). Semillas Surenas was primarily a rice seed supplier that ventured into beans when SEA said they would leave the bean seed market to the private sector. While the company made little or no profit on bean seed, Semilla Surenas was able to sell bean seed primarily to their rice seed customers as added business. However, SEA re-entered the market again a year later, and the three companies summarily exited the bean seed business (Semillas Surenas went out of business entirely).

4.5.4 Banco Agricola

Banco Agricola, the state agricultural development bank, offers subsidized loans for crops and livestock production at 18 percent annual interest. They have charged an average rate of 19 percent over the five-year period from 1993-97 (SEA, 1998), while market interest rates averaged 26 percent over the same time period – implying a subsidy of 6-7 percent. This subsidy is perhaps larger when considering that loans for bean production alone – apart from other business the farmer may have with the bank – are often made at a rate higher than the average commercial market rate, reflecting the risk of bean production (Libre, 1998). Loans to bean producers in 1997 accounted for 2,421 ha of bean area planted (7 percent of total bean area planted). By comparison, loans to rice growers accounted for 27,723 ha of the area planted (26 percent of total rice area planted). Of Banco Agricola's loan portfolio, 3.7 percent went to beans (which account for 3.7 percent of the total value of all DR crops produced in 1997), while 56 percent went to rice, which accounts for 25 percent of the total value of all DR crops for 1997 (SEA, 1998). As discussed in more detail in Chapter 5.10, Banco Agricola targets small to medium-size farmers, most of whom are not able to secure loans from commercial sources. Thus, Banco Agricola promotes developmental objectives while promoting domestic production of crops such as rice and beans, which employ many rural farmers and laborers and provide domestic sources of carbohydrates and protein for consumers.

4.5.5 PROSEMA

PROSEMA, a government agency, provides subsidized land preparation for various crops across the country. According to CRSP data, PROSEMA charges roughly one-half that of private land preparation services, at least in the San Juan Valley. However, as is noted in the following chapter, farmers who use PROSEMA often report problems with delayed service, poor land preparation, or both. According to PROSEMA data, 37 percent of the land planted to beans in 1997 received some land preparation service from PROSEMA (SEA, 1998). Roughly two-thirds (68 percent) of these services were utilized by farmers during September-December, coinciding with the planting periods in the San Juan and Cibao Valleys. However, the 1998 producer survey showed that within the San Juan Valley, only 25 percent of farmers contracted with PROSEMA (CRSP, 1998).

4.5.6 INDRHI

INDRHI, the *Instituto nacional de Recursos Hidraulicos*, is the government agency that builds and maintains much of the irrigation infrastructure in the DR. User rates charged to recipients are subsidized. In the San Juan Valley (SJV), this rate is US$13.16 per hectare per year (RD$12/ta), although the on-going JICA/SEA Yaque del Sur Integrated Rural Development project estimates that a fee of approximately US$31.00 per hectare per year would be required for the SJV Irrigation District to recover all operating costs (JICA, 1998). The IDB is currently working in the SJV with INDRHI (through the PRODAS project) to try and improve the infrastructure, as well as the efficiency of water distribution and management in the valley.

4.5.7 CVMA Input Sales

The government also subsidizes various chemical inputs purchased by farmers at CVMA distribution centers. However, while data on amount of product(s) sold is not available, various sources indicate that CVMA sales represent a very small proportion of bean farmers' input purchases.

4.6 The Bean Marketing System

4.6.1 Marketing Channels

Most domestic bean growers sell their produce to commercial truckers that come to the growers' field at or soon after harvest. However, producers also sell to local middlemen (suppliers of local credit and/or chemical inputs), INESPRE, SEA, and bean processing agro-industries. In addition, producers with access to transportation sell directly to wholesalers or retailers (Heikes, 1993).

Commercial truckers are usually based in urban areas, traveling throughout the country collecting beans either directly from the producers' bean fields or from the producers' homes or storage facilities. In turn, these commercial truckers sell their purchases to professional traders, or directly to wholesalers or retailers (Heikes, 1993).

Local middlemen usually operate on a smaller scale within a given region. Often they provide growers with financing or other inputs in exchange for exclusive rights to the production or a percentage of the production. These regional middlemen usually collect the beans directly from the producers' fields, sometimes storing the beans before selling them to wholesalers. Some of these regional middlemen also sell to commercial truckers (Heikes, 1993).

As discussed at length above, the government parastatal *INESPRE* is also involved in bean marketing, although it typically only purchases in the San Juan and Cibao Valleys. Likewise, the government seed multiplication program run by *SEA* provides a marketing option for selected growers (50 or so) in the San Juan Valley and a few in other regions.

The role of *farmer associations* in the San Juan Valley in facilitating bean purchases by INESPRE was discussed above in Section 4.5.2.2. While these farmer associations have other activities common to cooperatives, with respect to output marketing, these organizations only facilitate sales to INESPRE, not to private buyers or agribusinesses. One farmer organization in the SJV is investigating export opportunities in Venezuela and Cuba, and is in the process of moving towards becoming a cooperative, which may eventually lead to cooperative output marketing to private sector agents.

Agro-industries receive their bean supplies directly from producers, as well as from middlemen. In turn, packaged bean products are either distributed to wholesalers or retailers (Heikes, 1993).

Imported beans mostly come into the country through the private sector, but are also procured by INESPRE. Private sector bean imports are initiated by bean processing agro-industries or importers, who are either wholesalers or retailers themselves, or who in turn sell to wholesalers and retailers. Beans imported by INESPRE are either sold by INESPRE directly to consumers or are sometimes channeled through wholesalers, retailers, and agro-industries (Heikes, 1993).

Wholesalers usually have large storage facilities and many actually own and operate commercial trucking services. These wholesalers store beans, then distribute and sell to retailers throughout the country (Heikes, 1993).

Retail outlets vary, depending on location. In rural areas, a retailer is typically a small store located in one room of a house, or a small structure just outside the house (*colmados*). However, beans are also retailed in open air central markets (*mercado centrales*) in rural areas. In urban areas, although *colmados* and *mercado centrales* exist, beans are mostly sold at mid-sized grocery stores (*mercados*), and many large, modern, luxurious, and even air-conditioned supermarkets (*supermercados*), which offer a complete assortment of the world's food products and consumer goods. Packaged or processed beans are found in some urban *mercados*, but primarily in *supermercados*. *Supermercados* in Santo Domingo have bagged domestic beans that are differentiated by size and quality (*i.e.* for the Pompadour bean, retail classes include original, select, and super select). *INESPRE* sells beans directly to consumers (at slightly subsidized prices) from the backs of trucks or from small vending centers (Heikes, 1993).

While the Dominican Republic does not officially *export* beans to Haiti, many commercial truckers from throughout the country, and regional middlemen along the Haitian border, "unofficially" sell or barter beans to Haitian "importers" (Heikes, 1993). Various sources also alleged that in recent years, beans donated to Haiti have often ended up entering Dominican markets.

4.6.2 Farm-level Bean Storage and Sales

Nearly all respondents (96 percent) to the 1992 nationwide survey said they stored beans for home consumption. Most stored them in sacks while some use steel or plastic drums. One-half of all respondents stored beans which they later sell, and 41 percent stored beans for use as seed (Heikes, 1993). Most of the respondents to the 1992 nationwide survey participated in bean markets, with 88 percent selling some or all of their bean production. The remaining twelve percent of the respondents grew beans for subsistence use only. Using SJV growers from the 1998 producer survey as a proxy for growers in other regions, while these growers may store some beans for seed the following year and/or for home consumption, those who sell beans typically do so within a few weeks to a month after harvest. This is not surprising, given that the high costs of bean production mean that producers need cash to pay off input loans.

While SEA buys between 1,800 to 2,700 metric tons of beans each year for its seed program, and while INESPRE (in years of operation) may buy up to 3,000 metric tons of beans, these purchases are made almost entirely in the San Juan or the Cibao

Valleys. The implication is that while growers in those valleys may have the option to sell some or all of their beans to SEA and/or INESPRE[13], growers in the rest of the country sell to commercial truckers and middlemen or local wholesale and retail markets at lower prices.

4.6.3 Alternative Marketing Institutions

The Junta Agroempresarial Dominicana (JAD), a agricultural consulting firm based in Santo Domingo that is often hired by the government, agribusinesses, and even by some farmer associations, has tried in recent years to move the bean marketing system towards a more open-market orientation, at least within the domestic market. They bemoan INESPRE's domestic and import purchasing processes as inefficient and corrupt institutions that create more harm than good by insulating bean producers from competitive forces and allowing part of the benefits of low-priced imported pintos to be captured by government officials and importers in the non-transparent licensing process.

To address the uncertainty created year in and year out by INESPRE's non-guaranteed purchase quantities and prices, not to mention their late payments, in 1998, JAD instituted the Bolsa Empresarial, an open trading market to facilitate market transactions and (hopefully) contracting between producers and private sector buyers of beans. Although several San Juan Valley farmer associations approved of the initiative in spirit, in practice they nevertheless sold again to INESPRE in the spring of 1998. Thus, the Bolsa was not used to coordinate bean marketing in 1998.

---

[13] In the San Juan Valley in 1998, 26 percent of growers sold to SEA, 64 percent to INESPRE, and 28 percent to middlemen (CRSP 1998 Producer Survey and Chapter 5).

To address the uncertainty and corruption evident in INESPRE's import licensing process, JAD recommended an open permit system in which permits would be sold in transparent auction to the highest bidder. JAD argues that SEA could use the income from the sale of licenses to fund the seed program, bean research, etc. In other words, any difference between the world price and the domestic price (minus marketing costs) would be spent by SEA on productive investments, rather than ending up in the pockets of the buyers and sellers of import licenses.

4.7 Research and Extension to Improve Bean Varieties and Management Practices

4.7.1 Bean Breeding and Foundation Seed Production

In the 1960s, the first government bean seed processing facility was established in San Cristobal. In 1971, the SEA's Department of Seeds was officially established and given its mandate to regulate the production of all seeds in the country. In 1976, the Seed Multiplication Program was created through the small-scale agricultural producer project funded by a loan from USAID. Part of this loan was used for the construction of infrastructure, including a storage facility in Juma, a processing and drying facility, and an experiment station and scientific laboratory (CESDA, located in San Cristobal) (Heikes, 1993).

In 1979, through PIDAGRO III (an integrated agricultural development project that was financed by USAID and the IDB), new and additional equipment was purchased for CESDA in San Cristobal, and a processing plant and experiment station were constructed in San Juan de la Maguana (Heikes, 1993).

The USAID Bean/Cowpea CRSP began collaborative bean research support to SEA in 1984, with research centered at CESDA in San Cristobal and CIAS in San Juan/ Arroyo Loro. To date, CRSP support has included funds for research, training, conference and project travel, and technicians' salaries; SEA provided researcher salaries, buildings, land, and vehicles. By the mid-1990s, the CRSP-trained DR staff included two Ph.D.'s (Dr. Eladio Arnaud at Nebraska and Dr. Graciela Godoy at Wisconsin) and a MSc. (Segundo Nova at Oregon State).

CRSP bean research in the DR has included varietal development (Chapter 5.6.1), research on optimal planting dates for the SJV (Chapter 5.5.4), and research on cultural practices, including all aspects of bean production, from land preparation to post-harvest and seed storage. The philosophy of the CRSP staff has been to combat the disease and pest problems facing SJV farmers with both varietal resistance and improved cultural practices. While CRSP varieties have been diffused across the country through the SEA Seed Multiplication Program, CRSP-recommended cultural practices have been diffused primarily in the SJV through field days and production courses (Chapter 5.3.5) as well as instructional phamplets (cited in CRSP Annual Reports).

4.8 Chapter Summary

This subsector analysis demonstrates that the high adoption rate of PC-50 is due to a combination of better field results (yields and uniformity; Chapter 5), continued/ increased government support to bean farmers in the form of negotiated prices above those of the market, the multiplication and distribution of subsidized PC-50 seeds, and continuing import protection which maintains high farm-level bean prices. Since 1984, CRSP research has successfully developed yield-augmenting technologies and disease prevention practices. However, past and existing government policies towards beans have created a situation in which production and marketing risk has increased, resulting in declining area planted and hence decreased national production. Future domestic bean production (and future CRSP impact) hinges primarily on the nature of future government activities in bean purchasing and marketing, the government's policies toward import levels and import administration, and consumer preferences for domestic beans with respect to imported pintos.

In summary, the policy and institutional framework, as defined by the Dominican government, has promoted the rights of producers to produce beans at the expense of consumers' rights to cheaper beans. In the process, over the past few years, the erratic and poorly defined policies of the government marketing board, with respect to both domestic support prices for beans and the timing and quantity of bean imports, has created a large amount of uncertainty in the production and marketing of beans. This uncertainty is simultaneously creating substantial risk for bean farmers and traders, while providing avenues for the extraction of rents by select farm and trader groups at the expense of other farmers, traders, and consumers of beans in general. Existing government policies toward the bean subsector - coherent or not - are clearly promoting substantial inefficiencies at both the production and marketing levels.

The past, present, and future aggregate rate of return to bean research and farm-level profitability in the DR is highly dependent upon the policy environment that shapes the opportunities and incentives facing Dominican producers and marketing agents. At present, that policy environment attempts to favor producers over consumers of beans. Yet in the long run, the policies work to the benefit of the few at the expense of the many producers who grow ever more dependent upon the policy framework to grow beans for commercial purposes. Smaller and medium size producers are both more vulnerable to lower-priced imports and less able to adjust to price changes either through cost reduction or substitution of alternative crops. Therefore, they will eventually bear most of the costs of any move away from the current policy framework.

CHAPTER FIVE: BEAN PRODUCTION IN THE SAN JUAN VALLEY

5.1 Introduction

This chapter presents results from two surveys completed by the CRSP in 1998 which focused on technical and financial aspects of bean production in the SJV. Results from these surveys include a descriptive analysis of the process, costs, and profitability of bean production in the San Juan Valley (SJV), both on average and by farm size. The chapter assesses the profitability of SJV bean production and its sensitivity to changes in bean yield and price. Given the uncertainty of future government policy regarding input and output subsidies and the historically high level of government support to bean farmers, the sensitivity analysis demonstrates the farm-level effect of various yield and/or price changes on financial and economic profitability. In addition, the analysis demonstrates which producers will bear the adjustment costs that inevitably will arise from any future changes in government policy towards the bean subsector.

In the previous chapter, subsector analysis was employed to explain how benefits of technological change in bean production are distributed between consumers and producers. By contrast, this chapter explains how benefits that accrue to producers are distributed among various types of producers and highlights areas of leverage in which changes in government policy and/or farm management practices could most easily increase the profitability of bean production through cost reduction.

Over the last five years, the SJV has produced close to one-half of the country's total annual bean production. The valley has traditionally led the country in bean production and is an important producer of other grains such as rice and maize. In fact, the valley is affectionately known in the DR as *el granero del sur* (the granary of the south) and the red beans produced there are preferred by a most Dominicans[1]. The valley is almost completely irrigated and is not surprisingly a highly commercial farming community. Nevertheless, resource distribution in the valley mirrors that of the agricultural sector across the DR and of Latin America in general; land ownership is highly skewed, as are other critical factors of production such as human capital and access to technical knowledge.

Using farm size (bean area cultivated) as a proxy for a farmer's general resource constraint (including land, human capital, technical knowledge, credit, etc), average asset levels and profitability of large farmers are compared with that of small farmers. This comparison is used to highlight how hypothetical variation in prices and yields farmers would affect the profitability of farmers with different asset levels. Realistic scenarios of increases in price variation could come from either reduced government bean purchases in the valley or from increased import levels of beans, while variation in yields could result from existing or future biological pressures and constraints on bean production in the valley. Finally, the impact of the CRSP on bean production in the valley, as well as the potential for future impact, is also explored within the context of the aggregate and subgroup farmer levels.

---

[1] There are some consumers who prefer other types of red beans grown in the DR, such as Jose Beta (red with white speckles) or Constanza (a large red bean grown in the Constanza valley (Mather, 1999). However, the vast majority of consumers in Santo Domingo prefer the Pompadour Checa variety grown in the SJV.

5.2 Data

Results reported in this study utilize two primary data sources. First, during the 1997-98 winter season (November-February), farm record keeping ("RK survey") data were collected by CRSP DR staff, supervised by Project PI Dr. Eladio Arnaud-Santana. These data were collected on the primary bean parcel cultivated by 29 irrigated SJV farmers who grew beans as a monoculture. Data were collected on farmer's socioeconomic/household characteristics, bean area that season, tenure type, total production from that parcel, credit amount and sources, and the cost, amount, and type of chemical inputs, labor and equipment used for each operation from land preparation to harvest/threshing. Second, retrospective data were collected from the same 29 RK farmers plus 71 additional randomly selected SJV farmers (for a total of 100) through the 1998 CRSP producer survey ("Producer Survey")[2]. The Producer Survey was used to augment the RK information related to total bean area and yields, land tenure, and credit, and to add new information regarding production constraints, sales, farmers' technical knowledge, and farmers' perceptions of varieties, mandated planting dates, and the future of bean production in the SJV. Whereas the RK survey collected precise input/output production data from 29 representative farmers, the producer survey collected retrospective data from 100 randomly selected farmers (including producer bean area and

[2] In this chapter, "RK Survey" will refer to the 1998 Record-Keeping Survey managed by Eladio Arnaud Santana during 1997-98 winter bean season, and "Producer Survey" will refer to the 1998 CRSP Producer Survey managed by David Mather in July-August 1998. Dr. Arnaud also managed producer surveys in the SJV following the 1995-96 and 1996-97 winter bean seasons; when statistics are drawn from *these* earlier surveys, the reader will be duly notified.

yields from the previous 5 years).

This chapter reports estimates of average input use, costs of production, and profitability for the total RK sample of farms (parcels), and then compares the performance of small versus large farms. As all farmers in the RK sample (and almost all farmers in the valley) use improved varieties and fertilizer, variation in yields and profitability across farmers is due to factors such as level of fertilizer use, technical knowledge, irrigation quality, land and land preparation resources, scale of bean operations, access to credit, and price received for output. While some small farmers' yields are as high as those of large farmers, larger farmers were generally more profitable due to higher output prices received and lower production costs per hectare.

5.3 Human Capital

5.3.1 Introduction

Farmers differ greatly in terms of their ability to manage their fixed and variable resources to maximize profit (allocative efficiency). Technical knowledge of the bean production process is essential for application of fixed and variable resources in combinations that maximize financial returns per hectare. Thus, technical knowledge enables a farmer to make optimal input and output choices given his opportunity set. technical knowledge or human capital can be proxied by various indicators, including years of experience producing beans, education level achieved, extension advice received, and field days/courses attended.

By contrast, socioeconomic status and political affinity helps to shape a given farmer's opportunity set with respect to their access to low priced, high quality, timely inputs, as well as to higher output prices. For example, SJV farmers from the *Productores Agricolas, Inc.* or *ASOTEPRO* producer associations will very likely have contact with other association members that have university training in the agricultural sciences. Thus, farmers in these associations likely enjoy access to the human capital resources of an agronomist friend, which are unavailable to a farmer in another association. Although some SJV producer associations are quite socioeconomically diverse, most associations attract members with common socioeconomic characteristics or political orientations. Producer association membership can bring significant benefits to the farmer, such as differential access to inputs, credit, storage, and marketing opportunities.

5.3.2 Producer Associations

Producer associations can solve collective action problems for farmer groups such as cost-sharing of high exclusion cost goods (lobbying/negotiation with INESPRE or SEA), as well as cost-sharing of more easily recuperable costs stemming from large fixed investments (tractors, threshing machines, etc.). By its collective nature, an association can also facilitate access to other inputs by reducing transaction costs such as when an association purchases inputs or negotiates output market prices for its members. In the SJV, the benefits of association membership are seen in improvements in seed access, timeliness, and quality via association-managed seed banks, their access to credit from Banco Agricola[3], and their ability to sell grain to INESPRE (discussed below).

[3] In most cases, credit from Banco Agricola is facilitated by the association for each member individually; in other cases, credit is associative or shared.

Over 95 percent of bean growers in the SJV belong to a producer association (see Appendix A). This high participation rate facilitates political mobilization and enhances the producers' bargaining power with respect to INESPRE during negotiations to set the parastatal's annual purchase price. From the perspective of technological dissemination and adoption, these associations appear to have played a significant role in the high rate of adoption of new varieties (PC-50) and associated management practices (mandatory planting dates) that have been developed and promoted by the CRSP in the DR.

5.3.3 Socioeconomic Characteristics of Producers

Using education as a proxy for human capital, Table 5.1 demonstrates that the average valley producer completed primary school, while the average small producer has less than half the education (4 years) of an average large producer (8.9 years). Therefore, farmers across the valley have different aptitudes for the adoption of technologies such as improved management practices, which require human capital as a complement.

With respect to gender, of the 100 respondents selected randomly from farmer association lists, only one was female. However, while women *in the valley* are not involved in farmer associations[4] nor in most aspects of bean production in general, they are the principal providers of labor in drying, sorting, cleaning, and bagging harvested beans. More significantly, they most often are the household member who purchases beans from local markets and prepares the household meals. Therefore, if we consider the

---

[4] While it is possible that a household male could merely serve as the "negotiator" of the harvest (via the association) while a woman manages the bean production, this is a very atypical situation, according to key informants -- one of whom is one of the few female bean farmers in the valley.

process of bean production as encompassing all activities that create utility from the farm level to the consumer's plate, then the women's role in this process is primarily at end of the production chain – at both the retail and food preparation levels[5].

Table 5.1 Socioeconomic Characteristics of Producers by Bean Area, SJV, 1998

Variable	Total (N=100)	Small (< 2.5 ha) (N=37)	Medium (2.5 to 6.3 ha) (N=33)	Large (> 6.3 ha) (N=30)
Share of Bean Farms	100	42	32	26
Mean Age (years)	48	51	45	48
Mean Education (years)	6.3	4.0	7.2	8.9
Mean Household Size[a]	6.4	6.8	6.0	6.4

[a] Defined as the number of dependents currently living within the house.
Source: 1998 CRSP Producer Survey

5.3.4 Extension Advice Received

Given the importance of technical knowledge as a determinant of both technology adoption (Feder, 1985), yields, and net returns to bean production, various survey questions were used to investigate the sources of technical assistance sought and received by bean producers in 1998. First, respondents were asked whom they generally contacted first for bean production advice. Second, they were asked whom they had actually

[5] Preliminary results from a consumer survey in the DR (Mather, 1999) show that consumer preferences for beans are based on a combination of various product attributes, including freshness (taste) as well as cooking time (fresher beans cook faster), for which womens' demand as an product attribute would be expected to increase as household income increases. Therefore, the opportunity sets of women can have a profound effect on the demand for bean attributes, such as freshness and cooking time, and thus indirectly the profitability of bean production at the farmlevel.

contacted in the last year for advice and for what problem(s). Third, they were asked how many times during the past year they were visited by the government (SEA) extension agent assigned to them. Finally, the respondents were asked about their attendance at bean production courses or field days during the past year, as well as who sponsored or led the courses/field days.[6] The results of the first two questions are presented in Table 5.2.

Table 5.2 Farmers' Sources of Technical Assistance, SJV, 1998

Sources of Technical Assistance (TA) on Bean Production	Whom the farmer would generally contact first for TA (%)	Whom the farmer actually contacted for TA in 1998 (%)
SEA Extension Agent	50	27
Another Farmer	14	9
CRSP	7	11
Farmer Association	6	0
Federacion Dominicana de Desarrollo	6	8
Input Dealers	2	0
EYCA [a]	0	3
Does/Did not seek TA	13	46

[a]Ag Extension component of PRODAS (IDB project)
Source: 1998 CRSP Producer Survey

[6] Technical assistance in the SJV is supplied by SEA (the government extension service), the CRSP, input dealers, FDD (Fundacion Dominicana de Desarrollo), EYCA (the agricultural extension component of PRODAS, a large IDB irrigation project in the SJV), and IAD (the agrarian reform institute).

From the results in Table 5.2, about one-half the producers generally first contact their SEA Extension agent for technical assistance, while 13 percent report that they don't ask anyone for advice. When the respondents were then asked who they actually contacted first in 1998, twenty-seven percent reported contacting SEA, 11 percent contacted the CRSP, and 46 percent did not contact anyone. Of those respondents who sought technical assistance in 1998, 43 percent were interested in information regarding fungicide applications for rust, molds, spots, antracnosis, and other diseases; 30 percent asked about BGMV, 21 percent asked about early defoliation, 19 percent asked about insecticide applications, 9 percent asked about crop development, and 2 percent asked about irrigation and planting, respectively.

When asked about the number of extension contacts made in 1998 by SEA extension agents, 42 percent of the respondents reported not receiving any SEA extension visits during the past year, 13 thirteen percent reported being visited once, 20 percent were visited twice, and 27 percent received three or more visits. Key informant interviews indicated that SEA extension quality and consistency depends greatly on the agent in question. In general, low extension salaries and scarce transportation funds were often cited as a primary constraint to better extension.

In addition to extension visits, SJV farmers also gain technical knowledge by attending field days and/or production courses offered by many of the same sources of technical assistance. In 1998, forty-eight percent of the respondents attended a field day, and 39 percent attended a production course. The field day and course sponsors are reported in Table 5.3.

Table 5.3 Sponsors of Bean Production Courses and Field Days, SJV, 1998

Sponsoring Organization	Field Days[a]:	Production Courses[b]:
Farmer Association	66	15
CRSP	21	7
FDD[c]	15	17
Input Dealer	8	44
SEA	0	9
EYCA[d]	3	7

[a] Responses of 48% of respondents who attended a field day in 1998
[b] Responses of 39% of respondents who attended a production course in 1998
[c] Federacion Dominicana de Desarrollo [d] Ag Extension component of PRODAS (IDB project) Source: 1998 CRSP Producer Survey

While it is difficult to determine the sponsor of the events indicated by the response "farmer associations," it is very likely that these are CRSP-organized events (with certainty, this applies to the field days). If these events are attributable to the CRSP, then CRSP-organized field days reached 57 percent of the valley's farmers (87 percent of the 66 percent of the total sample who attended a field day in 1997-98), and CRSP-organized production courses reached 9 percent of the valley's farmers (22 percent of the 39 percent who attended courses in 1997-98). By contrast, 17 percent of valley farmers attended production courses sponsored by input dealers (44 percent of the 39 percent who attended production courses in 1998), which suggests that input dealers have considerable influence regarding farmers' input use in the SJV.

5.3.5 CRSP Extension of Technical Knowledge

From the statistics presented above, it is apparent that more than half of the valley's farmers in the SJV have attended field days or courses led by the CRSP, and 11 percent report that they contacted the CRSP first for technical advice in 1998. In addition, of the farmers who report going first to their association for technical assistance, it is very probable that the information received there originated from the CRSP. In recent years, the CRSP scientists in the DR have clearly helped to compensate for the DR's ineffective public agricultural extension system by extending new bean production technologies via pamphlets, courses, and field days organized for (and sometimes by) farmer associations and womens' producer groups. This effort by the CRSP is aided significantly by farmer associations, which help lower the transaction costs of information dissemination from the research station to farmers by providing the CRSP a forum from which to reach many members at the same time. And because those members are apt to share the bonds of association, it is likely that CRSP recommendations have been further disseminated among members who did not actually attend a field day or course.

5.4 Bean Cropping Patterns and Land Use

5.4.1 Farm Size

Bean farmers in the SJV are relatively large, compared to other countries in the Central America/Caribbean region. The average total bean area per farmer in the SJV is 8.2 ha (CRSP, 1998). However, this mean value in the SJV belies great variance in total bean area, both within the DR and within the SJV. Within the 1998 CRSP producer survey of 100 farmers, total bean area in the SJV varied from 0.4 to 100 ha. This study classifies farmers into three categories: small (< 2.5 ha), medium (2.5 to 6.3 ha) and large (> 6.3 ha).

While aggregate bean area in the San Juan Valley has decreased since 1993, it appears that farm size may have increased. According to the 1998 CRSP Producer Survey, during this five-year period, the share of small farmers dropped from 45 to 36 percent, while the share of medium farmers increased from 27 to 33 percent, and the share of large farmers increased from 27 to 30 percent[7].

Table 5.4 Characteristics of Sampled Bean Producers by Bean Area, SJV, 1998

Characteristics	Total (N=100)	Small (< 2.5 ha) (N=37)	Medium (2.5 to 6.3 ha) (N=33)	Large (> 6.3 ha) (N=30)
Bean Farms in SJV (%)	100	42	32	26
Mean Bean Area (ha)	8.2	1.7	4.6	23.0
Mean Yield (kg/ha)	1,128	1,083	1,111	1,226
Source: 1998 CRSP Producer Survey				

5.4.2 Land Tenure

Five types of tenure exist in the SJV, as demonstrated in Table 5.5. Nearly one-half of the respondents are owner operators (48 percent), while 41 percent sharecrop, 38 percent receive land from the state's agricultural land reform program, and 11 percent rent land. However, farmers typically cultivate beans under more than one form of tenure. The land share portion of Table 5.5 demonstrates that land distribution in the SJV is highly skewed. For example, farmers with land from the land reform program (38 percent of the

[7] However, it is possible that this reflects selection bias in that only current bean farmers are respondents. Thus, farmers who were small or medium in 1993 may have expanded their operations in the past five years and become medium and large producers respectively.

respondents) cultivate only 6 percent of the bean area in the sample. In addition, while one-half of respondents own some of the bean area they cultivate, in fact, most of the land in the sample is sharecropped (50 percent), while 37 percent is owner-operated, 6 percent is rented, 6 percent is associated with the state agricultural land reform program, and 1 percent is loaned (free of charge). For each tenure class the average percentage of land within that class operated by the farmer varies considerably (Table 5.5). For example, land owners (48 percent of the sample) own an average of 65 percent of their total bean area, while sharecroppers (41 percent) sharecrop an average of 75 percent of their total bean area.

Table 5.5 Land Tenure of Sampled Bean Producers, SJV, 1998

Tenure Class	Farmers by Tenure Class[a] (%)	Land Share by Tenure Class (%)
Owned	48	37
Sharecropped	41	50
Rented	11	6
Ag Reform	38	6
Loaned	3	1

[a] Figures do not sum to 100 because many farmers have bean area in more than one tenure class. Land Share is calculated as the percentage of a farmer's area in a given tenure class, weighted by the ratio of the farmer's total area divided by the total sample area. Thus, Land Share sums to 100.
Source: 1998 CRSP Producer Survey

When Land Tenure statistics are further analyzed by farm size (Table 5.6), it is not surprising that only 23 percent of small farmers own land and that 67 percent of small farmers cultivate land reform land. However, while 65 percent of large farmers own land, they only own an average of 47 percent of their total bean area. This is because 81 percent of large farmers sharecrop some land, with their average sharecropped land accounting for 75 percent of their total bean area. Similar results are found for medium farmers, although those who do own land tend to not sharecrop as much as the large farmers. These results suggest that land ownership in the SJV is highly concentrated, and secondly, that small farmers are not likely to be able to expand their operations due to resource constraints. This second result is not surprising, given the high production costs of beans relative to other crops, including high labor costs and mechanical land preparation.

Table 5.6 Land Tenure of Sampled Bean Producers by Bean Area, SJV, 1998

Characteristics	Total (N=100)	Small (< 2.5 ha) (N=37)	Medium (2.5 to 6.3 ha) (N=33)	Large (> 6.3 ha) (N=30)
Farmers owning land (%)	48	23	65	65
Land owned[a] (%)	65	80	73	47
Farmers sharecropping land (%)	41	19	40	81
Land sharecropped (%)	75	77	76	75
Farmers renting land (%)	11	2	9	27
Land rented (%)	33	22	33	33
Farmers with land reform land (%)	38	67	25	0
Land reform land (%)	87	93	62	0

[a] This should be interpreted as "Of farmers who own land (48%), land owned accounts for an average of 65% of their bean area." The same interpretation applies for the tenure type in the three subsequent rows.

Source: 1998 CRSP Producer Survey

Within the sharecropping tenure class are three different arrangements that differ in terms of the sharing of benefits, costs, and risk between the landowner and sharecropper. Eighty-five percent of sharecroppers farm *a la quinta,* 5 percent farm *a la cuarta,* and 10 percent farm *a la media*. Under *a la quinta*, by far the most common sharecropping arrangement, the sharecropper pays all bean production costs and gives the landowner 20 percent of the harvest[8]. Thus, sharecroppers under this system bear almost all the risk of bean production. Among sharecroppers, an average of 75 percent of their bean area was sharecropped, with only 16 percent owned.

Thirty-eight percent of the respondents were affiliated with the government's land reform program (IAD), whereby they received use rights (but not ownership) to farm 1.5 to 2.5 ha of irrigated land (25 to 40 tarea). Bean area under IAD accounts for about 6 to 7 percent of the total bean area in the SJV (JICA, 1998 and SEA, 1999). Although 71 percent of farmers affiliated with IAD cultivate only land from IAD, there is no restriction preventing them from owning, sharecropping, or renting additional plots. In fact, 29 percent of IAD farmers retained use rights to IAD land yet own or sharecrop other land for bean production. Of those using IAD land, an average of 86 percent of their bean area is IAD land, with 7 percent sharecropped and 4 percent owned. Thus, for the majority of IAD farmers, the land they receive from IAD represents nearly all of the land that they cultivate.

5.4.3 Irrigation

Although all bean farmers in the valley cultivate under irrigation, irrigation efficiency (including both the timing and quantity of the nearest canal as well as the

---

[8] *A la cuarta* is similar to *a la quinta* except the tenant gives the landowner 25 percent of the harvest. *A la media* allows for some cost-sharing as the landowner pays for land preparation, the sharecropper bears the costs of planting, and both share the remaining costs and revenues half and half.

farmer's water management) are also important yield performance factors. This survey focused only on the farmers' opinion of his/her water constraints by asking respondents about the sufficiency of their irrigation on each of their bean fields. Twenty-one percent of respondents report "not having sufficient water", with this constraint affecting an average of 90 percent of their total bean area. Forty-seven percent report "usually having sufficient water", with this condition accounting for an average of 88 percent of their bean area. Finally, forty-four percent report "always having sufficient water", with this condition accounting for an average of 84 percent of their area[9]. Analysis of water sufficiency of fields by farm size and by tenure of each field indicated that there are no significant differences in the frequency of water constraints by farm size or tenure.

These responses imply that 19 percent of the valley's bean area does not receive sufficient water (21 percent times 90 percent), 42 percent usually receives sufficient water, and 37 percent always receives sufficient water. Therefore, it is clear that although all farmers have access to irrigation, there are substantial differences in the timing and quality of access to that vital resource[10].

---

[9] These three figures do not sum to 100 because farmers were asked about water sufficiency on each of their various bean fields. Because many farmers have multiple fields that varying in irrigation quality, many farmers may have a certain percentage of their bean area under two or three of the constraint categories.

[10] The principal objective of the on-going PRODAS project (Inter-American Development Bank) is to improve irrigation efficiency and water distribution in the valley by strengthening infrastructural and managerial capacity.

5.4.4 Cropping Systems

In the San Juan Valley, beans are grown almost exclusively in the winter season in rotation with a variety of annual summer crops. During the winter 1997-98 season, only 9 percent of the respondents cultivated a crop in addition to beans. These additional crops were sweet potatoes (5 percent of respondents), cassava, peppers, rice, and pigeon peas (1 percent each). Summer annual crops cultivated by bean farmers are typically maize, rice, sweet potatoes, pigeon peas, and cassava (Table 5.7). In general, larger farmers in the SJV grow rice, sweet potatoes or pigeon peas in the summer. While small farmers grow primarily maize in the summer, some also plant rice, pigeon peas, or cassava.

Table 5.7 Summer Cropping by Bean Farmers by Bean Area, SJV, 1998

Crop	Percentage of Bean Farmers Cultivating Each Crop		
	Total (N=100)	Small (< 2.5 ha) (N=37)	Large (> 6.3 ha) (N=30)
Maize	47	55	39
Rice	18	17	20
Sweet Potato	10	3	20
Pigeon Pea	15	15	10
Cassava	8	10	0
Sorghum	1	0	5
Lechoza	1	0	3
Bean	1	0	3

Source: 1998 CRSP Producer Survey

5.5 Land Preparation and Planting Dates

5.5.1 Land Preparation

In the SJV, land preparation in carried out from July through November. While some farmers begin land preparation in July, most start in August or September. Farmers complete from three to eight land preparation operations, although the average is five (RK, 1997). Farmers vary in the number of operations, due in part to variance in both technical knowledge of land preparation and access to tractor services. Sixty percent of farmers used only a tractor for their various land preparation operations, while 37 percent used both a tractor and animal traction, and 3 percent use only animal traction. Almost all (88 percent) of the tractor users rent these services from either the government (PROSEMA), their farmer association, or private contractors. A few farmers (7 percent) owned their own tractors, and 2 percent borrowed a tractor from a family member or friend. Farmers who rented utilized several different sources, including private companies (29 percent), farmer associations (27 percent), PROSEMA (24 percent), individuals (18 percent) or IAD (2 percent). Although PROSEMA's tractor service rates were subsidized (costing about 40 percent less than market rates), survey and rapid appraisal interviews indicated that PROSEMA's tractor services are unreliable in terms of punctuality and quality. For this reason, 23 percent of respondents using tractors chose a mix of rental services from two or more sources[11].

---

[11] Several farmers who rented tractor services from PROSEMA reported that the service was of such poor quality that they either paid the PROSEMA operator to redo the same operation or they simply hired a private operator to do so.

While most farmers were satisfied with the tractor services that they hired, 11 percent of respondents said that tractor services were not available when needed, and 15 percent reported that they were not satisfied with the quality of the service. Respondents were most dissatisfied with the PROSEMA service, which accounted for 46 percent of the complaints about poor service availability and 46 percent of poor quality complaints (although PROSEMA accounted for only 28 percent of tractor rentals). Association tractors accounted for 36 percent of reported availability problems but only 15 percent of quality problems. By contrast, private tractor operators accounted for 10 percent of availability problems and 30 percent of the quality complaints. By far, the most common quality problem was simply poor depth of cut (89 percent of the 15 percent who complained of poor quality).

5.5.2 Fallow Period and Planting Dates

Since the occurrence of a serious outbreak of BGMV in the SJV during the 1989-90 bean season, planting dates have been a very serious economic and political issue[12]. Research carried out by CRSP scientists showed that the valley's whitefly vector increases in the late fall (August through October) when there are ample host crops, primarily beans, peppers, tomatoes, and melons. Thus, in an effort to reduce whitefly populations, in 1990, CRSP researchers recommended that the regional government impose both a fallow period and a planting date period. CRSP scientists reasoned that the fallow period would

[12] According to several sources, the whitefly population in the Southwest region exploded in the late 1980s due to the promotion of melon production in Azua (an area to the southeast of the San Juan Valley) by a USAID export promotion project.

eliminate the host crops on which the whitefly reproduced in the months prior to the main bean season, thus suppressing the whitefly vector until at least late December, after which most farmers' beans would no longer be vulnerable to the whitefly[13]. In 1991, the government implemented this advice by initiating a fallow period which prohibited the cultivation of host crops in the valley from 1 August to 15 November.

Concurrently, the government implemented a planting period which was intended to work in tandem with the fallow period; beans could only be planted in the SJV between 15 November and 10 January. This planting period ensured first that no farmer would plant prior to 15 November – and thus risk serving as a breeding ground for the whitefly that could then spread across the valley – and that no farmer would find themselves with pre-flowering beans in mid-January, by which time the whitefly population was expected to be rejuvenated. As a result of these regulations, farmers were restricted to growing a single bean crop[14]. Therefore, the benefit of maintaining control of BGMV in the valley for the large winter season came at the cost to some farmers, who lost the opportunity to cultivate two crops of beans; one in the smaller fall season, and one in the primary winter season.

These decrees and their subsequent enforcement (violators' fields were plowed under almost immediately by the army) were vital to the success of efforts to control the

---

[13] The whitefly, which may carry and transmit BGMV, can only transmit BGMV to a given bean plant up until it flowers.

[14] Prior to the initiation of the fallow period, some farmers grew two crops of beans from August-March, although the majority only grew beans in the winter season (November/December - February/March).

whitefly vector. The decrees were deemed necessary due to the high information costs of discerning the origin of whiteflies in the valley and the potentially disastrous externalitites involved – farmers who grow a host crop during fallow period enable the whitefly to multiply and to potentially infect other farmers' fields with BGMV. Although some farmers violated these regulations in the first few years, most farmers have generally followed the fallow period and planting dates – in large measure due to the ability of farmer associations to both disseminate information about the whitefly and to enforce compliance by its members and those of other associations. Clearly, the economies of scale embodied in the farmer associations have helped to lower the transaction costs of both information dissemination concerning the regulations (the value and rational behind the decrees) and enforcement of these regulations.

Because it appeared that farmers who planted earlier in the planting period tended to avoid serious BGMV attacks, in 1993-94, CRSP researchers carried out experiments to isolate the effect of planting date on yield. When these trials confirmed that the optimal planting period opening and closing dates should be earlier, the CRSP researchers advised the regional government to move the planting date period to 5 November to 15 December. Prior to the 1994-95 season, the government acted on this advice, moving the planting date period back as recommended by the CRSP. In 1994-95, as a result of both the new planting dates and CRSP-recommended cultural practice, crop losses in the valley due to BGMV declined to only 10 percent (CRSP, 1994).

5.5.3 Planting Equipment

While most farmers used a tractor for land preparation, planting is still carried out using traditional technologies. Ninety percent of respondents planted with *caballo y sembradora* (horse and planter), one percent planted with a tractor and planter, and 5 percent with a donkey and planter.

5.5.4 Farmer Opinions on Planting Date Period

Given a continuing political debate in the valley over the timing of the start of the planting period, respondents were asked if they felt that the beginning of the planting period should be modified (to a date earlier or later than 5 November), what date would be better, and why. Forty-eight percent reported that they wanted to keep the starting date as it is. Some of those who wish to maintain the current starting date commented that the date should not be changed until there is more time to study the results.

However, fifty-two percent of the respondents said they would prefer to modify the current 5 November planting date. Of these respondents who desired a change in the start of the planting period, 64 percent prefer an earlier starting date (before 5 November), while 36 percent prefer a date after (Table 5.8). It should be noted that 69.6 percent of those who suggest modifying the starting date suggested an optimal date within 6 days of the current starting date. Therefore, the current starting date of 5 November does not appear to be significantly out of line with the opinion of even those who prefer to modify it.

Table 5.8 Farmers' Recommended Starting Dates for the Winter Bean Planting Period, SJV, 1998

Number of Respondents	Percentage[a]	Recommended Starting Dates[b]
2	3.8%	10 to 20 October
9	17.3%	25 to 28 October
5	9.6%	30 October
17	33.0%	1 or 2 November
12	27.0%	7 to 10 November
5	9.6%	12 to 15 November
1	1.0%	5 December

[a] Percentage of respondents, out of the 52 who prefer an earlier/later starting date for the bean planting period.
[b] Dates are reported in unequal increments of time in order to demonstrate that the responses were clumped around a few dates.
Source: 1998 CRSP producer survey

Of the 33 respondents preferring a earlier starting date, 46 percent said that planting earlier would enable farmers to further reduce insect and disease problems, 33 percent simply said that "planting earlier is better," 12 percent said that planting earlier would enable them to take better advantage of the late October rains, and the remaining 9 percent suggested that the date should be earlier to "try something new." Of the 19 respondents preferring a later starting date, 61 percent simply said that "planting later is better," 25 percent said that planting early results in more disease problems, 16 percent cited the need to avoid heavy rains, and the remaining 16 percent said that it's too hot in early November to plant..

5.6 Use of Improved Bean Varieties

5.6.1 Improved Bean Varieties and Yields

5.6.1.1 History of the Development of PC-50

In 1983, the Loyola Polytechnic Institute began efforts to collect local germplasm when they acquired 250 lines of Pompadour Checa from commercial producers and subsequently grew out and characterized the lines. In 1984, the CRSP began collaborative research with SEA in the DR, with Ing. Freddy Saladin serving as PI. From these 250 lines, CRSP researchers identified the 18 most promising lines. Of these, PC-50 and PC-157 were selected for yield testing throughout the country, to be compared with two lines from CIAT (BAT-1412 and DOR-198), as well as a popular Pompadour Checa line (Guerrero, 1987). From 1984-85 to 1987-88, screening continued, with 10-15 trials conducted each winter season. The primary selection criteria were grain type (color, size, growth habit), number of seeds/pod and pods/plant, and resistance to Rust, Common Blight, and Web Blight. Promising best selections were eventually tested on-farm (semi-commercial tests).

While the CIAT lines were higher yielding than PC-50 and PC-157, the CIAT materials had a tough seed coat and were too dark red in color. In 1986, PC-50 was identified as the best selection and registered. In the same year, the CRSP supplied approximately 930 kg of PC-50 foundation seed to the SEA Department of Seeds to be used in the SEA Seed Multiplication Program. In 1997, SEA multiplied PC-50 by incorporating PC-50 into its Seed Multiplication Program, which contracts farmers in the Azua, San Juan, and Higuey valleys to multiply the seed. SEA first sold PC-50 to farmers across the DR for the 1988-89 season. By the 1989-90 season, PC-50 accounted for roughly 50 percent of SEA's bean seed sales.

5.6.1.2 PC-50

In experimental and semi-commercial trials conducted by CRSP researchers between 1984-1989, PC-50 yielded an average of 1,585 kg/ha, 45 percent more than the Pompadour Checa commercial selections grown by SJV farmers at the time. When tested in six regions to compare the various attributes of PC-50 versus Pompadour Checa (and other red varieties), PC-50 averaged a 30 percent higher yield than Pompadour Checa. In addition, PC-50 showed tolerance[15] to rust and common web blight, heat, drought, and low fertility soil. Finally, due to its early and uniform maturity, PC-50 grain was expected to have a higher commercial value.

The experimental results from 1984-88 were largely confirmed by the 1998 CRSP Producer Survey: 76 percent of the respondents reported obtaining higher yields with PC-50 (compared to Pompadour Checa), 13 percent reported obtaining the same yield, and 10 percent reported obtaining lower yields. Of the farmers reporting a higher yield from PC-

---

[15] "Resistance" means that a particular bean variety is completely resistant to the disease and no disease will develop on that variety. "Tolerance" implies that the disease will attack the variety, but the variety will show less disease development or less yield loss than a susceptible variety. "Highly tolerant" is an arbitrary term implying a greater level of tolerance (*i.e.* less disease or less losses to disease with that variety). In the case of rust on beans, there are varieties that are completely resistant, but if a new race or strain of rust appears that variety may prove to be susceptible and many such cases have been documented. Varieties like PC-50 have a more generalized form of resistance that does not prevent disease development, but dramatically reduce the incidence compared with a susceptible variety. These varieties are referred to as tolerant or highly tolerant, depending on the viewpoint of the researcher, breeder, agronomist, or pathologist (Kelly, 1999).

50, 72 percent said that their yield increased by 30 to 60 percent[16].

PC-50 yields reported by the 1998 CRSP Producer survey respondents from the 1993-94 through 1997-98 winter seasons are shown in Table 5.3. Farmers' yields over the 1993/94 - 1997/98 period averaged 1,107 kg/ha, compared to an area-weighted mean yield of 1,204 kg/ha during the same period. It is not surprising that the area-weighted yield is higher, given the asymmetric land distribution in the valley and the fact that larger farmers consistently have the highest yields.

Table 5.9 Mean Farmer Yields of PC-50 in the San Juan Valley, 1993-97

Year	Mean Yield (per farmer) (kg/ha)	Mean Yield (area-weighted) (kg/ha)	Small Farmers (per farmer) (kg/ha)	Large Farmers (per farmer) (kg/ha)
1993/94	1,082	1,126	740	1,536
1994/95	1,173	1,223	1,008	1,507
1995/96	1,166	1,262	1,024	1,224
1996/97	1,023	1,265	926	1,267
1997/98	1,091	1,143	1,045	1,166
5-year average	1,107	1,204	949	1,340
Source: 1998 CRSP Producer Survey (total N=100; small farmer N=37; large farmer N=30)				

[16] It should be noted that the yield increase (30-60 percent) reported by respondents is subject to rounding errors. Because farmers in the DR estimate their yields in terms of quintals/tarea, which typically range from 0.5 and 2.5, asking how much a farmer's yield increased (in terms of quintals/tarea) exposes the response to rounding error. In addition, while farmers were asked about their yield history back to 1993, by 1998 almost all of the farmers in the SJV had already adopted PC-50. Thus, it was impossible to collect accurate data on farmers' Pompadour Checa yields.

When asked about varieties used prior to PC-50, respondents reported planting Pompadour Checa (77 percent), Jose Beta (9 percent), Negra (6 percent), Brasilena (2 percent), Constanza I, Indiana, and Blanca (1 percent each). Respondents were then asked to identify advantages or disadvantages associated with PC-50, compared to their previous variety. Ninety-one percent of the respondents saw advantages, 52 percent saw disadvantages, and 8.7 percent saw no advantages or disadvantages of PC-50. Of those who saw advantages, 76 percent reported that it "yielded more," 49 percent said that it was "more resistant," 17 percent said that it commanded a "better price/market," 8 percent reported "better uniformity," and 5 percent said it has a "shorter growing cycle."

Of those who saw disadvantages to planting PC-50, 18 percent said it is "less resistant," 18 percent said it has a "bad price/market," 5 percent said it has "degenerated," 5 percent said it requires "more inputs," and 4 percent said it "yields less."

5.6.1.3 JB-178

While PC-50 is the most commonly-grown variety in the SJV, a newly released variety – JB-178 – is rapidly gaining popularity. JB-178 is a cross between CX1308 and Jose Beta (a local red variety). In experimental and semi-commercial trials by CRSP researchers between 1993-1995, JB-178 yielded 1,446 kg/ha. In six regional trials designed to compare various attributes of JB-178 versus PC-50, JB-178 averaged 3 percent higher yield than PC-50. However, the advantages of JB-178 are embodied not in higher yield but in high resistance to rust, tolerance to drought and low fertility soil, early maturity and uniformity, and – perhaps most important for growers – seed color and culinary qualities (faster cooking) from Jose Beta that command a higher commercial value (approximately 5 percent higher market retail value.[17] The CRSP's planting and fertilizer recommendations for JB-178 and PC-50 are identical. JB-178 has the same cycle of 75-80 days, although it flowers a little later than PC-50 (30-33 days as compared with 28-30). Although both JB-178 and PC-50 are susceptible to BGMV, JB-178 is resistant to rust while PC-50 is only tolerant.

JB-178 was first tested semi-commercially by SJV farmers in 1995, and was then multiplied in 1996 by some SJV growers through SEA's seed multiplication program. The variety was officially registered and released in 1996, and was first sold by SEA to farmers in 1997. According to the Producer Survey, 41 percent of SJV farmers have tried JB-178, and 34 percent grew JB-178 in the 1997/98.

Respondents who had planted JB-178 were asked to identify its advantages and disadvantages. Ninety-three percent of these farmers reported advantages, including: high yield (45 percent), good market (23 percent), more resistant (13 percent), good culinary qualities and taste (12 percent), and good color (2 percent). Sixty-eight percent of those who have tried JB-178 saw disadvantages, including: less resistant (44 percent), low yield (25 percent), bad uniformity (6 percent), uses more inputs (6 percent), bad color (2 percent), and a longer cycle (2 percent).

In 1997/98, farmers' yields of JB-178 averaged 1,261 kg/ha, compared to an area-weighted mean yield of 1,332 kg/ha during the same period. As with PC-50, area-weighted yields are higher because larger farmers usually obtain higher yields. While JB-

---

[17] SEA/INESPRE pay the same for JB-178 or PC-50 seed/grain, although the former is usually 5 percent more expensive in the SJV market.

178's yield performance in 1997 is better than that of PC-50, it should be noted that JB-178 was only sold by SEA to all valley farmers in 1997/98. Thus, few farmers outside of the seed multiplication program have grown this variety for more than one year, and those non-seed program farmers who adopted in 1997/98 are very likely higher-resource farmers who learned about JB-178 via contact with the CRSP. In fact, the mean yield in 1997 of non-SEA seed program farmers was 1,178 kg/ha, compared with 1,371 kg/ha obtained by the seed program farmers the same year. Nevertheless, JB-178's yield performance, combined with strong market demand for the Jose Beta culinary attributes, makes it an attractive and valuable addition to the mix of Dominican red bean varieties available to farmers.

5.6.1.4 Other Newly-released Varieties

The CRSP developed and tested the white variety *Anacaona*, a multiple cross of (2b-5-1/2 x Nep-2/Black Turtle Soup) x BON 355, which was crossed at Michigan State University in 1984. *Anacaona* is a high-yielding, stable white variety with tolerance to rust, web blight, common blight, heat, and drought. It was registered in 1992-93 and included in the SEA seed multiplication program. However, it is not widely grown because white varieties are not very popular among Dominican consumers, who strongly prefer reds.

Several other varieties have been developed and tested by the CRSP in the 1990s, including CIAS-95 (red), *Saladin-97* (red) and *Arroyo Loro Negro* (black). While these varieties have been registered and released in the last three years, they have not yet been incorporated into SEA's seed multiplication program. CIAS-95, a cross between PC-50 x

BAT-1274 which was made by Jim Beaver in Puerto Rico, is more tolerant to rust than PC-50, is a darker red, matures one week later than PC-50, and out-yielded PC-50 an average of 3 percent across six regional locations. *Saladin-97,* a cross between PC-50 x BAT-1274, has a higher tolerance to rust than PC-50 and yields on average 6 percent higher than PC-50 across six regional locations.

5.6.2 Distribution Channels of Bean Seeds

As discussed in Chapter 4.6.3, the CRSP and SJV growers play important roles the SEA seed multiplication program. According to the 1997 CRSP producer survey, 58 percent of SJV farmers used their own stored seed in the 1996/97 season, 34 percent purchased seed from SEA, 4 percent from another farmer, and 4 percent from a warehouse (CRSP, 1997).

5.6.3 Seed Cost

Prices paid by farmers for bean seed ranged from RD$900/qq for SEA seed to about RD$1,000 for seed purchased from farmer associations[18]. Farmers in the RK survey who reported using own seed were assumed in the cost of production analysis to have seed costs of RD$1,000/qq.

5.6.4 Seed Density

Data from various surveys indicate that SJV farmers use more seed than is recommended by the CRSP. The 1998 Producer Survey respondents used an average of 132 kg/ha (18.4 lb/ta), and the RK farmers used an average 136 kg/ha of seed (18.9 lb/ta),

[18] Farmer associations have access to free cold storage in the San Juan Department of Seeds storage facility. Thus, the association seed price does not include the physical cost of storage from February to November (8 to 9 months).

which is higher than the 94 to 108 kg/ha (13 to 15 lb/ta) recommended by the CRSP. Similarly, the 1997 CRSP Producer survey (Arnaud, 1997) found that more than one-half of the respondents used more than 108 kg/ha (15 lb/ta). Dr. Arnaud attributed this primarily to the fact that close to one-half of the respondents used discs that left a short distance between rows planted, resulting in a high seed density. However, since seeds constitute the primary purchased input cost component (Table 5.10), lowering the seed density could effectively lower input costs per hectare without threatening yield.

5.7 Chemical Inputs

5.7.1 Fertilizer

Fertilizer was used by nearly all (94 percent) of the 1998 CRSP Producer Survey respondents and constituted the second largest purchased input cost component in bean production[19]. Although the 29 RK farmers applied twelve different basal formulations, the most popular were 16-20-6 (12 farmers) and Urea (12 farmers). For the total RK sample, farmers spent an average of $121.41/ha on basal fertilizer and applied an average of 447.6 kg/ha (Table 5.4). The unit cost of 16-20-6 averaged $1.95/kg and ranged from $1.73/kg to $2.21/kg, while the unit cost of urea averaged $2.26/kg. Seventy-seven percent of fertilizers were purchased from private input companies such as Fersan or Ferquido.

Twenty-one RK farmers used foliar fertilizers in addition to basal. Six different foliar formulations were used by RK farmers, the most popular being a generic foliar mix

---

[19] References to "valley farmers" are drawn from the 1998 CRSP Producer Survey, whereas references to RK farmers are drawn from the 1998 RK Cost of Production Survey. While the Producer Survey collected data on frequency and level of input use, the RK Survey is the sole source of primary cost of production data.

(10 farmers). Farmers applying foliars spent an average of $7.82/ha and applied an average of 79 grams/ha.

Total equivalent nitrogen, phosphate, and potassium from aggregate basal and foliar fertilizer application averaged 81.2 kg/ha of nitrogen, 65.2 kg/ha of phospate, and 20.3 kg/ha of potassium for the RK farmers. For small farmers (<2.5 ha), these equivalent averages were 74.2 kg/ha of nitrogen, 58.5 kg/ha of phosphate, and 23.7 kg/ha of potassium. In contrast, for large farmers (>6.3 ha), who applied about 30 percent more nutrients than small farmers, these equivalent averages were 100.51 kg/ha of nitrogen, 70.51 kg/ha of phosphate, and 27.0 kg/ha of potassium.

5.7.2 Insecticide

Nearly all farmers (98 percent) used insecticide, averaging 3.0 applications per farmer (1998 CRSP Survey). Although RK farmers used 23 different insecticides, the most popular were Nuvacron (9 farmers), Decis (8), and Sistemin (6). RK farmers spent an average of $30.06/ha on insecticides. As products were applied in various forms (kilograms, liters, etc.), application rates varied by product. The average use rate was 0.63 liter/ha (l/ha) for Nuvacron, 0.24 l/ha for Decis, and 1.08 l/ha for Sistemin. The price for Nuvacron averaged $15.45/liter, Decis averaged $33.17/liter, and Sistemin averaged $11.14/liter. RK farmers purchased 64 percent of these insecticides from private companies such as Bayer, Ferquido, Monsanto, Fersan, Shell, and Brugal.

Table 5.10 Average Quantity and Cost of Purchased Input Use Per Hectare by Type of Farmer, Winter 1997-98, SJV

Item	Total Sample (N=29)		Small Farms (N=9)		Large Farms (N=9)	
	Quantity	Cost (US$/ha)	Quantity	Cost (US$/ha)	Quantity	Cost (US$/ha)
Seed (kg/ha)	136.0	$215.09	144.1	$224.76	128.4	$220.66
Basal Fertilizer (kg/ha)	447.6	$121.41	418.5	$118.84	533.4	$144.35
Foliar Fertilizer (g/ha)	79.0	$5.66	52.0	$3.38	100.0	$11.56
Insecticide	na	$30.07	na	$32.60	na	$23.27
Fungicide	na	$17.99	na	$14.46	na	$21.97
Herbicide	na	$4.82	na	$3.14	na	$9.78
Other	na	$0.72	na	$0.45	na	$0.65
Total Cost (US$/ha)		$395.75		$396.84		$432.25

Note: Total Sample, Small, and Large Farm averages are sample/subsample averages, not the average of those farmers within the sample/subsample who used the item. Exchange rate used is 14.5 RD$ / US$, the average rate during the season.
Source: 1998 RK Survey

Small RK farmers spent more per hectare on insecticides than did large farmers, primarily because the former average 3.3 applications compared to 2.9 for the latter. In addition, the RK data indicates that small farmers also tended to apply higher concentrations of identical products compared to large farmers. By contrast, small farmers (N=37) in the Producer Survey averaged 2.9 applications, compared to 3.4 for large farmers (N=30). While the prices of identical products in the RK data varied across farmers, they did not seem to vary by farm size. Small farmers may make more applications due to less technical knowledge, or they may simply have more exposure to insects since they generally plant later (due to poorer access to tractors and seeds). Thus, when larger farmers' plants are mature, smaller farmers' beans are still in the early growth stage and attract more insects (notably the whitefly).

5.7.3 Fungicide

Many farmers (79 percent) also applied fungicide, averaging 1.6 applications per farmer (Producer Survey, 1998). Although RK farmers used 13 different products, the most popular were Alto 100 (14 farmers), Dithane (12), and Anvil (4). These farmers spent an average of $19.33/ha on fungicides. As these products were applied in various forms (kilograms, liters, etc.), application rates varied by product. The average application rate was 0.007 liter/ha (l/ha) for Alto 100, 0.112 l/ha for Dithane, and 0.036 l/ha for Anvil. The price of Alto averaged $96.00/liter, Dithane averaged $7.30/liter, and Anvil averaged $20.41/liter. RK farmers purchased 67 percent of these fungicides from the local affiliates of private companies such as Bayer, Ferquido, Monsanto, Fersan, Shell, and Brugal.

Small RK farmers spent less on fungicides than did large farmers, although the former average 2.0 applications, compared to 1.8 for the latter. By contrast, small farmers who used fungicide (N=27) in the Producer Survey averaged 1.5 applications compared to 1.7 applications for large farmers (N=25). As with insecticides, while prices varied across farmers, they did not vary by farm size.

5.7.4 Herbicides

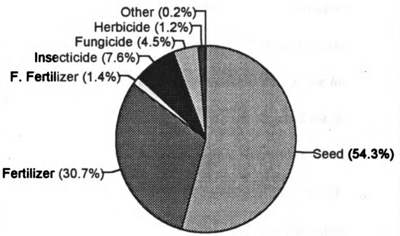
Herbicides are not used by many farmers (11 percent; Producer Survey), although CRSP researchers feel that increased use could help to decrease production costs, especially given increasing wage rates. Among the RK farmers, there is considerable variation in use rates, herbicide prices, and costs per hectare, indicating that there is not a standard procedure used by farmers for integrating herbicide use into crop management. Nine RK farmers applied herbicides, with six using one application and three using two applications. Among the Producer Survey farmers who used herbicide, 9 made one application and two made two applications. Although the RK farmers used 7 different products, the most popular was Gamoxone (6 farmers). Other products included Dual, Afalon, Gamozil, and Paradox. RK farmers using herbicides spent an average of $15.53/ha on herbicide and $5.50 on the labor for application. The average application rate was 0.075 liter/ha (l/ha) for Gramoxone, while its unit cost averaged $10.84/liter. Herbicide costs per hectare (without labor included) ranged from $2.03 to $63.33/ha (RD$1.85 to $57.75/ta). The economics of substituting herbicides for manual weeding is discussed later in this chapter.

5.7.5 Total Purchased Input Costs

5.7.5.1 Purchased Input Cost Shares

The primary cost components of the average RK farmer's purchased input costs are seed (54.3 percent of input costs) and basal and foliar fertilizers (31 percent). In contrast, insecticides (7.6 percent) and fungicides (4.5 percent) are small purchased input cost items, compared to seed and fertilizer (Figure 5.1). While RK farmers used the

Figure 5.1 Purchased Input Cost Shares
1998 RK Average, San Juan Valley



CRSP's recommended fertilizer levels, they planted 28 kg more of seed per hectare than is recommended. At an average unit cost of $1.73/kg, this excess seed density amounts to $48.46/ha in additional input cost. Thus, planting at the recommended 108 kg/ha seed density would reduce the average farmer's input costs by 10 percent, and his/her total production costs by 5 percent.

5.8 Machine and Labor use

5.8.1 Introduction

Labor accounts for 63 percent of total machine and labor expenses, while machine accounts for 37 percent (RK survey, 1998). The primary machine and labor operations are harvesting (31 percent of operation costs), land preparation (29 percent), irrigation (13 percent), and manual weeding (13 percent). The only machine-intensive activity is land preparation, 94 percent of the cost of which is mechanized (tractors). By contrast, only

20 percent of the cost of harvesting is machine cost (threshers).

Table 5.11 presents the average cost of each operation for the RK sample (N=29), large farmers (N=9), and small farmers (N=9), separated into equipment and labor components. The table presents operation averages for those farmers who *used* each operation (ssTotal columns), as well as averages calculated for the *total* sample (Total columns). The "ssTotal" column indicates the average expense for that operation for the subsample of farmers who carried out the respective operations. To calculate the *total* sample average expense for that operation, the number of farmers who used that operation was multiplied by their average operation expense, and then the subsample total was divided by 29, the number of RK farmers in the sample.

A farmer's cost for each operation category depends upon the number of operations performed during the season, the hourly wage or per hectare fee paid to the labor or machine performing the operation, and the hours/hectare of labor or machine employed by the farmer. Table 5.12 reports sample and subsample (large and small farmers) averages for hours/ha for each operation and the average sample wage paid for that operation. Average hours/ha multiplied by the average wage does not equal average operation cost per farmer as reported in Table 5.11 (just as multiplying average farmers' yield by average farmers' price does not necessarily equal average gross returns). The average wage rate across operations is weighted by the hours/ha. As family labor makes up a very small percentage (of even small farmer's labor costs), family labor was included with hired labor in this table. Family labor was valued at RD$10/hour, close to

TABLE 5.11: Equipment and Labor Use per Hectare, SJV, 1998 ($US/ha)							
	RK Average Farmer (N=29)						TOTAL
Operation			**Equipment**		**Labor**		**Equipment**
	ss	# op	ssTotal	Total	ssTotal	Total	**and Labor**
Land Preparation	29	5.2	$127.54	$127.54	$7.75	$7.75	$135.29
Planting	29	1.0	$14.79	$14.79	$25.23	$25.23	$40.02
Fertilizer Application	24	1.8	$0.00	$0.00	$7.11	$5.88	$5.88
Insecticide Application	29	3.3	$0.00	$0.00	$13.44	$13.44	$13.44
Fungicide Application	24	2.0	$0.00	$0.00	$6.10	$5.05	$5.05
Manual Weeding	29	1.7	$0.00	$0.00	$61.22	$61.22	$61.22
Herbicide Application	8	1.0	$0.00	$0.00	$5.50	$1.52	$1.52
Irrigation	29	6.4	$0.00	$0.00	$61.26	$61.26	$61.26
Harvest	29	1.0	$28.70	$28.70	$115.34	$115.34	$144.03
TOTAL				$171.03		$296.69	$467.72
Equipment and Labor Use per Hectare							
	RK Small Farmers (N=9; <2.5 ha)						TOTAL
Operation			**Equipment**		**Labor**		**Equipment**
	ss	# op	ssTotal	Total	ssTotal	Total	**and Labor**
Land Preparation	9	4.2	$86.09	$86.09	$10.90	$10.90	$96.99
Planting	9	1.0	$13.96	$13.96	$27.42	$27.42	$41.38
Fertilizer Application	7	1.3	$0.00	$0.00	$6.69	$5.20	$5.20
Insecticide Application	9	3.3	$0.00	$0.00	$17.90	$17.90	$17.90
Fungicide Application	6	2.0	$0.00	$0.00	$7.83	$5.22	$5.22
Manual Weeding	9	1.2	$0.00	$0.00	$60.62	$60.62	$60.62
Herbicide Application	2	1.0	$0.00	$0.00	$11.15	$2.48	$2.48
Irrigation	9	5.0	$0.00	$0.00	$58.28	$58.28	$58.28
Harvest	9	1.0	$34.77	$34.77	$120.28	$120.28	$155.05
				$134.82		$308.30	$443.12
Equipment and Labor Use per Hectare							
	RK Large Farmers (N=9; >6.3 ha)						TOTAL
Operation			**Equipment**		**Labor**		**Equipment**
	ss	# op	ssTotal	Total	ssTotal	Total	**and Labor**
Land Preparation	9	6.2	$150.30	$150.30	$12.06	$12.06	$162.37
Planting	9	1.0	$16.13	$16.13	$25.73	$25.73	$41.86
Fertilizer Application	8	2.5	$0.00	$0.00	$9.74	$8.66	$8.66
Insecticide Application	9	2.9	$0.00	$0.00	$10.29	$10.29	$10.29
Fungicide Application	8	1.9	$0.00	$0.00	$5.20	$4.62	$4.62
Manual Weeding	9	2.2	$0.00	$0.00	$50.43	$50.43	$50.43
Herbicide Application	5	1.0	$0.00	$0.00	$3.36	$1.86	$1.86
Irrigation	9	7.0	$0.00	$0.00	$58.82	$58.82	$58.82
Harvest	9	1.0	$27.81	$27.81	$108.76	$108.76	$136.56
				$194.24		$281.22	$475.46
"ss" = number of farmers who performed that operation "# op" = number of operations							
"ssTotal" = average operation cost of those farmers who performed the operatio							
"Total" = average operation cost of farmers, including those who did not perform the operation							

Table 5.12 Hours per hectare and wage rates for Bean Production Operations by Farmsize, San Juan Valley, DR, 1998

LABOR Operation	Average Hours/ha	Average Wage $US/hr	Small Hours/ha	Small Wage $US/hr	Large Hours/ha	Large Wage $US/hr
Land Preparation	9.2	$1.02	14.0	$0.82	13.4	$1.07
Planting	41.5	$0.63	45.8	$0.64	41.2	$0.65
Fertilizer Application	8.9	$0.98	7.2	$1.46	11.8	$0.87
Insecticide Application	12.2	$1.25	13.5	$1.60	10.8	$1.08
Fungicide Application	5.2	$1.32	4.3	$1.92	5.2	$1.16
Manual Weeding	81.6	$0.93	74.9	$0.89	75.2	$0.66
Herbicide Application	5.6	$0.95	8.4	$1.47	4.9	$0.62
Irrigation	73.0	$0.92	78.5	$0.82	73.8	$1.07
Harvest	148.5	$0.77	150.4	$0.76	147.4	$0.75
TOTAL hours/ha and Average wage	385.7	$0.93	397.0	$0.92	383.7	$0.87
EQUIPMENT Operation	**Average Hours/ha**	**Average Rent fee $US/hr**	**Small Hours/ha**	**Small Rent fee $US/hr**	**Large Hours/ha**	**Large Rent fee $US/hr**
Land Preparation	15.9	$13.62	20.4	$8.63	20.2	$14.16
Planting	18.3	$0.80	16.9	$0.83	19.6	$0.83
Harvest	1.9	$16.93	2.1	$18.21	2.2	$11.98
TOTAL hours/ha and Average wage	36.1	$6.36	39.3	$5.14	42.0	$6.57

Source: 1998 RK Survey (N=29)

but slightly below the average wage paid (RD$13.49/hour) by the average RK farmer for all operations.

On average, small farmers (<2.5 has) pay a higher wage for labor used in bean operations (5 percent more than the average wage paid by large farmers), yet employ fewer hours of labor per hectare. In contrast, large farmers (>6.3 has) pay a rental rate for machine and utilize more hours per hectare of that machine. There are two potential explanations for why small farmers pay higher wages. First, larger farmers can negotiate a lower wage because they have a larger number of hours to offer each laborer (although not necessarily more hours per hectare). Secondly, higher labor wages paid by small farmers may be the result of a different service being provided. For example, for insecticide, fungicide, and herbicide application, smaller farmers may pay for the laborer's time plus the laborer's application machine use, while large farmers may own several backpack sprayers and just pay for the laborer's time.

Higher machine rental fees paid by large farmers is very likely explained by the fact that large farmers infrequently hire PROSEMA for land preparation (subsidized state tractors) due to the poor quality and availability of these tractors/operators. Another possible explanation is that larger farmers simply are hiring better quality services and/or are willing to pay more to secure the services as early as possible in the planting date period. For example, the 1998 Producer Survey indicates that 30 percent of small farmer's hired land preparation from PROSEMA, compared to only 16 percent of large farmers. In addition, the average small farmer planted on 13 November, while the average large farmer planted on 8 November. This suggests that large farmers pay higher land preparation fees because they do not utilize the services of PROSEMA. They are willing to pay higher rental rates to insure higher quality land preparation and fewer delays. The following sections provide details on the calculations of operation costs.

5.8.2 Land Preparation

The seven RK farmers who owned tractors reported only gas expenses for their land preparation, and data were unavailable to calculate depreciation. Given this situation, a rental rate was calculated[20] and used to estimate farmers' land preparation expenses in

---

[20] The rental rate was calculated as the median of the rented land preparation rates for large farmers, so as to avoid the influence of low and high rates.

the place of the lower reported figures.

Land preparation is the source of the largest differential in operation costs between large and small farmers. Besides the fact that larger farmers pay higher tractor rental fees (for reasons discussed above), larger farmers average 6.2 land preparation operations before planting whereas small farmers average 4.2 (the average for all RK farmers is 5.2). Thus, the total land preparation cost differential is not surprising.

5.8.3 Planting

Farmers did not report any costs for machine use (although hours of machine were recorded) because each RK farmer owned a horse. However, a "rental" rate was charged to each farmer (for a horse and boy at RD$12/hour together), based on local rates reported for the previous season (Arnaud, 1997).

5.8.4 Application of Insecticide

Small farmers spend more on insecticides, both because they apply them at higher rates and because they average 3.3 applications, compared with 2.9 for larger farmers. Larger farmers probably make fewer insecticide applications because they plant earlier (thus their plants flower before the whitefly vector multiplies), prepare their fields better (thus have fewer weeds), and follow the spraying recommendations (both application rates and number of applications).

5.8.5 Manual Weeding, Irrigation, and Harvest

These three operations account for 78 percent of the average farmer's labor expenses. Although the average large farmer manually weed more frequently (2.2) than do small farmers (1.2), large farmers spend $10/ha less on manual weeding due to lower wages paid for this operation (25 percent less). Irrigation includes both cleaning the irrigation canals and managing the irrigation water when it arrives at the farm. Larger farmers performed more irrigation operations (7) than did small farmers (5), and paid higher wages. However, at harvest, large and small farmers hire approximately the same amount of labor (hours/ha) and pay very similar wages. This finding implies that large and small farmers attain similar yields.

5.9 Other Costs

5.9.1 Credit

Financing costs play a significant role in determining profitability of bean production in the San Juan Valley for two reasons. First, because the vast majority of production costs are monetary, farmers must obtain loans in order to purchase inputs, rent labor and machine, etc. (either directly from banks or indirectly from input dealers). Second, because many farmers sell their harvested beans to the government, which often delays final payment for months, their outstanding debts continue to increase until they receive payment. Thus, a farmer's interest rate and loan size, relative to production cost outlay, are important determinants of his/her net returns to bean production.

Eighty-six percent of the Producer Survey respondents received some form of credit for bean production activities during the 1997-98 winter bean season. The remaining 14 percent did not receive credit, either because they did not need financial assistance (9 percent) or could not obtain a loan (5 percent). Of those who received credit, 69 percent received one loan, 28 received two loans, and 3 percent received three loans. Seventy-three percent of those receiving at least one loan indicated that they received enough credit for their bean production activities. Loan sources and related information are summarized in Table 5.13 below. For the 27 percent of respondents who reported not receiving enough credit, they indicated that they could have used additional loans for harvest (50 percent), inputs (21 percent), land preparation (14 percent), machine purchase/repair (7 percent), weeding, and irrigation (each 3.5 percent).

Table 5.13 Credit for Bean Production, SJV, 1997-98

Loan Source	Total value of loans[a] (%)	Farmers served[b] (%)	Average annual interest rate	Range of interest rates	Loans received on time (%)	Amount requested actually received (%)
Banco Agricola	42	39	18	18	80	80
Commercial Banks	37	11	28	18 - 38	88	100
Moneylenders	8	25	111	48 - 180	95	97
FDD	6	12	19	18 - 24	42	100
Farmer Associations	4	11	41	18 - 48	97	100
Input Dealers	3	2	36	36	100	100

[a] % of total loans (value) by each source [b] % of farmers receiving loans from each source
Source: 1998 CRSP producer survey (N=100)

Loan form varied among sources, although the primary lenders gave credit to farmers in the form of cash, input vouchers, or inputs themselves. Banco Agricola gave 67 percent cash and 33 percent input vouchers, commercial banks gave 100 percent cash, and moneylenders gave 78 percent cash and 22 percent inputs.

Commercial banks lend exclusively to landowners and mostly (75 percent of commercial bank loans) to larger farmers, as the risks of bean production are simply too high for commercial banks to lend to small or medium-size farmers (Libre, 1998). Banco Agricola, a state-run development bank that offers a subsidized annual interest rate of 18 percent, had a more balanced spread across the sample with large farmers receiving 30 percent of Banco Agricola loans, medium farmers receiving 41 percent, and small farmers 29 percent. In contrast, Moneylenders lent primarily to small farmers (58 percent of moneylender loans), although they also lent to medium (31 percent) and large (11 percent) farmers.

Due to the interest rate differentials across loan sources (Table 5.13), it is not surprising that average interest rates by land tenure situation are significantly different. Land owners paid an average annual interest rate of 38 percent, sharecroppers an average interest rate of 47 percent, and land reform farmers an average interest rate of 135 percent. Because land reform farmers have use rights but no title to their land, they could not secure loans from commercial banks, as well as few from Banco Agricola. Land reform farmers obtained 61 percent of their loans from moneylenders, 19 percent from Banco Agricola, 10 percent from their association, and 5 percent from input dealers and FDD. Thus, these farmers pay more than twice the interest rate of large farmers due to their heavy reliance on moneylenders for loans.

The proportion of loans to total cost of production (the loan burden) was estimated using average costs of production by farmer from the RK data, combined with that RK farmer's loan information reported in the 1998 producer survey. The results show that the loan to cost of production ratio averages 69 percent, but was higher for small farmers (77 percent) compared to large farmers (68 percent). When the loan burden statistics are combined with the interest rate differential across farm sizes, it is clear that the resource limitations of smaller farmers (less collateral and higher production risks) imply greater debt and lower profitability. Although more than 98 percent of Banco Agricola loans went to non-landowners, only 14 percent of Banco Agricola loans went to land reform farmers. Thus, while the Banco Agricola is reaching some small and medium-size farmers, it is not reaching land reform farmers with access to irrigated land; the majority of these farmers rely on moneylenders.

Although these conclusions are not surprising, one policy implication is that subsidized credit is not reaching the poorest farmers in the SJV. Key informants reported that the Land Reform Institute's (IAD) continued delay in granting title to these farmers is a factor that contributes to reducing these farmers' access to Banco Agricola credit. While Banco Agricola did in fact lend to a greater percentage of bean farmers in 1997/98 than in the previous year (PRODAS, 1997), this is likely explained by the simultaneous effect of an increase in the average farm size (as discussed above) and the decrease in the number of farmers planting beans.

5.9.2 Irrigation Charge

In the winter season, bean farmers pay $13.16/ha (RD$12/ta) for irrigation water which is provided by INDRHI, the government irrigation agency.

5.9.3 Internal Transport

Each RK farmer also incurred expenditures related to transportation to and from their bean fields, as well as the use of transport during harvest to move beans from the field to areas for drying/sorting/bagging. Based upon RK survey data and government cost of bean production budgets, $10.00/ha is assumed to cover the average farmer's transport costs.

5.10 Total Costs of Production

5.10.1 Cost Shares

Machine and Labor operations (Land Preparation, Planting, Labor for Input Application, and Harvest) from Table 5.6 account for 48 percent of total costs, purchased inputs account for 42 percent, and transport and financing make up the remaining 10 percent. Table 5.15 below uses the average total input costs from Table 5.3 and operations costs from Table 5.4 to develop a representative farm budget for the RK average farmer (small and large farm budgets are included in the appendices). Figure 5.2 shows the shares of the cost components. The following sections discuss these tables and their implications for the present and future profitability of bean production in the San Juan Valley.

5.10.2 Decreasing the Costs of Production

While technical change is perhaps the most general method to reduce production costs in agriculture, the RK data show that there are various measures which farmers could implement to decrease their costs of production, as well as options for government policymakers.

Table 5.14: Financial Costs of Production, Red Beans

Winter Season 1997-98, San Juan Valley, DR

RK Farmer Average (N=29)				
		Value		Cost
1. Purchased Inputs		($US/ha)		share/ha
Seeds		$215.09		22.1%
B. Fertilizer		$121.41		12.5%
F. Fertilizer		$5.66		0.6%
Insecticide		$30.07		3.1%
Fungicide		$17.99		1.9%
Herbicide		$4.82		0.5%
Other (hormones, adhesives, etc)		$0.72		0.1%
subtotal		*$395.75*		*40.7%*
2. Labor				
Land Preparation		$7.75		0.8%
Planting		$25.23		2.6%
App. Fertilizer		$5.88		0.6%
App. Insecticide		$13.44		1.4%
App. Fungicide		$5.05		0.5%
Manual Weeding		$61.22		6.3%
App. Herbicide		$1.52		0.2%
Irrigation/Clean Canals		$61.26		6.3%
Harvest		$115.34		11.9%
subtotal		*$296.69*		*30.5%*
3. Equipment				
Land Preparation		$127.54		13.1%
Planting		$14.79		1.5%
Harvest		$28.70		3.0%
subtotal		*$171.03*		*17.6%*
4. Other Inputs				
Internal Transport		$10.00		1.0%
Irrigation Charge		$13.16		1.4%
Financing (@40% annual; 4 months)		$85.10		8.8%
subtotal		*$108.26*		*11.1%*
Total Costs of Production/ha		**$971.73**		
Profitability				
Average Yield (kg/ha)	1128	Gross Revenue/ha		**$1,680.72**
Average Adjusted Price ($/kg)	$1.49			
Total Cost/kg	$0.86	Net Revenue/ha		**$708.99**
Exchange rate ($RD/$US)	14.5			
Source: 1998 RK Survey, 1998 CRSP Producer Survey				

5.10.2.1 Input Application Rates

As noted above in the seed and insecticide sections, input application rates are higher than those recommended by the CRSP. Farmers' seed density is especially significant because seed itself constitutes 22 percent of total production costs for the average farmer. The average farmer could reduce his production costs by 6 percent, if he lowered his seed density from the sample average of 18.9 lb/ta to the recommended 14 lb/ta. As noted above, the high seed rate appears to be a function of not using wider discs.

5.10.2.2 Manual Weeding vs. Herbicides

CRSP researchers believe that SJV farmers can reduce their production costs by replacing manual weeding with herbicide use. Twenty-one RK farmers used only manual weeding, while 8 RK farmers used manual weeding, combined with one herbicide application. According to this data, the cost implication of this tradeoff appears to be negligible because the 21 "manual-only" farmers spent an average of $67.81/ha (61.84/ta) on manual weeding, while the 8 "manual-herbicide" farmers spent an average of $49.43/ha (45.06/ta) on manual weeding, $15.53/ha (14.16/ta) on herbicide and $5.51/ha (5.02/ta) on herbicide application – a total of $70.47/ha (64.23/ta). Analysis of RK data from the 1998-99 season may provide additional evidence by which to test the hypothesis that switching to herbicides may enable farmers to cut their production costs[21].

[21] However, this data do not control for other production management factors. To test this hypothesis formally, CRSP researchers would need to set up experimental trials or ask farmers to perform superimposed trials.

5.10.3 Government Policy and the Costs of Production

5.10.3.1 Input Prices

As the primary purchased input cost components, the total cost of seed (52 percent of input cost) and fertilizers (30 percent) are important components of total production costs, whether valued in financial or economic terms. It is clear that seed sold by SEA are subsidized at about $0.35/lb (500/qq), which is about 36 percent of the total economic cost of seeds purchased by a farmer directly from SEA. This calculation, however, assumes that seed is purchased from SEA, although only about 34 percent of the valley's farmers buy seed directly from SEA in a given year (Arnaud, 1997). Since, many farmers store their own saved seed in SEA's cold storage facility (free of charge), the only subsidy for these producers is free storage. Using a private sector cold storage rate of $0.01/lb per month of storage (reported by one respondent), the SEA free cold storage is essentially worth $0.08/lb. In the absence of SEA seed subsidies, farmer financial prices for seed would thus increase from between 9 percent (for those storing their own seeds) to 36 percent (for those purchasing direct from SEA[22]). The implication of the loss of either the storage or seed sale subsidy is that total costs of bean production could increase between 3.6 to 5 percent for the average SJV farmer.

Several farmers and farmer associations complained that fertilizer prices in the DR are excessive, thus contributing to higher production costs than necessary. Monthly data collected at the wholesale level in-country across Central America during 1996 and 1997

[22] It is difficult to establish the private sector rate for seeds because the private sector share of the bean seed market is less than 5 percent, according to the 1998 CRSP Producer Survey (N=100).

(and including the DR) by CORECA (Consejo Regional de Cooperacion Agricola), an affiliate of IICA, indicates that while Urea prices in the DR are somewhat higher than the Central America average, Ammonium Sulfate is cheaper and 15-15-15 is essentially the same. The DR distributor-level price for Urea is approximately 25 percent higher than the average in Central America during November-December, and the DR price of Ammonium Sulfate is about 30 percent less during the same time period. A study by IICA of the fertilizer subsector found that fertilizer prices are roughly 10 percent higher than they would likely be with a more competitive subsector (Nunez, 1999).

5.10.3.2 Wage Rates in the San Juan Valley

Labor accounts for 30 percent of the average RK farmer's total costs, compared to 31 percent for small farmers and 28 percent for large farmers. According to key informants, hourly wages in the San Juan Valley (and in agriculture in general) are considered to be high and have been increasing in recent years. Several explanations are given for increasing wages, including high labor demand during critical periods (planting, harvest), a general shortage of labor due to emigration to higher-paying jobs in urban areas (Santo Domingo and Santiago's Free Trade Zone jobs), and emigration to the U.S. or other countries.

5.10.3.3 Financing, Fertilizer Prices, and Implications

As the price of seed is not likely to be lower in the future, wage rates will likely continue to rise, and input use levels (aside from seed density) are not excessive, decreasing the costs of bean production (without technical change) will require either finding a way to reduce financing costs, reducing the cost of fertilizer, or increased mechanization of harvesting and threshing. As the sections on profitability below demonstrate, if bean prices begin to fall due to increased pinto imports, changed consumer preferences towards pintos, or lower SEA and/or INESPRE support, higher-cost producers will not remain profitable unless production costs are lowered or associations find a way to command higher prices for their beans in the private market (through forward contracting, storage, etc). However, the associations and farmers most capable of adapting new production or marketing techniques are those farmers whose costs are low enough to avoid having to make these changes in order to remain competitive.

5.11 Production Problems

Respondents were asked to identify their principal production problem during each of the past five winter bean seasons. The responses in Table 5.15 indicate that "Bean Golden Mosaic Virus" (BGMV) remains the principal production problem for most farmers. However, in 1997/98, "early defoliation" was the primary production problem. In addition, "water availability" (and excess rain on occasion) is a recurring problem for some farmers. While BGMV was the principal production problem perceived by farmers in the past five years, its incidence and/or severity has diminished since the major epidemic of 1994.

Table 5.15 Principal Bean Production Problems, SJV, 1997-98

Production Problem	Percentage of Farmers with Production Problem					
	1993/94	1994/95	1995/96	1996/97	1997/98	5-year average
BGMV	18	40	20	36	24	27.6
Early Defoliation	0	0	1	5	30	7.2
Rust	5	2	6	2	2	3.4
Drought/water availability	2	5	1	8	7	4.6
Vaneo de la vaina (insect)	2	0	0	0	8	2
Excess rain	5	1	4	5	2	3.4
gusano (worm)	0	0	0	2	1	0.6
Weeds	4	3	1	1	2	2
Germination Problem	1	0	4	4	2	2.2
Respondents by year	N=67	N=83	N=88	N=95	N=99	
Source: 1998 CRSP Producer Survey (N=100)						

5.12 Marketing

5.12.1 Marketing Channels

There are three primary marketing options for bean farmers in the SJV: the SEA seed multiplication program, the INESPRE bean marketing program, and private traders (the market). Twenty-six percent of the Producer Survey respondents sold beans to SEA, 64 percent sold to INESPRE, and 29 percent sold to the market (many farmers sold to more than one buyer). However, in terms of total volume of sales aggregated across respondents, SEA accounted for 35 percent of bean sales, INESPRE 37 percent, and the private market 28 percent.

5.12.2 SEA Seed Program

The highest bean prices in the valley are paid by the SEA bean seed program, which officially only purchases bean seed from pre-approved farmers participating in its seed multiplication program. SEA pays these growers a premium price (above that of INESPRE and the market price) to ensure that farmers under contract do in fact sell their seed to SEA. While SEA paid US$1.79/kg (RD$1,175/qq) for seed in 1998 in the SJV, they did not pay growers until an average of 7.2 weeks after the time of sale. Thus, adjusting the SEA seed price (the same for all seed program farmers) by the opportunity cost of the farmer's delayed payment (the value of each farmer's sale, times the commercial interest rate of 24 percent, times the weeks waiting for payment) and the farmer's estimated loan payments during the waiting period (the farmer's total loan burden times the farmer's average interest rate, weighted by loan size, times the weeks waiting for payment), SEA's adjusted average price was actually $1.70/kg (RD$1,117/qq). For those farmers who sold to SEA, this buyer accounted for an average of 83 percent of the farmers' total sales.

5.12.3 INESPRE

While INESPRE is authorized to purchase beans for their national consumer food program from any farmer in the valley, in recent years, they have purchased almost exclusively through farmer associations. All farmer associations are able to sell to INESPRE, although INESPRE does have standards for the grain. However, while a classification system that linked price with quality (3 classes) used to offer a premium (discount) for higher (lower) quality beans, in 1998, only one classification existed.

Eight-seven percent of the survey respondents who sold to INESPRE said they did so because it offered the best price (for those farmers who did not have the option of selling seed to SEA). For these farmers, INESPRE accounted for an average of 87 percent of their total sales. Although INESPRE purchased beans at $1.57/kg (RD$1,035/qq) in 1998, they did not pay growers in full until an average 13.8 weeks after the sale (as discussed in Chapter 4.6.2.3). Thus, INESPRE's adjusted price for the Producer Survey farmers was actually $1.47/kg (RD$964/qq), a decline of about 7 percent from the nominal "purchase" price. This point is not lost on SJV farmers, who organized a protest against the government in July of 1998; by that time, many of these farmers had not received payment for beans delivered in February. INESPRE has delayed payment in this fashion several times in recent years, although each year they promise quicker payments to farmers, and farmers continue to sell to INESPRE.

5.12.4 Private Traders

Farmgate prices paid by private traders averaged $1.29/kg (RD$849/qq), although the prices ranged from $0.91/kg to $1.67/kg (RD$600/qq to RD$1,100/qq)[23]. Eighty

---

[23] It is not clear to the author why this price variance is so large. Transport cost differentials are not likely the explanation given the small size of the valley. Quality differentials are likely part of the explanation, but not all of it, given that retail quality differentials are not as large proportionately as these farmgate differentials. This price variance may well be seasonal (wholesale and retail prices fall dramatically in January, February and March), although this analysis has not been done. Another potential explanation is that the farmers who received the lowest prices were typically those who borrowed from moneylenders, who in some cases are also bean traders who may have simply purchased the farmer's harvest and taken the farmer's loans out of the price paid to the farmer.

percent of farmers selling to the market said they chose this buyer because they needed cash immediately to repay debts. For farmers who sold to traders, this buyer accounted for an average of 75 percent of their sales.

5.12.5 Average Farmer Prices by Farm Size

Average prices for all beans sold per farmer were calculated across the sample. These prices were then adjusted for the payment delay of SEA and INESPRE, as described in Chapter 4.6.2.3. Adjusted average prices varied considerably among farm sizes, with small farmers receiving an average price of $1.43/kg (938/qq), medium farmers $1.47/kg (969/qq), and large farmers $1.54/kg (1,012/qq). Farmers selling primarily to SEA and INESPRE – even considering adjustments – obtained higher prices for their beans. The average adjusted price for the total sample was $1.48/kg (977/qq), compared to the unadjusted average price of $1.55 (1,019/qq).

5.12.6 Implications of SEA and INESPRE Bean Purchases

Just as the distribution of land and capital resources has a large effect on the interest rate paid by a given farmer, a farmer's financial and production situation determine the price he receives for his harvested beans. It should be noted that SEA pays a premium for disease-free, uniform seed, and INESPRE has legitimate needs for quality, uniform grain for human consumption. Thus, these prices reflect higher quality domestic grain delivered by certain farmers. However, a farmer's financial and production capabilities determine to whom he can sell beans. Only a limited number of approved growers can sell seed to SEA each year. Although INESPRE pays a premium for quality beans produced by anyone, due to delayed payments, farmers with high debt and poor cash flow cannot afford to sell to INESPRE due to the risk of delayed payment.

However, these two government procurement programs do not escape the typical problems of corruption and quality management that are associated with such high information cost activities that are managed by political agents. There were reports of SEA buying seed from non-contracted (i.e. non-approved) farmers or of contracted farmers delivering to SEA grain from another source, rather than seed grown on pre-approved parcels. On the other hand, there were also several farmers with contracts to deliver seed that had to sell to INESPRE instead because their seed did not meet SEA standards. While it is difficult to determine through rapid appraisal how impartial SEA is in choosing program growers and in monitoring the quality of seed delivered, it is clear that this process is not free from the political partiality that seems to characterize many government programs in the DR.

Quality management issues can perhaps be best assessed in terms of farmer decisions regarding seed source. When asked why they stored their own seed (rather than buying SEA seed at subsidized prices), many respondents said that SEA seed was unreliable in regards to both quality and timing. Thus, it is not surprising that many SJV farmers are storing their own seed or buying seed from their association's seed bank, even when SEA seed typically sells for RD$ 900/qq. According to the 1996 producer survey implemented by the CRSP DR staff, seed sources for the 1996-97 season included own (58 percent), SEA (34 percent), other producer (4 percent), and warehouse (4 percent).

In the case of INESPRE, their price supports primarily benefit larger farmers, and sales volume to INESPRE and SEA may result in thinner markets for small producers.

There were also reports of non-bean-growing members of farmer associations selling beans to INESPRE. These association members simply purchased beans from small valley or mountain farmers at the lower market price, and then sold these same beans to INESPRE at the higher negotiated price.

5.13 Profitability of Bean Production

5.13.1 Financial Profitability

The following financial and economic profitability analysis (Table 5.16) uses average yields and adjusted prices from the Producer Survey, and average cost of production data from the RK Survey[24]. It is clear that given 1997/98 average yields, costs of production, and average adjusted farmgate prices, bean production in the SJV is financially profitable (Table 5.16). Enterprise Profit in this analysis includes returns to management[25].

---

[24] Yields and prices received on average and by farm size are taken from the Producer Survey because this sample is considerably larger (N=100) than that of the RK survey (N=29), and because the RK farmers were among the better farmers in the valley (they have higher yields and receive higher prices, regardless of farmsize). However, the cost of production data (Table 5.15) is from the RK survey, because the Producer Survey did not collect this type of detailed extensively. In fact, the genesis of the RK survey lay in the difficulty of collecting accurate cost of production data from recall surveys.

[25] The opportunity costs of land, labor, and capital are deducted from gross revenue in Table 5.15. The opportunity cost of land is assumed to be the sharecropping payment, equivalent to one-fifth of expected gross returns/ha. The opportunity cost of labor is not an issue in the SJV because all labor is hired. The opportunity cost of capital is accounted for in the financing line item in variable costs (for the 69 percent of variable costs financed with external loans) and in equity capital in Table 5.15, which is the additional cost of production financed by the producer himself. Therefore, gross margin less land and equity capital opportunity costs gives enterprise profit - the returns to management.

Although average financial costs of production per hectare are similar for small and large farmers, large farmers have higher average yields (14 percent higher), lower costs/kg (13 percent lower), and higher adjusted price received/kg (8 percent higher). Therefore, both higher yields and higher prices explain why large farmers' average net revenue/ha is 64 percent higher than that of small farmers.

5.13.2 Economic Profitability

By contrast, under economic valuation of inputs and outputs, SJV bean production is not profitable (Table 5.16). Removing seed, fertilizer, and irrigation subsidies/taxes (Chapter 6.7) from the financial RK budget increases the average RK farmer's 1998 variable costs per hectare by 7 percent. However, this increase in cost (decrease in profitability) is quite small compared to the decrease in the farmgate output price embodied in valuing farmer output at the economic import parity price (IPP) (Table 6.2). Even assuming a 20 percent consumer preference premium (Chapter 6.6.2) on top of the economic IPP (calculated in Table 6.2) of $0.78/kg in 1998, the inflated economic IPP price of $0.94/kg is 37 percent lower than the financial farmgate price of 1998 – and returns per hectare are negative.

Table 5.16 Financial and Economic Profitability of Bean Production in the SJV, DR 1997/98

	Financial Profitability			Economic Profitability		
Item[a]	RK Sample	RK Small	RK Large	RK Sample	RK Small	RK Large
Average Yield (kg/ha)	1,128	1,083	1,239	1,128	1,083	1,239
Adjusted Farm Price [b] ($US/kg)	$1.49	$1.43	$1.54	$0.94	$0.94	$0.94
Gross Revenue ($US/ha)	$1,680.72	$1,548.69	$1,908.06	$1,060.32	$1,018.02	$1,164.66
- Seed ($US/ha) [c]	$215.09	$224.76	$224.76	$280.58	$290.25	$286.15
- Fertilizers ($US/ha) [d]	$127.07	$121.42	$121.42	$114.36	$109.28	$140.32
- Irrigation Charge ($US/ha) [e]	$13.16	$13.16	$13.16	$31.00	$31.00	$31.00
- Other Variable Costs ($US/ha)	$616.41	$603.92	$655.16	$616.41	$603.92	$624.77
- Total Variable Costs ($US/ha)	$971.73	$963.26	$1,014.50	$1,042.36	$1,034.45	$1,082.24
Gross Margin ($US/ha)	$708.99	$585.43	$893.56	$17.96	($16.43)	$82.42
Opportunity Costs						
- Land ($US/ha) [f]	$349.68	$333.56	$401.44	$212.06	$203.60	$232.93
- Equity Capital ($US/ha) [g]	$9.09	$6.59	$9.88	$9.09	$6.59	$9.88
Enterprise Profit ($US/ha)	$350.21	$245.28	$482.25	($203.19)	($226.62)	($160.39)

a Yield and Price data are from 1998 Producer Survey (average, N=100; small, N=37; large, N=30);
Cost data are from 1998 RK Survey (average, N=29; small, N=9; large, N=9)
b Financial Prices adjusted to account for SEA and INESPRE payment delays as described in Chapter 5.12.2 and 5.12.3
Economic Price is the Economic Import Parity Price (Table 6.2), plus a 20% consumer preference premium over imported pintos
c Economic cost of seed is US$65.49/ha more due to various subsidies (Chapter 6.7.3)
d Economic cost of fertilizers is assumed to be 10% less under free market pricing (Chapter 6.7.2)
e Economic Cost of irrigation described in Chapter 6.7.4.
f Opportunity cost of Land is eassumed to be the expected sharecrop payment (20%*yield*price)
g Equity Capital is the additional cost of production financed by the producer himself (not already included in variable costs)
Source: 1998 Producer Survey, 1998 RK Survey

5.13.3 Alternative Crops in the SJV

There are various cropping alternatives[26] to winter bean production in the SJV, although these alternatives are not as financially profitable (Table 5.17). Apart from this advantage, the bean market at present is much larger and more stable, as discussed at length in Chapter 4. However, when economic import parity prices are used to compute economic net returns, pigeon pea and sweet potato become the most profitable crops for the winter season.

Table 5.17: Financial and Economic Profitability of Selected Annual Crops, D.R., 1998						
	Average Yield	Financial Farm Price	Economic Farm Price[a]	Cost of Production	Financial Net Rev[b]	Economic Net Rev[b]
Crop	(kg/ha)	($US/ha)	($US/kg)	($US/ha)	($US/ha)	($US/ha)
Rice	2,884	$0.70	$0.61	$1,633	($12)	($226)
Maize	2,091	$0.32	$0.32	$443	$97	$97
Pigeon Pea	1,370	$0.67	$0.67	$565	$172	$172
Sweet Potato	9,373	$0.14	$0.14	$747	$325	$325
Sorghum	2,524	$0.19	$0.19	$444	($51)	($51)
Red Bean	1,128	$1.49	$0.94	$972	$373	($124)
a National average farmgate price in February-March 1998; Economic Import Parity Price for and Red bean. Other financial crop prices are assumed to be equivalent to economic IPP.						
Source: SEA Diagnostico del Sector Agropecuario, 1998; 1998 RK Survey; 1998 Producer S						

5.14 Sensitivity Analysis

5.14.1 Introduction

In the following tables, sensitivity analyses are carried out by changing bean yields and bean prices – using the average net revenue per hectare in the base run – in order to

[26] These alternative crops were those most frequently mentioned by 1998 CRSP Survey respondents as the crops that they would switch to if bean prices fell substantially.

identify the variables that most affect the level of net revenue per hectare. As this sensitivity analysis does not take into account the probability of any of the changes actually occurring, risk is not considered.

5.14.2 Changes in Bean Yields and Prices

The results of sensitivity analyses are reported for average, small, and large SJV farmers using average yield and price from the Producer Survey, and average cost of production from the RK Survey. For each farmsize group, average bean yield is varied from -50 to +40 percent of the average yield, while the adjusted bean price is varied between -50 and +30 percent, thus showing the sensitivity of net revenue per hectare (by farmsize) to changes in yield and/or adjusted prices, *ceteris paribus*.

The average farmer with no yield reduction will remain profitable with up to a 20 percent decline in adjusted price received, while the same farmer with no price reduction will remain profitable with even a 20 percent decline in yield (Table 5.16). However, once yield and price are simultaneously reduced by more than 10 percent each, (or a 10 percent reduction in price (yield) combined with a 20 percent reduction in yield (price)), the average RK farmer becomes unprofitable (enterprise profit less than zero).

The average small farmer's bean operation becomes unprofitable if price declines more than 10 percent or if yields decline more than 10 percent (Table 5.17). If both yield and price decline by more than 10 percent each, the average small farmer becomes unprofitable. By contrast, the average large farmer is more resistant to declines in yield and/or price as they can remain profitable even with a 25 percent reduction in either yield and price, or combinations of yield and price reductions of 10 and 20 percent respectively

(Table 5.18).

These results suggest that if the DR administered tariff-rate quotas instead of the current import licensing regime, domestic farmgate prices could fall as much as 20 to 30 percent, to the 1998 Financial Import Parity Price of approximately $1.03/kg. Assuming a 20 percent consumer preference premium for red beans, the farmgate price would be $1.23/kg – a price slightly above the "break-even" price of $1.19/kg with which the average RK farmer can maintain positive enterprise profits. However, if this consumer price premium were to fall or disappear over time, then the average RK farmer would not remain profitable.

If the DR both abolished import licensing and removed the 25% tariff and 8% value-added tax from bean imports, domestic farmgate prices could fall to the 1998 Economic Import Parity Price of approximately $0.78/kg ($0.94/kg with the 20 percent consumer preference premium). In this case, the average SJV bean farmer would no longer remain be profitable, even with the twenty percent price premium. It should be noted that these scenarios are for average producers (average prices, yields, costs), thus lower-cost producers and/or producers who find ways to decrease production costs would possibly still be able to compete with pintos.

Table 5.18: Sensitivity Analysis of Enterprise Profit/ha, Red Beans, SJV, 1997/98										
Average Farmer								COP/ha		$972
				Bean Price ($US/kg)*			Op Cost Land/Equity Cap.			$359
Yield*	%	$0.75	$0.89	$1.04	$1.19	$1.34	$1.49	$1.64	$1.79	$1.94
(kg/ha)	Change	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%
564	-50%	(910)	(826)	(742)	(658)	(574)	(490)	(406)	(322)	(238)
677	-40%	(826)	(725)	(625)	(524)	(423)	(322)	(221)	(120)	(20)
790	-30%	(742)	(625)	(507)	(389)	(272)	(154)	(36)	81	199
902	-20%	(658)	(524)	(389)	(255)	(120)	14	149	283	417
1,015	-10%	(574)	(423)	(272)	(120)	31	182	333	485	636
1,128	0%	(490)	(322)	(154)	14	182	350	518	686	854
1,241	10%	(406)	(221)	(36)	149	333	518	703	888	1,073
1,354	20%	(322)	(120)	81	283	485	686	888	1,090	1,291
1,466	30%	(238)	(20)	199	417	636	854	1,073	1,291	1,510
1,579	40%	(154)	81	317	552	787	1,023	1,258	1,493	1,728
* The column (row) with a 0% change represents the 1998 average price or yield										
Source: 1998 Producer Survey (yields, prices); 1998 RK Survey (COP/ha)										

Table 5.19: Sensitivity Analysis of Net Revenue/ha, Red Beans, SJV, 1997/98										
Average Small Farmer (<2.5 ha)								COP/ha		$963
				Bean Price ($US/kg)*			Op Cost Land/Equity Cap.			$340
Yield*	%	$0.72	$0.86	$1.00	$1.14	$1.29	$1.43	$1.57	$1.72	$1.86
(kg/ha)	Change	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%
542	-50%	(916)	(839)	(761)	(684)	(607)	(529)	(452)	(374)	(297)
650	-40%	(839)	(746)	(653)	(560)	(467)	(374)	(281)	(188)	(95)
758	-30%	(761)	(653)	(545)	(436)	(328)	(219)	(111)	(3)	106
866	-20%	(684)	(560)	(436)	(312)	(188)	(64)	59	183	307
975	-10%	(607)	(467)	(328)	(188)	(49)	90	230	369	509
1,083	0%	(529)	(374)	(219)	(64)	90	245	400	555	710
1,191	10%	(452)	(281)	(111)	59	230	400	571	741	911
1,300	20%	(374)	(188)	(3)	183	369	555	741	927	1,113
1,408	30%	(297)	(95)	106	307	509	710	911	1,113	1,314
1,516	40%	(219)	(3)	214	431	648	865	1,082	1,298	1,515
* The column (row) with a 0% change represents the 1998 average price or yield										
Source: 1998 Producer Survey (yields, prices); 1998 RK Survey (COP/ha)										

Table 5.20: Sensitivity Analysis of Net Revenue/ha, Red Beans, SJV, 1997/98										
Average Large Farmer (>6.3 ha)								COP/ha		$1,014
				Bean Price ($US/kg)*			Op Cost Land/Equity Cap.			$411
Yield*	%	$0.77	$0.92	$1.08	$1.23	$1.39	$1.54	$1.69	$1.85	$2.00
(kg/ha)	Change	-50%	-40%	-30%	-20%	-10%	0%	10%	20%	30%
620	-50%	(949)	(853)	(758)	(663)	(567)	(472)	(376)	(281)	(186)
743	-40%	(853)	(739)	(624)	(510)	(395)	(281)	(166)	(52)	62
867	-30%	(758)	(624)	(491)	(357)	(224)	(90)	43	177	311
991	-20%	(663)	(510)	(357)	(205)	(52)	101	253	406	559
1,115	-10%	(567)	(395)	(224)	(52)	120	291	463	635	807
1,239	0%	(472)	(281)	(90)	101	291	482	673	864	1,055
1,363	10%	(376)	(166)	43	253	463	673	883	1,093	1,303
1,487	20%	(281)	(52)	177	406	635	864	1,093	1,322	1,551
1,611	30%	(186)	62	311	559	807	1,055	1,303	1,551	1,799
1,735	40%	(90)	177	444	711	978	1,245	1,513	1,780	2,047
* The column (row) with a 0% change represents the 1998 average price or yield										
Source: 1998 Producer Survey (yields, prices); 1998 RK Survey										

5.14.3 Sensitivity to Changes in Input Costs

Table 5.21 presents a similar sensitivity analysis for the average farmer in which input costs (seed, fertilizers, other chemicals, and irrigation charges) and/or Labor Costs are allowed to vary between +40 percent to -40 percent. With even a 30 percent increases in both input and labor costs, the average farmer earns $142/ha in enterprise profit, which constitutes a 59 percent decline in returns from the 1998 average. Thus, it is apparent that the average farmer will remain profitable – even under reasonably potential increases in labor or input costs. One such potential scenario is that if farmers faced the economic values of both seed and irrigation charges, this would result in an increase in input costs by 18.5 percent. In this case, the average farmer's enterprise profit would fall to $271/ha, which amounts to a decline in returns of about 23 percent. Thus, the abolishment of seed and irrigation subsidies would have a noticeable effect on the profitability of the average SJV farmer.

Perhaps the principal implication of the results of these sensitivity analyses is that the significant support that bean farmers receive in the DR has little to do with overt subsidies of inputs (seed, irrigation, etc) and primarily to do with import protection. This point will be reiterated and further supported in the following chapter which presents benefit-cost analysis of bean research in the DR.

Table 5.21: Sensitivity Analysis of Enterprise Profit/ha, Red Beans, SJV, 1997/98										
							Gross Revenue/ha			$1,681
Average Farmer							Equip & Other/ha			$279
				Input Cost ($US/ha)*			Op Cost Land/Equity Cap.			$359
Labor										
Cost*	**%**	**$554**	**$514**	**$475**	**$435**	**$396**	**$435**	**$475**	**$514**	**$554**
($US/ha)	**Change**	**40%**	**30%**	**20%**	**10%**	**0%**	**10%**	**20%**	**30%**	**40%**
$178	-40%	311	350	390	429	469	429	390	350	311
$208	-30%	281	320	360	400	439	400	360	320	281
$237	-20%	251	291	330	370	410	370	330	291	251
$267	-10%	222	261	301	340	380	340	301	261	222
$297	0%	192	231	271	311	350	311	271	231	192
$326	10%	162	202	241	281	321	281	241	202	162
$356	20%	133	172	212	251	291	251	212	172	133
$386	30%	103	142	182	222	261	222	182	142	103
$415	40%	73	113	152	192	232	192	152	113	73
$445	50%	44	83	123	162	202	162	123	83	44
* The column (row) with a 0% change represents the 1998 average cost										
Source: 1998 Producer Survey (yields, prices); 1998 RK Survey										

These results also indicate that efforts to reduce costs of production, while helping to maintain or improve profitability, will not be able to compensate for similar percentage reductions in yields or prices. Of course, every effort to reduce costs of production by improving allocative efficiency will help maintain profitability. For example, the average farmer could lower his total production costs by 6 percent simply by reducing his seed density to the CRSP-recommended level.

5.14.4 Farmers' Sensitivity to Price Declines

In order to measure farmers' sensitivity to bean price declines, respondents were presented with a hypothetical situation regarding expected bean prices for the upcoming season. Respondents were asked if their primary buyer reduced their price RD$100/qq below the price they paid this year (1998), would the respondent continue to plant beans? If the respondent said they would continue to plant beans, they were then asked how they would respond to an expected price decline of RD$200 pesos/qq, and so on until a decline of RD$500 pesos/qq was reached (by which point all had indicated they would switch to an alternative crop with the exception of one farmer who said he'd plant beans regardless of the price). The results of this hypothetical market situation are shown in Table 5.22.

These results imply that if the farmgate bean price fell by 10 percent[27], *ceteris paribus*, 38 percent of SJV farmers would not plant beans. If the farmgate price fell 20 percent (approximately), 67 percent of SJV farmers would not plant beans. As the responses of small farmers indicate, they are more sensitive to an initial 10 percent drop in price, compared to large farmers. However, some small farmers claim that they would continue to grow beans, even if prices dropped as much as 30 to 40 percent. By contrast, large farmers are initially less sensitive to a 10 percent price drop, although they more quickly switch out of beans as the magnitude of price declines increase. While this type of hypothetical market situation is certainly not a substitute for actual price variation in

[27] The price elasticity of supply estimates of these farmers are derived from the price levels of each individual farmer in the survey. Thus, these results are not generalizable across other price levels.

assessing farmer price responsiveness, all of these farmers are commercial producers. Thus, this hypothetical market provides a useful insight into their likely response to falling bean prices.

Table 5.22 Farmer Reactions to Declines in Hypothetical Farmgate Bean Prices, SJV, 1998

Farmgate Bean Price Decline	Mean of Sample Price[a] - Price Decline	cumulative % of Sample Farmers who stop planting at this price	Mean of Small Price - Price Decline	cumul. % Small	Mean of Large Price - Decline	cumul. % Large
-100	919	38	912	46	967	26
-200	819	67	812	63	867	72
-300	719	84	712	78	767	87
-400	619	90	612	82	667	94
-500	519	99	512	98	567	100

[a] The average price received by each group was: sample $RD1019/qq, small 1012, and large 1067.

Source: 1998 Producer Survey

Respondents were also asked what alternative crops they would plant, if they stopped growing beans. For small farmers, the primary alternative activities included pigeon peas (34 percent), maize (26 percent), nothing (12 percent), livestock grazing (8 percent), sweet potato (7 percent), rice and peanuts (4 percent each). For large farmers, the primary alternative activity included rice (29 percent), nothing (19 percent), livestock grazing (12 percent), maize (11 percent), sweet potato and pigeon peas (10 percent each), papaya, onion and aguacate (3 percent each).

5.16 Alternative Cost of Production Figures

5.16.1 San Juan Valley

There are several alternative bean cost of production figures available for the SJV. First, SEA reports bean cost of production to be $1,304/ha for "high input level" farmers in the southwest region (i.e the San Juan Valley) (SEA, 1998). This figure is approximately 29 percent higher than that obtained for large farmers in this study ($1,015/ha). Another figure comes from a report published by the farmer association Productores Agricolas, Inc., and estimates the SJV "high input" bean cost of production to be $1,053/ha[28]. This figure is approximately 4 percent higher than the result obtained in this study. The CRSP production cost budget considered the same cost items as both the SEA and farmer association budgets.

5.16.2 Rainfed Bean Production

The distinction between the yield and profitability performance of San Juan Valley farmers, compared with rainfed farmers in other regions, can only be demonstrated through use of government estimates of rainfed bean production costs. SEA's "national" rainfed bean budget estimates cost of production for these farmers to be $763/ha, which is 27% less than the average SJV cost of production figure ($971/ha). However, this SEA figure is likely to be inflated, given the difference between the CRSP and SEA bean production budgets for the SJV. Using the SEA figure for an average rainfed farmer (arbitrarily adjusted downward 25 percent to $572/ha, and then adding the opportunity

---

[28] Land rental cost is removed from the Productores Agricolas' original total in order to make a comparison with the other two cost of production budgets.

cost of land yielding $686/ha), and assuming an average rainfed yield of 600 kg/ha, the cost per unit of the average rainfed farmer is $1.14/kg, which is actually lower than that of the average SJV farmer ($1.17/kg). At the adjusted rainfed cost of production level and a farmgate price of $1.32/kg (SEA's reported annual farmgate price for 1998), the average rainfed farmer with a yield of 520 kg/ha will just break even.

5.17 Chapter Summary

While the financial rate of return at the farm level is high, the financial profitability of smaller farmers is sensitive to variation in yield and output price. Although this chapter highlights various opportunities to decrease farm-level production costs, the prospect of lower farmgate bean prices due to increased imports (because of GATT commitments as well as falling domestic production levels) does not bode well for producers with below average yields and above average costs of production. The long-term competitiveness of beans at financial prices in a more open economy (i.e. economic profitability) is questionable, given the nature and extent of government involvement and support in supporting output prices as well as significant subsidies of bean inputs such as seed. While economic analysis in Chapter 6 shows that societal welfare would increase with lower bean prices, the adjustment costs of such a policy adjustment will be borne by those producers least apt to find suitable alternatives without public investments in alternative crop production and marketing assistance.

CHAPTER SIX: ECONOMIC IMPACT OF BEAN RESEARCH IN THE D.R.

6.1 Introduction

CRSP bean research in the DR has focused primarily upon improving productivity through the development of both improved varieties and management practices. Varietal development has balanced demands for increased yields with greater diseases tolerance/resistance. The first technology analyzed in this study is the red bean variety PC-50, whose primary benefits are improved yields, tolerance to rust and common bacterial blight, and better grain uniformity.[1] The principal benefit of PC-50 is higher yields for irrigated producers. The second technology, analyzed in tandem with PC-50 adoption, is the fallow period in the San Juan Valley (SJV), which is credited with controlling BGMV in the SJV and thus averting enormous bean yield losses.

The standard hypothesis posed by *ex post* benefit-cost analysis is whether or not the incremental[2] economic benefits of the adoption of a technology – such as PC-50 – outweigh the costs of developing and extending that technology (as well as any

---

[1] More uniform grains typically receive higher prices. While it is possible that producers and/or consumers have benefitted from the value of more uniform grain, measuring the farmgate value of grain quality improvement would require a sample including both PC-50 and Pompadour Checa growers, which is not possible for the SJV.

[2] The economic concept of opportunity cost is central to benefit-cost analysis. The benefit of a new technology is not the total revenue it generates, but the *incremental* revenue relative to the farmer's next most renumerative use of his/her resources, which is assumed to be the "without technology" scenario. For example, take a farmer who received $1.39/kg for Pompadour Checa and who had an average yield of 1,080 kg/ha. After adopting PC-50, assuming he received the same price for his beans, and assuming his new average yield was 1,242 kg/ha (15 percent higher than with Pompadour Checa), then the benefit generated by adoption was not his new total revenue ($1.39/kg * 1242 kg/ha) but rather his incremental revenue ($1.39/kg * (1,242 - 1,080)kg/ha)).

incremental costs to producers or consumers resulting from adoption). However, to be considered profitable, the investment must not only cover its operating costs, but also generate more return than the next-best alternative investment, as reflected in the opportunity cost of capital. In addition, donors are often interested in more than solely aggregate-level indicators of efficiency. Thus, the distribution of benefits and costs among various producer and consumer groups is also of interest. The distribution of benefits and costs depends upon the nature of the technology, the resource allocations of producers and consumers, and the institutional and policy environment that shapes the opportunity sets of producers and consumers.

This chapter presents the data and results from benefit-cost analysis of the two principal technologies developed by CRSP bean research in the DR: the new bean variety PC-50, and the fallow period in the SJV. In this chapter, the returns to PC-50 alone (assuming the fallow period as a given) are presented first in their entirety, before the returns to PC-50 combined with the fallow period are discussed. Each of these analyses start with discussion of underlying assumptions made, clarifying the differences between the with- and without-technology scenarios that are central to benefit-cost analysis. Second, the source and estimation of the variables used in the analysis and the estimation of the financial and economic rates of return are presented. Finally, sensitivity analysis and the distribution of benefits are discussed.

6.2 Assumptions of the PC-50 Analysis

6.2.1 Farm-level Benefits from the Adoption of PC-50

Agricultural technology is only welfare-improving if it is adopted[3]. Since benefits accrue only from adoption, the adoption rate and the incremental net benefit per hectare must be estimated. However, it is widely known that the farm-level productivity improvement derived from a given technology often varies across farms with different resource endowments. This is especially true if the technology is developed specifically for a given resource environment. For example, many first-generation Green Revolution rice and wheat varieties were developed specifically for use with fertilizer and irrigation as complements.

Based on the recommendation of CRSP scientists, this analysis assumes that PC-50 only improves yields on irrigated bean area (Arnaud, 1998). This assumption is significant because this excludes the more than half of the DR's annual bean area planted that is rainfed (at least some of which is planted to PC-50, according to the 1993 CRSP nationwide survey). However, the CRSP/DR program has followed a common agricultural research model which assumes that the biggest aggregate return will come by focusing research on higher-resource farmers. The distributional results of following this strategy given the DR situation are discussed below.

---

[3] There can certainly be spillover benefits of technology developed in one country or area which is either directly or indirectly adopted and used in another to improve productivity, which is an implicit goal of the CRSP's regional initiatives. For example, the new black bean variety Arroyo Loro Negro developed in the DR was not widely adopted in the DR (due to overwhelming consumer preference for red beans), but this variety has recently been extended to Haiti, where it is in high demand by farmers and consumers (see the forthcoming CRSP impact study by Shields/Bernsten).

Estimates of the percentage of bean area in each region under "high", "medium", and "low" bean production technology (Sterling, 1998; UEPA, 1990; SEA 1999) were used to divide actual aggregated (irrigated and rainfed) data on red bean area in each region into three production technology categories (Appendix B), as defined by SEA. "High" technology implies high input levels and irrigation, "medium" technology implies medium input levels and irrigation, and low technology implies low input levels and rainfed production. Therefore, only the PC-50 area under high and medium technology is considered for this analysis.

6.2.2 Incremental Farm-level Production Costs

The benefit-cost analysis is constructed by starting with representative farm-level budgets and aggregating them to the project level. In this analysis, the incremental farm-level production costs of adopting PC-50 are assumed to be negligible because this variety is typically used with the same input package as was used with the previous variety (Pompadour Checa or Jose Beta). The only incremental cost of PC-50 adoption is assumed to be increased harvesting costs per hectare (given higher yields). Because the following analysis assumes a 15 percent incremental yield, the assumed increase in harvesting costs per hectare is 15 percent.

6.2.3 Incremental Farm-level Input Use

Key informant sources suggested that attributing yield increases since the early 1990s to PC-50 alone (*ceteris paribus*) ignores the potential role of changes in other factors of production on improved bean productivity, such as irrigation improvements and increased fertilizer use. In fact, annual data from 1989 to 1998 on estimated[4] bean costs of production (from SEA) do not indicate increased fertilizer rates in bean production in the Southwest region during this period. At least one rapid appraisal source in the SJV concurs that fertilizer usage has remained more or less constant before and after the introduction of PC-50 (Arnaud, 1998). Therefore, this analysis assumes that fertilizer use (and thus costs) did not increase due to PC-50 adoption. With regard to the potential effect on productivity of irrigation improvements, less than 10 percent of the SJV irrigation system was improved during the time period under review (Paniagua, 1998).

6.2.4 Economic Surplus Approach

The following benefit-cost calculations follow the economic surplus approach to benefit-cost analysis (Masters, 1996). The supply shift associated with adoption of new agricultural technology is usually assumed to be the result of an increase in total production, resulting in a horizontal shift in the supply curve. The supply curve can also shift vertically; up if costs of production per hectare increase and down if they decrease. In the case of *ex post* analysis, observed prices and quantities over the period under review already include the effects of research. Thus, the supply shift is based on estimating the magnitude of net cost reductions given the observed level of output, and then making an adjustment for the change in quantity associated with a change in price. However, the estimate of the net cost reductions is generally the most important determinant of the

---

[4] SEA's bean costs of production data were estimated via annual consultations with regional extension agents. While the data were not collected with the same attention to detail as the CRSP's record keeping data, SEA's cost of production figures are fairly representative.

results (Masters, 1996). The equation that follows (Table 6.1) does not include net production cost increases at the farmlevel (as in Masters' version); this analysis aggregates these farmlevel costs to the national level (although first aggregated by region and type of production system), and then subtracts them from the total benefit stream (as with research costs).

Table 6.1 Economic Surplus Equation Definitions and Formulas

Definition	Formula	Data & Typical Units
Incremental production due to the new technology, as a proportion of total production	$j = (\Delta Y * t * A) / Q$	ΔY: incremental yield (kg/ha) t: adoption rate A: total bean area (ha) Q: total bean production (kg)
Net change in production costs, as a proportion of the product price	$k = (j / eS)$	eS: price elasticity of supply
Change in the equilibrium quantity produced due to the new technology	$\Delta Q = (Q * eS * eD * k) / (eS * eD)$	eD: price elasticity of demand
Economic benefits from the adoption of the new technology	$SG = (k * P * Q) - ½ (k * P * \Delta Q)$	the second term is subtracted for *ex post* analysis

Source: Masters, 1996.

Because the economic theory underlying the economic surplus method of benefit-cost analysis proposes that a shift in the supply curve is responsible for changes in producer and consumer surplus, the analyst must make various assumptions regarding the supply and demand curves of the given commodity. Assumptions include the choice of functional form of the supply curve, the nature of the shift of the supply curve, and supply and demand elasticities. The choice of functional form is generally considered to be much less significant than the choice of the nature and magnitude of the supply shift (Alston, 1995). For this reason, the supply and demand curves are assumed here to be linear for expediency. By contrast, the nature of this supply shift is a key determinant of the distribution of benefits from research between producers and consumers, and on the measured level of total research benefits (Linder and Jarrett, 1978). A parallel shift of the supply curve implies the same absolute reduction in average costs for both low cost and high cost producers. In other words, a parallel shift describes the case in which the innovation lowers the per unit production costs of low cost producers (those representing the left portion of the supply curve) by a substantially greater percentage than for those producers with higher costs (ibid).

Given that only irrigated producers are assumed to benefit from PC-50, and that high technology bean farmers obtain greater benefits than do medium technology farmers, a parallel shift seems appropriate for this analysis. Therefore, in this analysis, the supply curve is assumed to be linear, and the supply shift is assumed to be parallel. Supply is expected to be price inelastic, given that bean is a staple crop for rainfed farmers, and given that valley farmers (for whom bean is a cash crop) enjoyed high and stable prices prior to 1994. Econometric estimation of supply response confirms this expectation; the price elasticity of supply is estimated to be 0.50 (Mather, 1999b)[5]. Demand is also assumed to be inelastic (0.7) because of the strong tradition of beans as part of the mid-

[5] However, a structural change appears to have occurred in 1994, the year that the Dominican government signed the GATT agreement and a pro-reform party came to the presidency. After 1994, the price elasticity of bean supply becomes elastic (1.15).

day meal and because bean remains the staple protein of the poor.

6.3 Financial Benefit Stream

6.3.1 Adoption Rates and Time-line

6.3.1.1 Introduction

PC-50 was publicly released in 1989 to growers in the San Juan Valley (SJV) and around the country. Although SEA funded a "PC-50 adoption" study in June 1990, the sample included only farmers "known" to have sown PC-50. Therefore, farmer adoption rates were not reported (Diaz, 1990). In June-July 1992, a CRSP-funded nationwide adoption study of PC-50 found the following farmer adoption rates at that point in time: San Juan Valley (SJV) 59.5%; Cibao Valley 30.6%; Higuey Valley 12.3%; and other regions 3.9% (Heikes, 1995). The 1998 CRSP Producer survey in the SJV provides additional information about adoption of PC-50 in the SJV, the main bean producing region in the DR.

Adoption studies traditionally fit a logistic curve to known data (adoption levels at given points in time determined through surveys) to estimate the diffusion of technology adoption among farmers over time. The logistic curve contains three parameters: origin, slope, and ceiling, as defined by the curve $P_t = K / 1 + e^{-(a + bt)}$ (Griliches, 1957). P_t is the percentage of either area or farmers employing the new technology at a given time *t*, *K* is the ceiling, *b* is the rate of growth coefficient, and *a* is the constant of integration which positions the curve on the time scale. Use of the logistic curve to approximate technology adoption over time makes intuitive sense in that the parameters capture several aspects of empirical diffusion dynamics. For example, lags in either local seed demand (knowledge of and/or desire for) or supply (availability) in given areas help explain differences across farms and across regions in the time and scale of adoption (differences in origins). The curve also captures differences in how quickly adoption proceeds (slopes or rates) toward a long-run equilibrium use of a given technology (ceiling). The use and method of estimating the parameters of the logistic function for use in this cost-benefit analysis are discussed in the following sections.

6.3.1.2 San Juan Valley

PC-50 adoption rates from the 1998 CRSP producer survey in the SJV are similar[6] to those of the 1992 study. The actual adoption of PC-50 in the SJV (based on the 1998 survey results) proceeds more quickly to the ceiling value than would be expected from the traditionally-assumed smooth logistic curve[7] (Figure 6.1). Because many farmers in the SJV were familiar with PC-50 before it was officially released[8], adoption therefore proceeded rapidly; the percentage of SJV farmers who adopted PC-50 in the first year of release (1989) was 23 percent (1998 CRSP survey).

---

[6] The 1998 survey asked respondents when they first used PC-50, thus an adoption curve for the SJV was created from the cumulative adoption information provided by the respondents. However, because the 1998 sample only included producers who grew beans in 1998, the adoption curve calculated from this sample may not include individuals who did not adopt PC-50 and have since gotten out of bean production. Thus, the percentage of adopters in the first few years may be biased upwards. Nevertheless, because the 1992 level of 60 percent in the 1998 survey is almost identical to the 1992 level found in Heikes' 1993 survey, the 1998 survey results are thus considered unbiased.

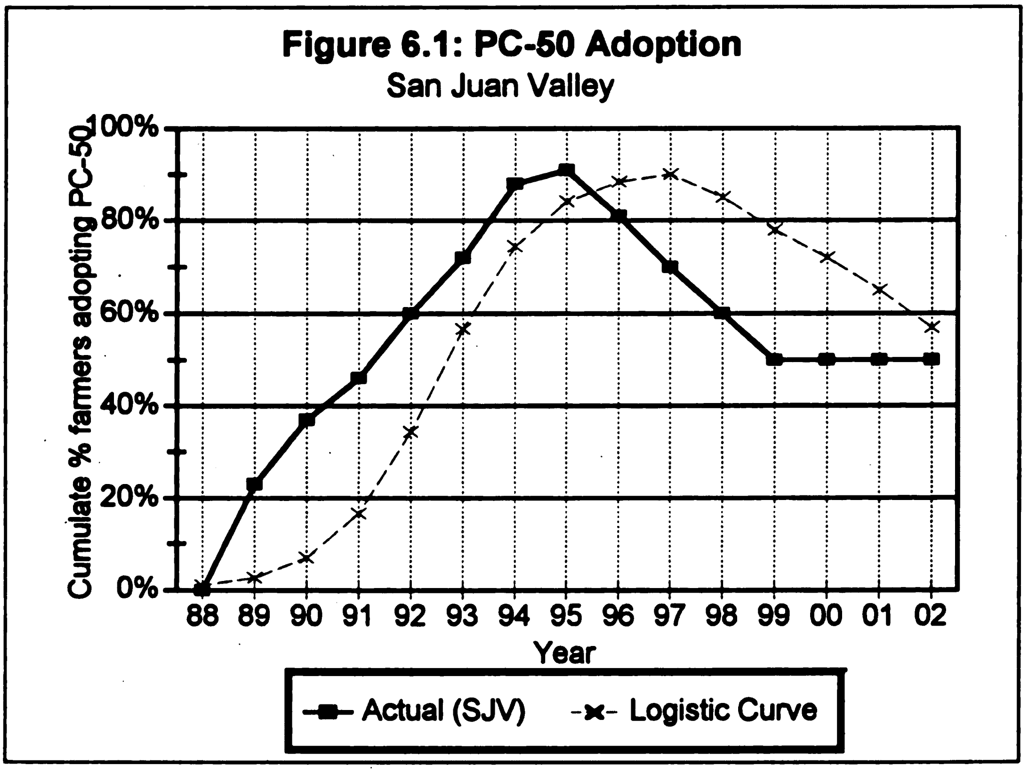
[7] Logistic curve calculated assuming a ceiling of 95% in 1995.

[8] Many SJV farmers were familiar with PC-50 prior to its public release because they were already growing PC-50 for seed multiplication, they had participated in semi-commercial testing of PC-50, or they simply knew about it from contact with CRSP personnel or association colleagues.

The logistic curve has an initial period of increasing adoption at an increasing rate, followed by a period of increasing adoption at a decreasing rate, followed by a peak adoption rate or ceiling. In addition, it is sometimes assumed that the ceiling rate can be followed by a decline in adoption as the variety either degrades or is replaced by farmers with newly improved varieties. In fact, the PC-50 adoption rate experienced such a decline following the release of JB-178, a new red variety developed by the CRSP, which was first released to several producer associations in the SJV in 1996. Adoption rates of JB-178 were 15% in 1996 and 36% in 1997, with 1997 being the first year that JB-178 seed was available directly from SEA[9]. While most farmers planting JB-178 continue to devote some of their bean area to PC-50, the per-farmer use rate of PC-50 nevertheless has fallen (Table 6.2). Because INESPRE purchases JB-178 at the same price as PC-50, and SEA contracts some growers in its multiplication program to deliver JB-178 seed, it is therefore not surprising that per farmer use of PC-50 area has declined since 1996, the year JB-178 was introduced to the SJV.

---

[9] JB-178 adoption rates in the SJV are from the 1998 Producer Survey and Arnaud (1998).



However, while JB-178 has taken area away from PC-50 in the SJV, it is not clear at this point whether or not it will replace PC-50 entirely due to consumer demand for specific bean attributes. The Jose Beta market class (JB-178 is similar in shape, coloring and cooking time to Jose Beta) has never been nearly as preferred by consumers as Pompadour Checa (PC-50). On the other hand, at least one-third of consumers of various income levels in Santo Domingo and the SJV indicate that freshness and cooking time are their principal desired attributes (Mather, 1999). These consumers often preferred imported pintos to local red varieties because of better relative freshness, even though they preferred the color of PC-50. Because JB-178 is known to have a shorter cooking time than PC-50, it is possible that consumers will increasingly demand JB-178 as they become more aware of this variety.

Table 6.2 Producer Adoption of Major Bean Varieties and Types, SJV, 1997-98

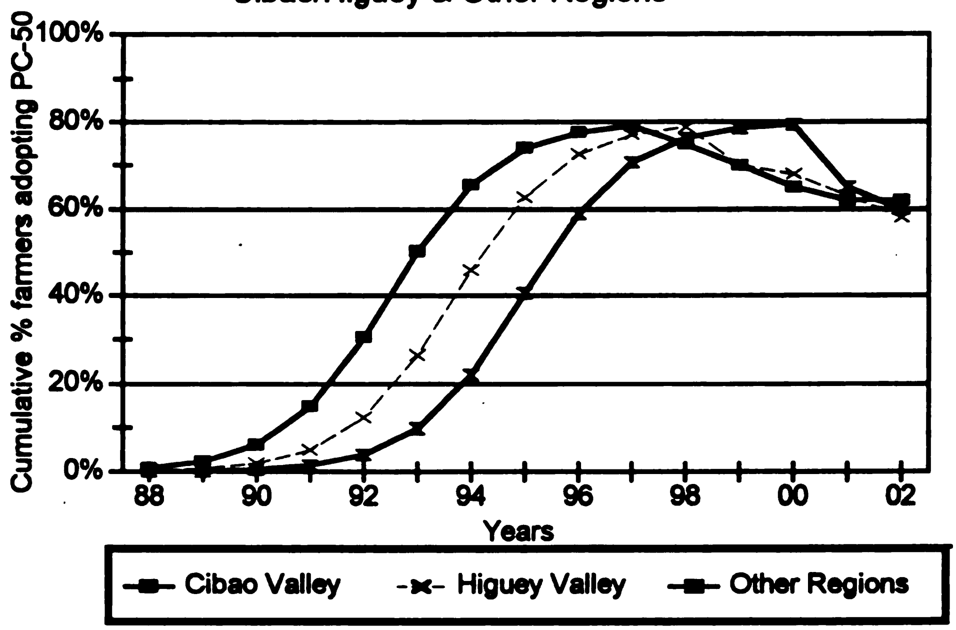
VARIETY / TYPE	Cultivars Included	Producers[1]	Area[2]
		%	%
PC-50	PC-50	79	64
JB-178	JB-178	36	24
Jose Beta	Jose Beta	7	2
Other	White: Blanca, Anacaona Black: Negra, Venezuela 44 Large Red: Constanza I Other Red: Pompadour Checa, Checa, Indiana Pinto: Pinta, Gira Cranberry: Jacomela	9 **131%**	10 **100%**

[1] N=100. Percentages add to more than 100 because some producers plant more than one bean variety.
[2] Area represents all land dedicated to bean production for the winter 1997-98 season. This data are aggregated from parcel level data.

Source: 1998 CRSP Producer Survey

The San Juan Valley PC-50 adoption curve, based on data collected during the 1998 producer survey, serves in this cost-benefit analysis as the PC-50 adoption rate for irrigated bean area in the Southwest Region (*i.e.* a logistic curve was not fit to data points given that the survey provided all the data points). The SJV adoption curve is likely to be different (*i.e.* rise faster and have a higher ceiling) from those of the other two main bean producing valleys (Cibao and Higuey) because of the presence of many SEA seed multiplication program growers in the SJV, and because the CRSP has been active and/or based in San Juan since the project's inception in 1984.

Figure 6.2: PC-50 Adoption
Cibao/Higuey & Other Regions



6.3.1.3 <u>Cibao and Higuey Valleys</u>

Logistic adoption curves for the Cibao (Northcentral Region) and Higuey (East Region), the two other major areas of production, are estimated by using point estimates from the 1992 Heikes/CRSP nationwide survey (31 percent adoption in the Cibao and 12.3 percent adoption in Higuey), and assuming that in 1988 the adoption rates in these two valleys were 1 percent each (*i.e.* essentially zero). Logistic curves are then fit using estimates of *b* derived from these two point estimates, and assuming an upper limit of 80 percent. The upper limit of 80 percent is implicitly less than that of 91 for the San Juan Valley given that the SJV has the majority of SEA seed program growers and the presence of the CRSP. Given that the SEA seed program switched from multiplication of Pompador Checa to that of PC-50 in 1990, and given available SEA Seed Department data on red bean seed distribution by region (see Appendix B), these adoption curve assumptions seem reasonable. These curves are presented in Figure 6.2, along with the curve for Other Regions.

6.3.1.4 Other Regions

The adoption curve for Other Regions[10] are estimated by using point estimates from the 1992 nationwide survey (3.7 percent adoption), and assuming that in 1988 the adoption rates in these regions were 1 percent each (i.e. essentially zero). The adoption ceiling of 80 percent is again assumed. This is a reasonable assumption given SEA seed distribution data and the fact that only irrigated area is included in this analysis.

6.3.2 Red Bean Area by Region

Data from SEA on red bean area by region from 1985-99 is used along with the estimated adoption curves described above to estimate the PC-50 area by region from 1989-2002. Although the proportion of irrigated area, as a percentage of total bean area, has varied over the period in question (1989-1999), it has averaged about 45 percent[11]. Therefore, this analysis assumes that annual irrigated area is 45 percent of total red bean area, as reported by SEA.

---

[10] Other Regions refers to irrigated bean area outside of the San Juan, Cibao, and Higuey valleys.

[11] Regional and/or national data on irrigated/rainfed proportions of bean area are only available for 1985-1990, 1993, and 1999; 45 percent irrigated is the average of 1990, 1993 and 1999.

6.3.3 Red Bean Yield by Region

6.3.3.1 Yield Differentials

Annual red bean yields by region from 1985-99 (SEA) are used to account for annual yield fluctuations across the DR. Because this data aggregates regional yields, it therefore includes production from both rainfed and irrigated area in a given region. Using the actual regional (aggregate) yields each year, the high technology PC-50 area in each region is assumed to have yields 30 percent higher than the regional average, while the yield of the medium technology PC-50 area is assumed to have yields 15 percent higher than the regional average.[12] Due to the widespread adoption of PC-50 in the SJV, the 1998 SJV producer survey could not estimate the counterfactual yield situation (*i.e.* yields during the 1990s of irrigated farmers who never adopted PC-50). Therefore, incremental yield estimates are based on research station trials and SJV farmers' perceptions of the incremental yield of PC-50 compared with Pompadour Checa (from the 1998 Producer Survey).

6.3.3.2 Incremental Yields

Semi-commercial yield trials by the CRSP project from 1985-89 showed that PC-50 yielded an average 30 percent more than Pompadour Checa (CRSP, 1990) across five trial sites (in various regions). In the 1998 Producer Survey, 76 percent of farmers said that their yields increased with PC-50 compared to Pompador Checa, 14 percent said their

---

[12] Thirty percent was chosen as the yield differential between high technology yields and the regional average because this is the average differential between irrigated and aggregate yields across all regions. Fifteen percent was arbitrarily assumed to be the yield differential between medium technology yield and aggregate regional yield.

yields remained the same, and 10 percent said their yields were lower with PC-50. Of those who claimed to have higher yields, 72 percent said that their yields increased between 30-60 percent.[13] Given that experimental yields are rarely achieved by farmers in practice, and given the potential rounding-error problems associated with the Producer Survey question regarding the percentage increment, an incremental yield of 23 percent is assumed, which is 75 percent of the experimental incremental yield. When this incremental yield of 23 percent is weighted by respondents' indications of yield increase, stability, or decline due to PC-50 adoption, the average incremental yield is approximately 15 percent[14]. Thus, the incremental yield attributable to PC-50 alone is conservatively assumed to be 15 percent for high and medium technology bean areas.

6.3.3.3 Incremental Production

Regional incremental production attributable to PC-50 can then be calculated given the total bean area under high and medium technology, the regional adoption rate, the incremental yield, and the actual regional yield for that technology area. Incremental

---

[13] It should be noted that there were problems with the question asked of farmers in the 1998 producer survey, "How many more/less quintales per tarea do you normally get from PC-50 compared with your previous variety?" Bean yields in the DR are reported in "quintals per tarea" (quintal = 100 or 110 lbs, depending on the buyer; 15.9 tarea = hectare), and the typical yield range is between 0.5 - 2.5 quintals per tarea. Because coded response categories went up and down by half-quintals, it is very likely that there is an upward rounding bias in the responses to this question. The implication is that while 76 percent of producers said their yields increased, "incremental" yields reported by some farmers to be as high as 60-80 percent are not plausible and are likely the result of the upward bias of rounding. If yield gains were as high as the average farmer reported, these gains would surely be so noted in aggregate regional yield improvements.

[14] That is, $(0.77*1.23) + (0.14*1) + (0.10*0.77) = 1.15$

production for a given high technology area in a region is therefore calculated as:

Incremental production (kg) = area adopted (ha) * regional yield (kg/ha) * yield differential for high tech area (%) * incremental yield (%)

Thus, incremental production is calculated on a regional basis using actual regional aggregate yield data and the assumptions presented. This incremental production is then aggregated across regions and plugged into the Economic Surplus model as the numerator of the j parameter (see below).

In sum, this analysis uses actual regional data, assumes that the annual yield for high technology area is 30 percent higher than the annual regional mean, and then assumes that 15 percent of the resulting high technology PC-50 production is attributable to variety alone. This incremental yield (15% of the high technology yield for a given region in a given year) is multiplied by the adopted high technology area in that region for the given year to estimate the incremental regional production under high technology area. A similar calculation is then performed for the medium technology area in each region, although in this case, the medium technology yield is assumed to be 15 percent higher than the annual regional mean, and that 15% of the medium technology PC-50 production is attributed to the variety alone. Once the incremental production due to PC-50 is estimated, the remaining steps involve calculating a real, discounted value of the national incremental production for each year.

6.3.4 Red Bean Financial Prices

This analysis uses an annual national average farmgate price series for red beans in the DR (SEA, 1998) as the nominal financial price series for the time period of adoption

1989-1999. The price series for 2000-02 is assumed to increase by 5 percent a year to approximate inflation.

6.3.5 CPI, Exchange Rate, and Discount Rate

The consumer price index (CPI)[15] used to deflate benefits and costs from 1984-1999 is from the Inter-American Development Bank Economics and Statistics Database (base year 1999=100). The annual average exchange rate used is also obtained from the Inter-American Development Bank. The discount rate is assumed to be 10 percent, as inflation in the 1990s ranged from 8 to 20 percent (averaging about 10 percent), and the nominal interest rate has been 24 to 30 percent during this period.

Key informants as well as a World Bank study (Valdes, 1995) suggest that the Dominican currency has not been overvalued since 1990. Because the figures prior to 1990 that this analysis uses are research costs, which are either in $US or are non-tradeables[16], the use of a shadow exchange rate is not necessary.

6.4 Financial Costs Stream

6.4.1 CRSP Research Costs

The project-level costs involved in the development and diffusion of PC-50 include CRSP expenses for research and training, as well as financial contribution from SEA in the form of technician salaries and the use of experiment station land. CRSP DR Project cost data was obtained from the CRSP Management office at MSU, and includes primarily

[15] The CPI is used because the Dominican government does not calculate a producer price index.

[16] CRSP research expenses are reported in $US, and SEA research expenses are non-tradeables such as technician salaries and land values.

salaries, training, and operational costs. Both host-country and US-based expenditures (charged to the DR project) from 1984-1989 are assumed to be relevant to the testing,

	Table 6.3 Real CRSP Research Costs						
	——— CRSP Research Costs ($US)———				SEA Support to the CRSP ($US		
	TOTAL	Nebraska	Nebraska	P.Rico	TOTAL	Technician	Land
YEAR	CRSP	HC	US for HC	HC	SEA	Salaries	
1984	$228,479	$228,479	$0	0	$39,452	$30,540	$8,911
1985	$183,000	$183,000	$0	0	$38,082	$29,480	$8,602
1986	$195,704	$177,612	$18,092	0	$37,210	$28,805	$8,405
1987	$177,957	$122,372	$55,584	0	$36,117	$27,959	$8,158
1988	$147,338	$76,202	$71,136	0	$34,757	$26,906	$7,851
1989	$118,822	$65,880	$52,943	0	$33,085	$25,612	$7,473
Source: CRSP Management Office, MSU; estimates from CRSP annual reports (1993-98							

screening and development of PC-50 and basic material for the SEA seed program. However, CRSP DR technical reports of research activities from 1984-1989 indicate that approximately one-half of CRSP researcher activities during this time period were related to PC-50[17]. Therefore, it is assumed that 50 percent of the total CRSP costs on the DR program (those shown in Table 6.3) are attributable to the development and release of PC-50.

6.4.2 SEA Costs

As the CRSP is a collaborative project, the Dominican government (SEA) contributed land and technician salaries to the project. The amount contributed by SEA is estimated to be US$19,000 per year (nominal) for technician and worker salaries (this figure is based on the amounts contributed by SEA in 1992 and 1993), and $5,544 for the

[17] One-half of the total experimental area during this period was used for screening, trials, multiplication, or other activities that involved comparisons of PC-50 with other material.

opportunity cost of 5.6 hectares of land (the total area of experiment station land used for bean research). This assumes that a hectare of irrigated land could have brought financial net return of $1,000/ha with two bean crops in a year in the late 1980s. Extension costs are not included as the extension service existed prior to the project, which implies that extension costs are not incremental costs. The "extension cost" of PC-50 is assumed to be embodied by the substantial SEA seed subsidy.

6.5 Financial Rate of Return to PC-50

Given the base assumptions discussed below, the financial rate of return to the development of PC-50 during the period 1984-2002 is 96.2 percent. As financial ROR's are consistently higher than economic ROR's in the case where production is subsidized/protected, sensitivity analysis will only be reported for the economic ROR's. The Net Present Value of the investment is US$ 63.9 million (valued at financial prices).

6.6 Economic Benefit Stream

6.6.1 Economic Import Parity Prices

The economic benefits stream uses the same area, yield, and adoption rates as does the financial benefits stream. However, the economic bean price series are economic import parity prices calculated using U.S. (Colorado) pinto bean season-average prices (Table 6.4) during the benefit period (1989-2002)[18]. Pintos typically constitute more than 90 percent of the DR's bean imports, and in recent years, almost all pintos have been

---

[18] The cut-off year of 2002 is arbitrary but represents a typical time-line of evaluation of a technology (13 years from release) as well as the reality that discounting reduces future benefits quickly beyond five years from the present. Adding more years of benefits to the following analyses analysis does not change the conclusions and has very limited effect on the magnitude of the benefit-cost indicators.

imported from the U.S. During the period 1989-99, the financial import parity price (IPP) of Colorado pintos averaged 22 percent less than the annual DR average farmgate prices for domestic red beans (PC-50, Pompadour Checa), while the economic IPP averaged 62 percent less than the farmgate price during this same period[19].

Table 6.4 Economic Import Party Price, Red Beans, DR			
Colorado Pintos US#1			
1999 season average price			
Description	%	US$/cwt	RD$/cwt
Exchange Rate			15.90
FOB dealer season average price		20.25	321.98
Ground/Sea Transport, Insurance		5.50	87.45
CIF Haina, D.R.		25.75	409.43
Bank Charge	3.0%	0.77	12.28
Customs/Port charges		0.96	15.26
Loss	1.0%	0.27	4.37
Cost leaving Customs		27.76	441.34
Transport Customs-S.D.		0.24	3.82
Transport S.Domingo-S.Juan		0.75	11.93
Cost in San Juan per cwt		$28.75	$457.08
Cost in San Juan per kg		$0.63	
Source: IICA, Santo Domingo, 1999; Ron Bannon, Bean Shipper, Toronto, 2000.			

6.6.2 Market Price Premium for Domestic Red Bean

The use of the pinto as a parity good for the Pompadour market class assumes that these goods are perfect substitutes and that the price difference is due solely to a

[19] IPP calculations are made by the author using import costs from Table 6.5 and pinto price series from USDA/AMS.

differential in the costs of production. However, this assumption would belie the fact that for many consumers, pintos and domestic red beans are not perfect substitutes. In fact, using retail price data that distinguishes between domestic reds and pintos[20] (from August 1998 to June 1999), Dominican consumers were willing (through 1999) to pay approximately 20 percent more for domestic reds compared to pintos. However, these market prices are not "free" market prices because pinto imports are still heavily regulated, although import levels have increased dramatically the past few years. This analysis will therefore assume that no consumer preference premium for red beans exists in the base scenario, but will add a premium in sensitivity analysis to incorporate the disparity between consumption value of the pinto compared to the domestic red.

6.7 Economic Cost Stream

6.7.1 Introduction

There are several inputs in Dominican bean production that are either directly or indirectly subsidized or taxed. Thus, economic analysis requires that these inputs be valued with subsidies/taxes removed (Tables 6.5). Additional economic costs include farm-level input subsidies (aggregated to the project level) from SEA (seeds), INDRHI (irrigation), and PROSEMA (land services). The calculations of these costs/ha are discussed below (Table 6.6). Additional economic benefits include lower fertilizer prices that would occur under more competitive pricing. For computational convenience, fertilizer savings per hectare are included in the economic cost section of the analysis. The

[20] Prior to August 1998, SEA did not report retail pinto prices as separate from the "red bean" price category.

Table 6.5 Real Economic Cost Components

	——— SEA Seed———		——— INDRHI ———		——— PROSEMA ———		Farmlevel Savings with Competitive Fertilizer	
	Subsidy	(seeds)	Subsidy	(irrigation)	Subsidy	(land prep)	Subsidy	
YEAR	(US$ / ha)	US$	(US$ / ha)	US$	(US$/ha)	US$	(US$/ha)	US$
1984		$0		$0		$0		$0
1985		$0		$0		$0		$0
1986		$0		$0		$0		$0
1987		$0		$0		$0		$0
1988		$0		$0		$0		$0
1989	$58.91	$1,417	$17.80	$1,428	$40.00	$802	($12.50)	($1,003)
1990	$58.91	$3,061	$17.80	$3,083	$40.00	$1,732	($12.50)	($2,165)
1991	$58.91	$8,159	$17.80	$8,218	$40.00	$4,617	($12.50)	($5,771)
1992	$58.91	$14,756	$17.80	$14,863	$40.00	$8,350	($12.50)	($10,437)
1993	$58.91	$28,197	$17.80	$28,400	$40.00	$15,955	($12.50)	($19,944)
1994	$58.91	$40,691	$17.80	$40,984	$40.00	$23,025	($12.50)	($28,781)
1995	$58.91	$60,947	$17.80	$61,386	$40.00	$34,487	($12.50)	($43,108)
1996	$58.91	$64,591	$17.80	$65,057	$40.00	$36,549	($12.50)	($45,686)
1997	$58.91	$61,010	$17.80	$61,450	$40.00	$34,522	($12.50)	($43,153)
1998	$58.91	$63,731	$17.80	$64,190	$40.00	$36,062	($12.50)	($45,077)
1999	$58.91	$63,470	$17.80	$63,928	$40.00	$35,914	($12.50)	($44,893)
2000	$58.91	$61,584	$17.80	$62,028	$40.00	$34,847	($12.50)	($43,559)
2001	$58.91	$54,698	$17.80	$55,093	$40.00	$30,951	($12.50)	($38,689)
2002	$58.91	$52,346	$17.80	$52,723	$40.00	$29,620	($12.50)	($37,025)
	Source: SEA, Diagnostico 1998; SEA Memoria, Depto. de Semillas, 1993-1998							

same CRSP and SEA project costs used in financial analysis are utilized for the economic analysis.

6.7.2 Indirect Fertilizer Tax

According to an on-going study of the Dominican fertilizer industry (Nuñez, 1999), fertilizer prices in the DR have been approximately 10 percent higher over the last decade than they would have been under a more competitive pricing environment (two firms share the entire DR fertilizer market and are considered to be oligopolists). Therefore, the economic valuation of these inputs would be the economic import parity fertilizer price (*i.e.* the international price plus international and domestic transport costs, insurance, etc), which is approximately 10% lower than existing market prices.

6.7.3 Seed Subsidy

On the other hand, farm-level production costs would increase if farmers were charged the full (economic) cost of seeds purchased from SEA, the full cost of irrigation services from INDRHI, and the full cost of land preparation by PROSEMA. In this analysis, the value of these subsidies are aggregated to the project level (i.e. nationwide), and are calculated using a subsidy value per unit of the input, multiplied by the amount of that input used per adopted hectare each year.

The value of the SEA seed subsidy aggregated to the national level is calculated as the subsidy per kilogram of seed multiplied by the total amount of SEA seed planted that year. The subsidy per quintal (cwt) of seed is calculated as follows. While SEA pays RD$1,175/qq for seed, the acquisition cost of seed-quality bean is assumed to be near the upper end of the distribution of market prices for grain (RD$1,000/qq). The cost of private "cold storage" is approximately RD$7/qq per month (RD$56/qq for 8 months of storage)[21], and the costs of cleaning and treatment are approximately RD$50/qq. The opportunity cost of not selling the grain at RD$1,000/qq in February (interest over eight months @ 2 percent/month) is RD$195/qq, and a 10 percent profit margin on operation costs is RD$110/qq. Under these cost assumptions, a private firm would sell seed for no less than RD$1,216/qq (US$1.85/kg). Because the SEA seed price is RD$900/qq (US$1.37/kg), this implies a subsidy of RD$316/qq (US$0.48/kg) of all SEA seed actually planted by farmers. To calculate the total subsidy per year, the subsidy per kilogram of seed ($0.48/kg) is multiplied by an assumed average seed rate (123 kg/ha or 17 lb/ta) across the DR. Thus, each farmer who purchased seed from SEA in a given year received a subsidy of (US$58.91/ha). This result is then multiplied by the total PC-50 hectares adopted each year, then multiplied by 30 percent (the assumed turnover rate for purchasing new seed)[22] (Table 6.5 and 6.6).

6.7.4 Irrigation and Land Preparation Subsidies

To calculate the aggregate value of subsidies on irrigation, the subsidy of a season's irrigation per hectare supplied by INDRHI (US$19.75/ha in the SJV) is multiplied by the adopted hectares each year (all adopted hectares are irrigated).

---

[21] This monthly storage fee is the rate quoted by a bean wholesaler in San Juan (who has a cold storage facility) in August, 1998.

[22] Although data on annual SEA seed sales by region is available and presented in Appendix B, the method used here to calculate the seed subsidy does not use these figures due to their suspect accuracy. However, annual SEA seed sales by region as compared with annual area planted by region does support the assumption that approximately 30 percent of bean area any given year is planted to seed purchased from SEA that year.

Likewise, the subsidy per hectare of land prepared by PROSEMA ($40/ha in the SJV) is multiplied by the adopted hectares each year and then by 25 percent, as this is approximately the percentage of national bean area serviced by PROSEMA (SEA, 1998) (Table 6.5 and 6.6).

6.8 Economic Analysis of PC-50

6.8.1 Economic Rate of Return

Given the base scenario assumptions discussed below, the economic rate of return to the development of PC-50 during the period 1984-2002 is 63.2 percent. Therefore, this *ex-post* analysis concludes that given the base assumptions made - namely, taking the fallow period as a given, the development of PC-50 has made the Bean/Cowpea CRSP project a profitable investment through 2002 (the economic ROR is greater than the discount rate/opportunity cost of capital of 10 percent). The Net Present Value of this investment over the same time period is US $28.0 million.

Although bean production in the SJV is uneconomic (Chapter 5), the economic ROR is positive because of a seemingly paradoxical situation: PC-50 yielded positive returns because it made a "bad" economic situation "less bad." That is, the import protection policy of the DR creates large deadweight losses and results in large transfers from consumers to producers, which is the result of the production of uneconomic crops (Chapter 5). Taking the trade policy regime situation as a given, a farmer using PC-50 has higher (yet still negative) economic returns than a farmer who does not use PC-50 (and has lower negative economic returns). Thus, PC-50 reduces the cost to society of import protection (the deadweight loss). In this case, the "with PC-50" scenario is an improvement in economic terms over the "without PC-50" scenario.

6.8.2 Sensitivity Analysis

As several key variables in the rate of return function are based on assumptions, analysis of the sensitivity of the economic ROR to the assumed values of these variables is presented below. The initial value of these variables include: discount rate (10 percent), elasticity of demand (0.7), elasticity of supply (0.5), incremental yield (15 percent), price differential between imported pintos (IPP) and domestic reds (20 percent), total CRSP/SEA project costs from 1984-89 (50 percent attributed to the development of PC-50), and cost of production increase due to increased harvesting costs (10 percent). Table 6.7 demonstrates the sensitivity of the economic ROR to variation in the values of the said variables, *ceteris paribus* (assuming all other variables remain at their base levels - in bold below).

As demonstrated in Table 6.7, the economic ROR is most sensitive to the assumed values for the price elasticity of supply, the percentage of CRSP/SEA total bean research costs attributed to PC-50 development, and the incremental yield incease. However, even when these variables are changed (*ceteris paribus*) to maximum/ minimum values, the investment remains profitable. The economic ROR is relatively insensitive to changes in the price elasticity of demand, level of government input subsidies (seed, land prep, and irrigation), and incremental farm-level harvesting and fertilizer costs, *ceteris paribus*.

Table 6.7 Sensitivity Analysis of the Economic ROR to PC-50 Adoption in the DR, 1984-02

Variable	Variable Value	ROR	Variable	Variable Value	ROR
% Adopted Area Adjustment (decrease)	*0*	*53.6*	% Total CRSP Project Costs (1984-89)	*50*	*53.6*
	- 10	51.5		75	45.8
	- 20	49.3		100	40.6
	-30	46.8	% Import Parity Price Adjustment ($P_{red} - P_{pinto}$) (increase)	0	49.9
Price Elasticity of Supply	0.4	58.2		5	50.8
	0.5	*53.6*		10	51.8
	0.6	49.9		15	52.7
	0.7	46.8		*20*	**53.6**
	0.8	44.2	% Incremental Yield (increase)	5	32.5
	0.9	41.9		10	45.5
	1.0	39.9		*15*	*53.6*
				20	59.6

6.8.3 Distribution of Benefits

6.8.3.1 Introduction

The distribution of the benefits and costs of technical change depends upon the policy situation and the structure of production and marketing systems (which includes consumer income, preferences, and their distribution). Critics of Green Revolution agricultural technologies decried the bias of these technologies towards larger, resource-rich farmers who had easier access to requisite complementary inputs such as irrigation and fertilizer. However, Scobie and Posada demonstrated that given the right circumstances, technology with this bias can still improve the welfare of a vast majority of urban and rural poor (even many non-adopting farmers). For example, in their study of the impact of technical change in rice production in Colombia, Scobie and Posada (Scobie, 1990) showed national supply increases large enough to substantially drive down rice prices, thus benefitting all consumers and all farmers who were net rice buyers. While they conceded that some commercial upland rice farmers were net losers from this technical change, the national welfare improvement for the urban and rural poor was far greater than the isolated losses.

This same economic argument is often employed to silence criticism of working exclusively with resource-rich farmers, as is the nature of CRSP research in the DR. The argument goes that the "bang for the buck" of working with rainfed producers is simply too low to justify the investment, and, more importantly, when resource-rich farmers' yields increase enough to drive down domestic prices of that staple, then all net buyers of the staple (including all of the urban poor and many of the rural poor) are better off. Therefore, given that the analysis above demonstrates that CRSP bean research in the DR had a profitable aggregate impact, it is still worth asking the question of whether or not consumers received any benefits from this technical change, and which producers have benefitted.

6.8.3.2 <u>Consumers</u>

Due to the nature of the Dominican government's supply control policies implemented via import restrictions, it is assumed that incremental domestic production did not expand total supply, but rather merely displaced imports. The DR scenario is not similar to the typical import quota scenario (Alton, 1995) in which incremental production expands total supply (because the size of the import quota remains the same), thus lowering retail prices. In fact, the DR scenario is more similar to the typical import tariff scenario (Altson, 1995) in which incremental production displaces potential imports and does not lead to an expansion of total supply - retail prices remain constant, and consumers receive no benefits from the technical change. Therefore, this analysis indicates that consumers have received little if no benefits from incremental bean yields; producers (farmers, importers, marketing agents) have captured all the benefits from technical change.

Real Dominican retail bean prices in fact only began to fall in the late 1990s as Dominican production fell dramatically and the government began to substantially increase imports of pintos, which – even after the inefficiencies of tariffs, rents, etc. (described in Chapter 4) – are cheaper than domestic reds and thus put downward pressure on domestic red retail prices. One scenario does exist, however, in which Dominican consumers could benefitted from the technical change. Assuming a price premium for domestic red beans would exist under free market prices, then the incremental production due to PC-50 multiplied by this premium would constitute consumer surplus because "displaced imports" are not valued as highly by consumers. However, this assumes that consumers who favor the domestic reds (and are willing to pay a premium) are not made better off when import levels increase - driving down the price of their favored domestic reds. In short, analysis into consumer surplus due to a price premium is not considered here.

6.8.3.3 Producers

Contrary to the usual result in agricultural technical change, the benefits of incremental yields in the DR have accrued primarily to producers. Among producers, benefits have accrued principally to those with irrigation. The financial benefits to SJV farmers have been the greatest, as they have received the highest farmgate prices due to INESPRE and SEA purchases at above-market prices. Since small farmers sell at lower prices, most of the benefits accrue to medium and larger farmers in the valleys. As noted in Chapter 5, smaller farmers receive lower prices for their beans in part due to generally lower quality beans, as well as to financial and organizational limitations.

6.9 Financial and Economic Analysis of The Fallow Period

6.9.1 Introduction

By the accounts of many key informants, the fallow period has enabled the San Juan Valley to effectively control the whitefly and to thus continue to grow bean in the winter season. However, the fallow period in the San Juan Valley has meant that since 1991-92, farmers no longer have the option of planting both an early fall bean crop (or other host crop for the white fly) prior to the main winter bean season. In short, if the fallow period is to be considered an output of CRSP research, then the "without-fallow period" benefit-cost scenario would have to include both more bean area and lower yields (due to continued BGMV problems that would have occurred in the absence of the fallow period) than would the "with-fallow" scenario[23]. Therefore, the fallow period represents

[23] It should be noted that not all bean growers planted in both seasons, and the winter season has always been the largest for bean production in the SJV.

the opportunity cost – foregone income from an early bean season – of the "with-fallow" scenario that enables a lower incidence of BGMV and thus higher yields in the winter bean season.

With regard to benefit-cost analysis of the fallow period, the "with-fallow" scenario is historical; that is, the fallow period was enacted in 1991, and the approximate SJV annual bean area since that time is known. While good data on yields specific to the SJV are not available, historic regional yields on irrigated area provides a close approximation, as the SJV makes up almost all the irrigated area in the Southwest region. By contrast, the "without-fallow" scenario is hypothetical; the SJV area under both an early fall and a winter bean season must be assumed, as well as BGMV incidence and subsequent yield loss. To estimate the area loss of the early fall season embodied in the with fallow period scenario (*i.e.* a gain in the without scenario), the average bean area for the SJV from 1986 to 1990 was compared with the average bean area for 1992 to 1997 (the fallow period began in 1991). The difference between these averages is approximately 900 ha. This small change is likely due to the fact that many farmers did not plant beans in both seasons. Thus, by moving to one season, area planted did not decrease substantially. Therefore, the "without fallow" scenario includes 900 ha/year in addition to the historical bean area for the SJV (Table 6.8).

Table 6.8 The SJV Fallow Period in With- and Without-Fallow Scenarios, 1990-02

Scenario	SJV Annual Bean Area	SJV Annual Bean Yield
With the fallow period	historical	1998 survey average yield[a]
Without the fallow period	historical + 900 ha/year[b]	1998 survey average yield - 33.75 percent yield loss per year due to increased incidence of BGMV

[a] Actual yields embody losses to BGMV; 25 percent of 1998 CRSP Survey respondents reported BGMV as their principal production problem. The 1998 survey average yield is used as time series data for alternative crops in the SJV is not available.
[b] Yield loss calculated as follows: 25% chance of 75% yield loss due to BGMV + 25% chance of 50% yield loss + 25% chance of 20% loss + 25% chance of 10% loss = average of 38.75% yield loss per year. However, this analysis assumes that historical yields embody a 25% chance of 20% yield loss per year + 75% chance of 0% loss, thus the incremental yield loss is 38.75% - 5% = 33.75%.

With respect to BGMV incidence and yield loss, this analysis assumes that without a fallow period, BGMV incidence and yield losses in the SJV would have been higher. Specifically, this analysis assumes that the "without fallow" scenario would have resulted in an expected average of 33.75 percent lower production than what actually occurred in the "with fallow" scenario (Table 6.8). The frequencies and respective yield percentage losses are based on the assumption that in any given year (without the fallow period), there would be a 25 percent chance of a devastating BGMV incidence (75 percent losses), a 25 percent chance of a serious incidence (50 percent losses), a 25 percent chance of a "normal" year (20 percent losses), and a 25 percent chance of only 10 percent losses. The assumed frequencies and losses are based very roughly on anecdotal estimates (Arnaud, 1995, 1996, 1997) of BGMV incidence and bean crop losses in the SJV since 1988, as well as survey responses (25 percent of respondents in 1998 claimed that BGMV was their principal production problem) (CRSP Survey, 1998).

However, under these expected average yield losses in bean production, bean would not have remained more profitable than alternative crops using financial valuation in the hypothetical "without fallow" scenario. For example, net returns analysis[24] using bean and alternative crops (Table 6.9 to 6.12) and assuming 33.75 percent yield loss on bean in the "without fallow" scenario[25], demonstrates that SJV bean farmers facing financial (market) prices in 1991 would have switched out of winter production of beans and into alternative crops, to a combination of maize (66 percent of area previously planted to bean) and pigeon pea (34 percent)[26].

---

[24] The crop budgets in Tables 6.9 to 6.12 were constructed as follows: SJV cropping area is based on the historical data on SJV bean area; crop prices and alternative crop costs of production are national averages from SEA (SEA, 1998); bean yield is the average for 1997 from the SJV Producer Survey; alternative crop yields for the SJV are from a local development project (JICA, 1998); bean costs of production are from the RK Survey; economic prices for bean are from the import parity price series discussed in Chapter 6.6.1; the alternative crops pigeon pea and maize are not protected. The alternative crops considered in this analysis were two of the crops indicated by the 1998 CRSP Producer survey respondents as the crops they would switch into if bean prices fell dramatically. The other alternative crops indicated by respondents have limited market demand and were therefore not considered as viable alternatives for the majority of producers. This analysis assumes that producers are profit-maximizers that make decisions based upon expected prices, costs of production, and yields. Producer risk preferences are not considered, and no price effects of increase maize or pigeon pea are considered. Nevertheless, it seems clear that pigeon pea and maize demand is large enough to accommodate these growers, and that any price effects would not make these crops less profitable than bean in the without fallow scenario.

[25] Tables 6.9 to 6.12 assume constant yield over time because no time series data on alternative crop yields is available for the SJV. Assuming constant yields for bean and alternative crops for this simple analysis would not likely change the result found, given that the area in question is irrigated.

[26] This proportion between maize and pigeon pea is based on the 1998 CRSP farmer survey respondents' "likely alternative crops" as well as the fact that the pigeon pea

To examine this result more closely, consider that the time series of bean net returns under the "with fallow" scenario (Table 6.9) in comparison with the net returns to pigeon pea (Table 6.11) and maize (Table 6.12) demonstrates that bean is the most financially renumerative crop in the SJV[27] (net returns of US$ 972/ha for bean in 1991, compared with US$ 679/ha for pigeon pea and US$ 669/ha for maize), assuming no yield loss from BGMV. It is also clear bean has lower economic returns than the alternative crops[28]. However, once yield losses to BGMV (averaging 33.75 percent per year) are assumed for the "without fallow" scenario (Table 6.10), it is clear that both pigeon pea and maize would be more financially renumerative (net returns of US$ 679/ha for pigeon pea in 1991, US$ 669/ha for maize, and US$ 316/ha for bean). Thus, assuming no transaction costs, risk-neutral farmers would have switched to these alternative crops during the 1991 to 2002 period. While the data used in this simple net returns analysis is not ideal, even these rough estimates of net profitability over time indicate that SJV farmers do have alternatives to bean, and would have switched to these crops if BGMV had not been controlled.

---

market is smaller than that for maize.

[27] While there are other alternative crops which have much higher returns (potatoes, sweet potatoes, tomatoes, etc), these are not considered viable alternatives for this analysis given their small market demand and the transaction costs associated with developing stable marketing coordination.

[28] The net returns to bean and the alternative crops do not include the opportunity cost of land or equity capital, which explains why bean net economic returns are not negative as they are in Chapter 5.

Table 6.9: Financial and Economic Returns to Bean Production, SJV: With Fallow						
		Real	Real Cost	Real	Real	Real
		Financial	of	Financial	Economic	Economic
Year	Yield	Price	Production	Net Return	Price	Net Return
	(MT/ha)	($/kg)	($/ha)	($/ha)	($/kg)	($/ha)
1991	1,128	$1.72	$971	$972	$0.83	($38)
1992	1,128	$1.67	$971	$916	$0.84	($27)
1993	1,128	$2.57	$971	$1,930	$1.03	$194
1994	1,128	$2.17	$971	$1,476	$1.08	$245
1995	1,128	$1.99	$971	$1,277	$0.82	($41)
1996	1,128	$1.64	$971	$877	$1.03	$190
1997	1,128	$1.55	$971	$776	$0.91	$61
1998	1,128	$1.33	$971	$534	$0.94	$86
1999	1,128	$1.22	$971	$406	$0.75	($121)
2000	1,128	$1.22	$971	$406	$0.86	($2)

Table 6.10: Financial and Economic Returns to Bean Production, SJV: Without Fallow						
		Real	Real Cost	Real	Real	Real
		Financial	of	Financial	Economic	Economic
Year	Yield*	Price	Production	Net Return	Price	Net Return
	(MT/ha)	($/kg)	($/ha)	($/ha)	($/kg)	($/ha)
1991	747	$1.72	$971	$316	$0.83	($353)
1992	747	$1.67	$971	$279	$0.84	($346)
1993	747	$2.57	$971	$951	$1.03	($199)
1994	747	$2.17	$971	$650	$1.08	($165)
1995	747	$1.99	$971	$518	$0.82	($355)
1996	747	$1.64	$971	$253	$1.03	($202)
1997	747	$1.55	$971	$186	$0.91	($287)
1998	747	$1.33	$971	$26	$0.94	($271)
1999	747	$1.22	$971	($59)	$0.75	($408)
2000	747	$1.22	$971	($59)	$0.86	($329)
* assumes average 33.75% yield loss due to increased BGMV incidence						

Table 6.11: Financial and Economic Returns to Pigeon Pea Production, SJV

Year	Yield[a] (MT/ha)	Real Financial Price[b] ($/kg)	Real Cost of Production[c] ($/ha)	Real Financial Net Return[d] ($/ha)	Real Economic Price[e] ($/kg)	Real Economic Net Return ($/ha)	PPea FNR less Bean FNR[f] ($/ha)	PPea ENR less Bean ENR[g] ($/ha)
1991	1,082	$0.73	$111	$676	$0.73	$676	359	1,028
1992	1,082	$0.73	$115	$672	$0.73	$672	393	1,017
1993	1,082	$0.83	$106	$793	$0.83	$793	(158)	993
1994	1,082	$0.91	$110	$869	$0.91	$869	219	1,035
1995	1,082	$0.96	$96	$946	$0.96	$946	428	1,301
1996	1,082	$0.70	$89	$664	$0.70	$664	411	867
1997	1,082	$0.70	$96	$659	$0.70	$659	473	946
1998	1,082	$0.70	$86	$671	$0.70	$671	645	942
1999	1,082	$0.63	$79	$599	$0.63	$599	658	1,006
2000	1,082	$0.57	$79	$541	$0.57	$541	600	869

Table 6.12: Financial and Economic Returns to Maize Production, SJV

Year	Yield[a] (MT/ha)	Real Financial Price[b] ($/kg)	Real Cost of Production[c] ($/ha)	Real Financial Net Return[d] ($/ha)	Real Economic Price[e] ($/kg)	Real Economic Net Return ($/ha)	Maize FNR less Bean FNR[f] ($/ha)	Maize ENR less Bean ENR[g] ($/ha)
1991	2,091	$0.37	$98	$669	$0.37	$669	352	1,021
1992	2,091	$0.35	$87	$656	$0.35	$656	376	1,001
1993	2,091	$0.37	$81	$684	$0.37	$684	(267)	884
1994	2,091	$0.44	$80	$834	$0.44	$834	183	999
1995	2,091	$0.29	$71	$532	$0.29	$532	14	887
1996	2,091	$0.30	$68	$564	$0.30	$564	311	766
1997	2,091	$0.33	$67	$621	$0.33	$621	435	909
1998	2,091	$0.29	$60	$556	$0.29	$556	529	826
1999	2,091	$0.23	$54	$421	$0.23	$421	480	829
2000	2,091	$0.23	$54	$421	$0.23	$421	480	750

[a] Estimate for 1998 from a JICA-funded development project in the SJV.
[b] National season-average farmer price series, SEA Diagnostico, 1998; deflated by CPI from Banco Central.
[c] Net return = (yield * price) - cost of production
[d] Net return = (yield * price) - cost of production
[e] Neither Pigeon Pea or Maize are protected or taxed, thus financial price = economic price.
[f] Pigeon Pea (Maize) financial net return minus bean financial net return.
[g] Pigeon Pea (Maize) economic net return minus bean economic net return.

Given this result, the ensuing benefit-cost analysis computes the incremental benefit of the fallow period for a given year by subtracting the value of the "without fallow" scenario (the aggregate value of net returns to alternative crops) from the value of the "with fallow" scenario (the aggregate value of net returns to bean production) (Table 6.13).

Table 6.13 With- and Without-Fallow Scenarios Assuming Switch to Alternative Crops, 1990-02

Scenario	SJV Cropping Area	SJV Net Returns
With the fallow period	historical bean area	value of bean production: net returns to bean production ($US / ha) multiplied by the bean area
Without the fallow period	historical bean area + 900 ha/year	value of alternative crop production: net returns to alternative crop production ($US / ha) multiplied by the (former bean area + 900 ha)

6.9.2 Intuitive Results

Given from what has already been presented regarding the financial and economic returns to bean and alternative crops, it is possible to intuit the results of benefit-cost analysis of the fallow period. In the "with fallow" scenario, bean is financially more profitable than alternative crops, yet economically less profitable. By contrast, in the "without fallow" scenario, bean (with large yield losses) is less financially profitable than alternative crops. Thus, we conclude that farmers would have switched to alternative crops in this scenario. This means that farmers are expected to be better off in financial terms with the fallow period (US$ 972/ha for bean, compared with US$676/ha for pigeon pea). However, because the alternative crops under economic valuation are more profitable than bean, society is much better off in economic terms without the fallow period, because farmers would have switched to alternative crops which are more renumerative in economic terms (US$ 676/ha for pigeon pea compared with US$ - 346/ha for bean).

Benefit-cost analysis subtracts the value of the "without" scenario from the "with" scenario. Thus, under financial valuation, the fallow period represents a large gain for SJV bean farmers, while under economic valuation, it represents a large loss to society. The reason for this dichotomous result is that since bean is much less profitable in economic valuation than alternatives, and since uncontrolled BGMV would have forced farmers to switch to alternative crops (and take financial losses), thus the fallow period enables farmers to maintain their relatively high returns from bean while preventing society from gaining the benefits of more efficient allocation of resources (namely, if the SJV stopped producing beans, the country would import more beans which are cheaper, thus benefitting consumers greatly).

6.9.3 Aggregate Financial and Economic Benefits of the Fallow Period

To aggregate the financial benefits of the fallow period, the annual net returns per hectare of beans and alternative crops (Tables 6.9 to 6.12) under financial valuation are multiplied by the number of hectares of bean in the SJV, as per the format of Table 6.13. The positive difference between the net returns to bean per hectare and the net returns to alternative crops per hectare in a given year is the benefit to SJV bean farmers of the fallow period, which enabled them to continue to plant bean. The results (Table 6.14) concur with the intuitive result, that the fallow period enabled SJV farmers to avoid switching to less renumerative alternative crops, thus resulting in very large benefits which

Table 6.14: Financial Analysis of the SJV Fallow Period						
		Financial	WITH	Financial	WITHOUT	INC. BENEFI
	SJV Bea	Net Return	SJV value of	Net Returns	SJV value o	WITH -
Year	Area	to Beans*	bean prod	to alt crops*	alt productio	WITHOUT
	(ha)	($/ha)	$	($/ha)	$	$
1991	11,053	$972	$10,746,886	$671	$8,021,798	$2,725,088
1992	7,332	$744	$5,457,024	$661	$5,443,986	$13,038
1993	9,393	$1,930	$18,132,692	$724	$7,447,768	$10,684,924
1994	10;257	$1,476	$15,139,626	$846	$9,443,668	$5,695,958
1995	9,798	$1,277	$12,512,338	$681	$7,288,943	$5,223,394
1996	10,326	$877	$9,058,528	$600	$6,738,898	$2,319,630
1997	6,164	$776	$4,782,048	$635	$4,484,803	$297,245
1998	6,412	$628	$4,029,550	$597	$4,367,386	($337,836
1999	7,634	$565	$4,311,426	$485	$4,139,071	$172,355
2000	7,634	$565	$4,311,426	$464	$3,961,008	$350,418
2001	7,634	$565	$4,313,309	$464	$3,961,008	$352,301
2002	7,634	$565	$4,313,309	$464	$3,961,008	$352,301
	* in the "with fallow" scenario, expected bean yields are assumed to be 1,128					
	** in the "without fallow" scenario, expected bean yields are assumed to be 74					
	alternative crops are pigeon pea (Table 6.12) and maize (Tabl					

accrue to the farmers when comparing the difference between aggregate returns to bean relative to alternative crops.

The same analysis is then completed by aggregating net returns under economic valuation. In this case, the difference between the net returns to bean per hectare and the net returns to alternative crops per hectare are large and negative. Thus, the actual results (Table 6.15) concur with the intuitive result, that the fallow period enabled SJV farmers to continue to grow bean, resulting in large financial gains to bean farmers (as compared with alternative crops) and large economic losses to society (as compared with alternative crops).

	Table 6.15: Economic Analysis of the SJV Fallow Period				
	Economic	WITH	Economic	WITHOUT	INC. BENEFIT
	Net Returns	SJV value of	Net Returns	SJV value of	WITH -
Year	to Beans	bean prod	to alt crops	alt production	WITHOUT
	($/ha)	$	($/ha)	$	$
1991	($27)	($303,620	$671	$8,021,798	($8,325,418
1992	($18)	($131,201	$661	$5,443,986	($5,575,187
1993	$201	$1,890,111	$724	$7,447,768	($5,557,657
1994	$251	$2,578,872	$846	$9,443,668	($6,864,796
1995	($36)	($354,286	$681	$7,288,943	($7,643,229
1996	$193	$1,992,651	$600	$6,738,898	($4,746,247
1997	$63	$387,387	$635	$4,484,803	($4,097,416
1998	$87	$557,171	$597	$4,367,386	($3,810,215
1999	($121)	($921,519	$485	$4,139,071	($5,060,590
2000	($15)	($117,117	$464	$3,961,008	($4,078,125
2001	($15)	($117,117	$464	$3,961,008	($4,078,125
2002	($15)	($117,117	$464	$3,961,008	($4,078,125
* in the "with fallow" scenario, expected bean yields are assumed to be 1,128 k					
** in the "without fallow" scenario, expected bean yields are assumed to be 747					
alternative crops are pigeon pea (Table 6.12) and maize (Table 6.13)					

6.10 Financial and Economic Analysis of PC-50 and the Fallow Period

6.10.1 Combining the Two Technologies in Benefit-Cost Analysis

Whereas the previous benefit-cost analysis has isolated the financial and economic returns to PC-50 and the fallow period as separate technologies, the following analysis focuses on the returns to these two technologies implemented in tandem. Simply looking at the net benefit streams of each technology separately indicates that the fallow returns - both under financial and economic valuation - are larger than those of PC-50. Thus, the fallow period greatly magnified both the financial benefits to irrigated farmers and the economic losses to society.

However, when considering the two technologies together, the analysis must be divided into two parts; one for the SJV and one for the rest of the DR. The following analysis assumes that the scenarios for the rest of the DR remain unchanged by the fallow period[29] from the original with- and without-PC-50 scenario. For the SJV scenarios, this analysis assumes that the incremental benefit of PC-50 adoption is essentially embodied in the constant yield assumed for the fallow period analysis. In other words, we assume that this constant yield would be approximately 15 percent lower over the 1991 to 2002 time period were it not for widespread PC-50 adoption. In the previous PC-50 analysis, we assumed that for adopters, a given percentage of historical yields across the DR was attributable to PC-50. This yield was then multiplied by the adopted area in a given year. Therefore, the following analysis simply combines the fallow result for SJV bean area with the PC-50 result for bean area outside the SJV.

6.10.2 Research Costs of the Fallow Period

This analysis assumes that there were minimal research costs either by the CRSP or by SEA in the development of the idea for the fallow period. The idea of prohibiting the growing of host crops for a specific insect or disease during a period of time is not new. While the CRSP did incur some costs in optimal planting date experiments in 1991 and again in 1993-94, these costs were very small and thus not quantified in this analysis.

6.10.3 Financial Return to PC-50 and the Fallow Period

Given the base scenario assumptions discussed above, the financial rate of return to the development of PC-50 and the SJV fallow period during the period 1984-2002 is

---

[29] This assumes there would be no price effects from the "without fallow" scenario in which SJV farmers shift out of beans (foregone bean production in the SJV would be replaced with cheaper pintos, which would likely lower the financial price of beans across the DR).

87.8 percent. The Net Present Value of this investment over the same time period is $91.4 million. This financial ROR is larger than that for PC-50 alone (73.2 percent), which follows the intuitive prediction above.

6.10.4 Economic Return to PC-50 and the Fallow Period

Given the base scenario assumptions discussed above, the economic rate of return to the development of PC-50 and the SJV fallow period during the period 1984-2002 is not calculable as it is negative. This is because the discounted "net benefits" of the fallow period under economic valuation are negative and much larger in magnitude than the positive benefits from PC-50. The Net Present Value of this investment over the same time period is US$ -47.2 million. Therefore, this *ex-post* analysis concludes that these two technologies analyzed in tandem make the Bean/Cowpea CRSP project an unprofitable investment through 2002 (the economic ROR is negative and uncalculable, and therefore less than the discount rate/opportunity cost of capital of 10 percent).

6.10.5 Paradoxical Result

This result says that PC-50 alone - with the fallow period as a given - yielded positive returns because it made a "poor" situation "less worse." That is, the import protection policy of the DR creates large deadweight losses and results in large transfers from consumers to producers. Taking that situation as a given, a farmer using PC-50 has higher (negative) economic returns than a farmer who does not use PC-50 (and has lower negative economic returns). Thus, PC-50 reduces the cost to society of import protection (the deadweight loss). In this case, the with scenario is an improvement in economic terms over the without scenario.

However, because the without-fallow period scenario would have been an economic improvement over the with-fallow scenario, the enactment of the fallow period meant that society missed an opportunity for net welfare improvement (transfers from producers to consumers, and reductions in deadweight loss). Therefore, this foregone opportunity is counted as a loss to society, and since this effect is larger in magnitude than the gains to society from PC-50 adoption, the overall economic effect is negative.

6.10.6 Distribution of Benefits

Analyzing PC-50 combined with the fallow period simply exacerbates further the benefit distribution of PC-50 – irrigated producers are even better off than they were just from PC-50 adoption, consumers still do not share in the benefits, and society now actually loses because the opportunity for more efficient allocation of resources is foregone.

6.11 Chapter Summary

6.11.1 Aggregate Results

The *ex post* benefit-cost analysis presented in this chapter demonstrates that the development and adoption of PC-50 has resulted in an economic ROR superior to the opportunity cost of capital, as well as an even higher financial ROR. The combination of high adoption rates of PC-50 with a favorable price premium in the market place with respect to the lower-priced imported pintos, helped to make the economic rate of return to CRSP research on PC-50 profitable – notwithstanding that import parity prices of pintos are significantly lower than financial prices of domestic red beans. Thus, the CRSP DR program from 1984-2002 is considered economically profitable on the basis of PC-50 alone. Other activities and achievements of the CRSP, such as development and promotion of improve cultural practices in the SJV, the institutional development of the SJV bean research team, potential spillover effects of DR research to the US, other CRSP countries, and to Haiti, or the existence value of the genetic base compiled by the DR staff are not included in this analysis. However, if the SJV fallow period is considered an output of the CRSP, joint analysis of PC-50 and the fallow period lead to the result that the CRSP research in the DR is not profitable in economic terms.

Benefit-cost analyses are typically undertaken to justify future investments in agricultural research or continued funding of the existing investment under investigation. Aside from performing the necessary benefit-cost analysis, a goal of this study was to demonstrate the role played by the policy environment in shaping the past, present, and future net benefits of technical change, as well as on the distribution of these net benefits.

Import protection is used by the DR because production costs are higher than import costs, but the import protection program has an associated economic cost. As development and adoption of new bean technology reduces production costs, the discrepancy between production costs and import costs falls, thus reducing the economic costs of the import protection program. Therefore, taking the import protection as given, bean research lowers the economic cost of the import protection program and thus has a positive economic impact.

6.11.2 Distributional Results

If the goal of benefit-cost analysis is simply to discern whether an investment is profitable or not, then CRSP bean research in the DR has indeed been successful.

However, the socioeconomic impact of bean research in the DR almost exclusively has been to increase the per hectare returns to irrigated bean farmers in the San Juan Valley. This distributional result is due simply to the realities of the economic environment facing bean farmers, the structure and demographics of the bean production and marketing system, and the CRSP approach towards working within that environment and system.

CHAPTER SEVEN: SUMMARY OF FINDINGS

7.1 Introduction

The general objective of this study is to assess the *ex post* impact of PC-50 and the SJV fallow period. *Ex post* benefit-cost analyses are typically undertaken to justify future investments in agricultural research or continued funding of the existing investment under investigation. In addition to performing this necessary *ex post* analysis, a goal of this study was to demonstrate the role played by the policy environment in shaping the past, present, and future net benefits of technical change, as well as on the distribution of these net benefits. This chapter summarizes the results of the subsector, profitability, and benefit-cost analyses in this study and provides policy recommendations to the CRSP.

7.2 Summary of Findings

7.2.1 Subsector Analysis

Subsector analysis (Chapter 4) demonstrated that the policy environment in the DR from the mid-1980s to the present has been conducive to adoption of new bean technologies for several reasons. First, bean production has remained profitable in the DR due to import protection. Second, SEA's role in multiplying seed and distributing it across the country (combined with a subsidized price) played an important role in technology dissemination. Third, farmer associations in the SJV helped facilitate high adoption rates of varietal and management technologies (*i.e.* the fallow period), and lobbied on behalf of the nation's bean producers to maintain import protection. The first and third reasons were especially important, given that the CRSP technologies were developed specifically for irrigated producers, for most of whom bean is a cash crop.

Thus, in the absence of favorable output prices, the adopters of CRSP technologies would have switched to alternative crops years ago (as has happened in the Cibao Valley, which shifted into tobacco and other export crops).

7.2.2 Profitability Analysis

Profitability analysis in Chapter 5 demonstrated that bean production in the San Juan Valley is profitable under financial valuation but not under economic valuation, considering the costs of local production relative to international prices, thus highlighting the sensitivity of Dominican bean production to maintenance of current import restrictions and input subsidy policies. Although the chapter highlights various opportunities to decrease farm-level production costs, the prospect of lower farmgate bean prices in the future does not bode well for those producers with below average yields and above average costs of production. The long-term competitiveness of domestic bean production in a more open economy is doubtful.

7.2.3 Benefit-Cost Analysis of PC-50

Benefit-cost analysis (Chapter 6) demonstrated that the development and adoption of the new bean variety PC-50 was a profitable investment for the CRSP during the 1984-2002 period under economic valuation. Although import parity prices of pintos are significantly lower than financial prices of domestic red beans, high adoption rates generated a benefit stream large enough to more than cover investment costs. These high adoption rates are principally the result of relatively high farm-level prices due to import protection, as well as ample seed distribution via subsidized government-managed seed multiplication and distribution. Although bean is uneconomic in the SJV (Chapter 5), PC-

50 adoption decreased the magnitude of economic loss that would have occurred without PC-50, thus generating a positive incremental benefit.

This seemingly paradoxical result can be explained in more general terms. Import protection is used by the DR because domestic production costs are higher than import costs, but the import protection program has an associated economic cost. As development and adoption of new bean technology reduces production costs, the discrepancy between production costs and import costs falls, thus reducing the economic costs of the import protection program. Therefore, taking the import protection regime as given, bean research lowers the economic cost of the import protection program and thus has a positive economic impact.

7.2.4 Benefit-Cost Analysis of PC-50 and the Fallow Period

When the SJV fallow period is considered an output of the CRSP, joint analysis of PC-50 and the fallow period lead to the result that the CRSP research in the DR is not profitable in economic terms. In sum, the CRSP has generated technologies in the SJV which have been widely adopted and have greatly enhanced the financial returns to irrigated producers. However, regardless of this success in scientific terms, because the CRSP is working with an uneconomic crop, the economic return to the successful generation and adoption of CRSP technologies in the SJV is negative. Continued import protection means that SJV farmers are able to maintain high financial returns at the expense of welfare gains for consumers in the form of lower priced imported beans.

7.2.5 Distribution of Benefits from Technological Change

If the goal of a benefit-cost analysis is simply to discern whether an investment is profitable or not, then CRSP bean research in the DR has indeed been successful. However, deciding that any given profitable project is the best use of scarce resources for investment in agricultural research is akin to claiming that since the Dominican economy has been growing at 7 percent a year since the mid-1990's that most poor Dominicans must be better off. That is to say that the socioeconomic performance of the investment should be compared with the stated socioeconomic goals prescribed by the CRSP to see whether or not the project impact meets those stated ends. The socioeconomic impact of bean research in the DR has primarily been to increase the per hectare returns to irrigated bean farmers. Consumers have received little benefits from the investment in PC-50, and the SJV fallow period left consumers and society worse off. This is due simply to the realities of the economic environment facing bean farmers, the structure and demographics of the bean production and marketing system, and the CRSP approach towards working within that environment and system.

7.3 Prospects for Future Economic Impact of the CRSP in the DR

7.3.1 General Outlook

CRSP research has successfully developed improved varieties and disease prevention practices since 1984. However, past and existing government policies towards beans have created a situation in which production and marketing risk has increased, resulting in declining area planted and hence decreased regional and national production. Future domestic bean production (and future CRSP impact) hinges primarily on the nature of future government activities in bean purchasing and marketing, the government's policies regarding import levels and import administration, and consumer preferences for domestic beans with respect to imported pintos. For example, if SEA continues to scale back INESPRE's bean purchases in the San Juan Valley, the decline SJV bean area since the mid-1990s will continue. Second, if imports are allowed to remain at 1997 to 1999 levels, there will not be a resurgence of bean area in the near future because retail, wholesale, and farmgate bean prices will continue to fall. Third, if import licences are administered by true public auction, wholesale pinto prices in Santo Domingo will fall 10 to 30 percent, and domestic red retail prices will subsequently fall. Finally, if consumer preferences change such that pintos are seen as near perfect substitutes (or preferred) to domestic red beans, this will put further downward pressure on domestic bean retail prices.

These likely events all point toward continued decline in irrigated bean area both within the SJV – the primary focus of CRSP research – and across the country. In fact, national irrigated bean area has decreased 50 percent since 1989, and 35 percent since the mid-1990s. In 1998, national irrigated bean area totaled 29,000 ha. Declining irrigated bean area means lower prospects for future economic impact of the CRSP in the DR.

7.3.2 Research for Rainfed Producers

The CRSP could significantly increase its potential future impact in the DR by focusing at least some of its resources on technologies that could benefit rainfed producers. The project argues that they are prohibited by Dominican law from promoting bean production in *zonas laderas* (steep-sloping zones). In June of 1990, the Dominican legislature passed a regulation prohibiting SEA from distributing seeds and other inputs to producers in zones with higher than 30% slope. The rationale was based on the fact that bean production on lands with greater than 30% slope produced low yields and was environmentally destructive. The resulting soil erosion was filling up the country's dams at an alarming rate, threatening bean and other production in the irrigated valleys (Heikes, 1995; SEA Breve, 1990).

However, there are two reasons why it is not clear why this should prevent the CRSP from promoting technologies for rainfed farmers[1]. First, according to the nationwide 1993 CRSP Producer survey, approximately 75 percent of rainfed producers (42 percent of the total sample) had sloped land, and 25 percent had steep-sloped land. Thus it is far from clear that all rainfed producers farm on steep-slopes. Second, the SEA law says, in fact, that the government may not work with steep-sloped bean producers *unless* it involves development and extension of soil conservation technologies (SEA Breve, 1990). In Honduras, both CIAT and the CRSP are carrying out research to develop and extend new varieties and management practices (including the use of vegetative strips to alleviate soil erosion) appropriate to the needs of limited-resource hillside farmers.

7.3.3 Extension of Technologies

It seems clear from both the successes and limitations of the DR project that the CRSP can no longer afford to ignore the critical issue of technology extension. The

---

1

It should be noted that the author did not specifically research this possibility in the field. This is an area that would require further investigation.

success of the DR project in meeting many of its stated goals is to some extent due to proactive measures by project personnel to use farmer associations as vehicles for technology dissemination. However, a serious limitation of the DR project is that first, its impact to date has been diluted by its sole focus on the SJV, and second, that its future impact will increasingly depend upon its ability to develop and extend technologies to farmers outside of the San Juan Valley, given declining irrigated bean area in general (most of which is in the SJV).

Unfortunately, the typical USAID response to this situation is to ask the CRSP to simply do more with the same (or less) funding. Given that USAID will not likely increase funding to the CRSP in the near future, a more realistic approach would be for the DR CRSP to reallocate resources toward activities that will facilitate the development and dissemination of CRSP-developed technologies to rainfed bean producers. For example, given situations common across the CRSP, in which the national public extension system is non-existent or behaves as such, CRSP funds designated to train NGO staff – organizations that work directly with small rainfed farmers – could perhaps further extend at least some of the CRSP technologies (those appropriate for the conditions of the small rainfed producers) far beyond the time, logistical, and knowledge constraints of the CRSP personnel themselves.

7.4 Limitations of This Study

The principal limitation of this study is its insufficient focus on bean production outside of the San Juan valley. In addition, the study lacks sufficient *ex ante* focus intended to guide the CRSP in a direction that would increase future impact. The irony of this study is that the *ex post* result confirms the worth of the investment to date in the DR project, yet present economic realities show that the project will not likely continue the same success given its current strategy. Another limitation is that other notable activities and achievements of the CRSP, such as development and promotion of improved cultural practices in the SJV, the institutional development of the SJV bean research team, potential spillover effects of DR research to the US, other CRSP countries, and to Haiti, or the existence value of the genetic base compiled by the DR staff are not included in this analysis. However, while these achievements could potentially improve the project's economic return, without refocusing the strategy of working exclusively with and for irrigated producers in the SJV, only large spillover effects in other countries (Haiti) would enable the CRSP to claim that the DR project was improving welfare of poor producers or consumers.

7.5 Recommended Socioeconomic Research

First, *ex ante* benefit-cost analysis using various area and yield projections would help demonstrate more clearly why the project needs to extend its focus beyond the San Juan Valley. Second, future research needs to focus on institutional and other constraints to increasing the project's ties with NGOs and government officials outside of the SJV that are necessary to expand the project's potential for future impact. Specifically, rapid appraisal outside of the SJV is necessary to determine the potential for the development of CRSP technologies in areas beyond the SJV.

APPENDIX A: Validity of the Sample Frame

The validity of the sample frame, assumed to consist entirely of 1,001 farmers from the lists of the 17 farmer associations in the SJV, is an important concern due to the bias that association of a farmer could represent for resulting "population" statistics. There are several reasons to believe that 95 percent or more of the SJV bean farmer population is included within the farmer association membership lists (all of which were obtained before sampling was initiated). First, several key informants, who work in various valley-wide projects, attest to this figure. Second, the mean farm size of the weighted sample (130.78 ta) multiplied by the 1001 farmers listed yields 130,910 ta, which is quite close the 139,000 ta of irrigated beans planted in the southwest region during the winter 1997-98 bean season (Sterling, 1998). Third, the economic power that association members enjoy is clear: unequaled access to government subsidized seed, credit, seed storage, and, most importantly, government purchases of beans by INESPRE at a negotiated (high) price. Lastly, the group Productores Independientes (Independent Producers) formed several years ago so that formerly non-associated bean farmers could band together to receive what amounted to free seed from the government (at that time), which was only distributing this valuable input via associations. In addition, at this time, INESPRE was beginning to purchase beans primarily through associations, meaning that individuals vying to sell their beans at the high INESPRE prices would have to store their beans for months while association members went first. Productores Independientes is the largest and most geographically diverse farmer association in the SJV, which is representative of the fact that it incorporates members from across the valley who were in most cases not associated previously.

APPENDIX B: Percentage of Regional Bean Area by Technology Level

	% of bean area by technology level and by reg							
Technolog	*Central*	*East*	*N.Centr*	*N.East*	*N.West*	*North*	*South*	*S.West*
High	5%	20	30	10	10	10	0%	40
Medium	25	0%	20	40	10	10	20	10
Low	70	80	50	50	80	80	80	50
Total	100	100	100	100	100	100	100	100
		% area harvested 1988-92: 45% irrigated/ 55% rain						

	% of bean area by technology level and by re							
Technol	*Central*	*East*	*N.Centr*	*N.East*	*N.West*	*North*	*South*	*S.West*
High	5%	20	30	10	10	10	0%	40
Medium	25	0	20	40	10	10	20	10
Low	70	80	50	50	80	80	80	50
	100	100	100	100	100	100	100	100
		% area harvested 1993-2004: 45% irrigated/ 55% r						

APPENDIX C: SEA Seed Sales

SEA Seed: Distribution of Sales				(100 cwt)					
Year	*Central*	*East*	*N.Central*	*N.West*	*N.East*	*North*	*South*	*S.West*	Total
1990	3,483	2,370	4,299	700	1,917	1,536	9,728	21,369	45,402
1991	4,376	2,977	5,400	880	2,408	1,929	12,220	26,844	57,034
1992	5,444	3,704	6,719	1,095	2,996	2,400	15,203	33,397	70,957
1993	1,725	2,600	5,562	500	2,300	2,720	3,500	22,917	41,824
1994	12,743	4,100	2,200	2,547	5,056	2,049	10,700	25,693	65,088
1995	450	800	2,750	100	140	600	6,300	1,686	12,826
1996	1,430	1,200	508	150	645	450	4,310	29,265	37,958
1997	1,322	750	1,412	256	905	250	3,912	9,100	17,907
1990-92 totals from SEA Diagnostico; 1993-97 data by region is from SEA Seed Dept Annual Reports									
1990-92 regional distribution estimated from 1993 distribution percentage by regio									
Potential PC-50 area by region @239 lb/ha (15 lb/ta) plus 10% SEA and farmer storage									
Year	*Central*	*East*	*N.Central*	*N.West*	*N.East*	*North*	*South*	*S.West*	Total
1990	1,312	893	1,619	264	722	578	3,663	8,047	17,097
1991	1,648	1,121	2,034	331	907	726	4,602	10,108	21,477
1992	2,050	1,395	2,530	412	1,128	904	5,725	12,576	26,720
1993	650	979	2,094	188	866	1,024	1,318	8,630	15,750
1994	4,799	1,544	828	959	1,904	772	4,029	9,675	24,510
1995	169	301	1,036	38	53	226	2,372	635	4,830
1996	538	452	191	56	243	169	1,623	11,020	14,294
1997	498	282	532	96	341	94	1,473	3,427	6,743
DR Red Bean Area Planted by Region (ha)									
Year	*Central*	*East*	*N.Central*	*N.West*	*N.East*	*North*	*South*	*S.West*	Total
1990	3,844	2,818	4,231	332	3,764	3,992	7,363	13,436	39,780
1991	2,516	2,908	2,839	539	1,953	4,164	6,980	14,780	36,677
1992	2,554	2,756	4,759	153	1,755	2,441	6,855	14,897	36,171
1993	1,661	3,166	5,074	350	2,385	3,311	4,736	25,929	46,614
1994	1,625	3,264	5,238	377	1,391	2,590	3,189	19,700	37,374
1995	1,534	4,856	4,676	376	2,033	1,844	7,875	20,795	43,991
1996	1,620	2,230	4,400	160	1,866	1,341	5,047	20,442	37,105
1997	2,584	4,212	3,736	247	1,190	1,471	4,021	14,946	32,406
Percentage (%) of planted area attributed to SEA direct seed sales									
Year	*Central*	*East*	*N.Central*	*N.West*	*N.East*	*North*	*South*	*S.West*	Total
1990	34	32	38	79	19	14	50	60	43
1991	66	39	72	62	46	17	66	68	59
1992	80	51	53	269	64	37	84	84	74
1993	39	31	41	54	36	31	28	33	34
1994	295	47	16	254	137	30	126	49	66
1995	11	6	22	10	3%	12	30	3	11
1996	33	20	4	35	13	13	32	54	39
1997	19	7	14	39	29	6%	37	23	21

Source: SEA Departamento de Semilla, Memorias

Although there are several cases in the final section of the table above which indicate inconsistent data (regional percentages of area planted to PC-50 greater than 100 percent), it is clear that if this data has any reliability, then PC-50 was in fact distributed widely across the country and across considerable bean area.

REFERENCES

Alston, Julian, George Norton, and Philip Pardy, *Science Under Scarcity: Principles and Practices for Agricultural Research and Priority Setting*, Cornell University Press, Ithaca, NY, 1995.

Arnaud Santana, Eladio, Juan Cedano, and Rodys Colon, "Pulso Productivo del Cultivo de Habichuelas en el Valle de San Juan, 1993-94," Proyecto Titulo XII Habichuela/Cowpea, May 1994.

Arnaud Santana, Eladio, Juan Cedano, Rodys Colon, and Segundo Nova, "Pulso Productivo del Cultivo de Habichuelas en el Valle de San Juan, 1995-96," Proyecto Titulo XII Habichuela/Cowpea, May 1996.

Arnaud Santana, Eladio, Segundo Nova, and Rodys Colon, "Pulso Productivo del Cultivo de Habichuelas en el Valle de San Juan, 1996-97," Proyecto Titulo XII Habichuela/Cowpea, July 1997.

Arnaud Santana, Eladio, *CRSP/DR Annual Report 1997,* San Juan de la Maguana, Dominican Republic, 1997.

Banco Central de la Republica Dominicana, Informe de la Economia Dominicana, 1997.

Byerelee, Derek, and Steven Franzel, "Institutionalizing the Role of Economists in National Agricultural Research Institutes," CIMMYT Economics Working Paper 93-01, Mexico, D.F.: CIMMYT, 1993.

Capalbo, S.M. and J.M. Antle, Incorporating social costs in the Returns to Agricultural Research, *American Journal of Agricultural Economics* 70 (2):281-288.

CRSP/SEA, PC-50 release brochure (reprint), 1997.

CRSP/SEA, JB-178 release brochure, 1997.

CRSP Record-Keeping (RK) Survey in the San Juan Valley, November 1997 - February 1998, directed by the Bean/Cowpea CRSP Dominican project Principal Investigator, Dr. Eladio Arnaud-Santana, in consultation with Dr. Rick Bernsten, Bean/Cowpea CRSP Economist.

CRSP Producer Survey in the San Juan Valley, July-August 1998, directed by David Mather (graduate research assistant and MSc/PhD candidate in the department of Agricultural Economics, Michigan State University), under the direction of Bean/Cowpea CRSP Economist Dr. Rick Bernsten; in consultation with the CRSP Principal Investigator for the DR, Dr. Eladio Arnaud Santana.

Daniels, L., James F. Oehmke, J. Howard, M. Maredia, and R. Bernsten, *The Impact of Agricultural Research: A Review of the Ex-Post Assessment Literature with Implications for Africa,* Department of Agricultural Economics Staff Paper No. 92-38, Michigan State University, East Lansing, MI, 1992.

Diaz, Vianela, and Ramon Almanzar, "Resultado de la Encuesta Aplicada a los Productores de Habichuela de la Variedad PC-50," Spectra Consultores, S.A., 1990.

Echeverria, Ruben, ed., *Methods for Diagnosing Research System Constraints and Assessing the Impact of Agricultural Research: Volume II Assessing the Impact of Agricultural Research*, Proceedings of the ISNAR/Rutgers Agricultural Technology Management Workshop, 6-8 July 1988, Rutgers University, New Jersey, USA. International Service for National Agricultural Research, The Hague, 1990, pp. 1-35.

The Economist, *Country Profile: The Dominican Republic*. The Economist Intelligence Unit, London, UK, 1997.

FAOSTAT (website), Food and Agriculture Organization of the United Nations (FAO), 1999.

Feder, G., R.E. Just, and D.Zilberman, "Adoption of Agricultural Innovations in Developing Countries: A Survey," Economic Development and Cultural Change, 33:2, 1985, pp. 255-98.

Foreign Agricultural Service (FAS), *Agricultural Situation - Dominican Republic,* Agricultural Attache Annual Report., Santo Domingo, Dominican Republic, 1997.

Gittinger, J. Price, *Economic Analysis of Agricultural Projects*, The World Bank, Johns Hopkins University Press, Washington, D.C. 1982.

Griliches, Zvi, "Hybrid Corn: An Exploration in the Economics of Technological Change," *Econometrica*, 25:4, October, 1957, pp. 501-522.

Guerrero, Ing. Ramon A., "PC-50: Nueva Variedad de Habichuela Roja," (Release Brochure), CRSP Proyecto Titulo XII/Secretaria de Estado de Agricultura, Republica Dominicana, 1987.

Heikes, Gregory A, *The Adoption of Agricultural Technology: The Case of Beans in the Dominican Republic,* (unpublished/unfinished M.Sc. thesis, MSU Ag Economics) Michigan State University, E. Lansing, MI, 1995.

Hirschman, Albert O., *Exit, Voice, and Loyalty*, Harvard, 1970.

Holtzman, J.S. "Rapid Reconnaissance Guidelines for Agricultural Marketing and Food System Research in Developing Countries," Michigan State University International Development Papers, Working Paper No.30, Department of Agricultural Economics, Michigan State University, East Lansing, MI, 1986.

InterAmerican Development Bank (IDB website), Economic Statistics Database, 1998.

JICA, Study on the Integrated Rural Development Project of the Yaque del Sur River Basin in the Dominican Republic, June 1998.

Lancaster, Kelvin, *Consumer Demand: A New Approach,* New York: Columbia University Press, 1971.

Libre, Frank, Vice-President, Citibank, Santo Domingo, Discussion in August 1998.

Lindner, R.K., and F.G. Jarrett, "Supply Shifts and the Size of Research Benefits," American Journal of Agricultural Economics, February 1978.

Masters, William, with Anne Williams and Mamadou Sidibe, "The Economic Impact of Agricultural Research: A Practical Guide," Department of Agricultural Economics, Purdue University, West Lafayette, IN, February 1996.

Mather, David, preliminary results of rapid appraisal and a pilot consumer survey of bean purchases and desired attributes, Santo Domingo and the San Juan Valley, July-August 1999.

Mather, David, "Bean Supply Response in the DR", term paper for *EC 823: Applied Econometrics*, Dr. Wooldridge, Fall 1999.

Mellor, John, *The Economics of Agricultural Development* (Ithaca:Cornell University Press, 1966).

Norton, G. and J. Davis, Evaluating Returns to Agricultural Research: A Review, *American Journal of Agricultural Economics* 63 (4): 685-699.

Nuñez, Ruben, IICA Economist, informal conversation in Santo Domingo, July, 1999.

Nuñez, Ruben, "Estudio Sobre la Comercializacion del Arroz en la Republica Dominicana," IICA/USAID/SEA, August, 1998.

Nuñez, Ruben, "Estudio Sobre el Mercado de Leguminosas en La Republica Dominicana," IICA/USAID/SEA, July, 1999.

Oehmke, James F., "The Calculation of Returns to Research in Distorted Markets," *Agricultural Economics*, vol. 2, 1988, pp. 291-302.

Rogers, Beatrice. 1987. "Resultados Preliminares del Estudio de los Efectos de Ingreso y Precios Sobre el Consumo de Alimentos en la R.D."

Schmid, A.A., *Property, Power and Public Choice: An Inquirty into Law and Economics*, Praeger Publishers, New York, NY, 1987.

Schmitz, A. and G. Seckler, "Mechanical Agriculture and Social Welfare: The Case of the Tomato Harvester," *American Journal of Agricultural Economics*, 52:4, November 1970, pp. 569-578.

Schuh, G.E. and Helio Tollini, "Costs and Benefits of Agricultural Research: The State of the Arts," World Bank Staff Working Paper No. 360, October 1979. IBRD.

Scobie, G. M. and T.R. Posada, "The impact of technical change on income distribution: The case of Rice in Colombia," *American Journal of Agricultural Economics* 60: 85-92.

SEA Breve, 1990.

SEA, Secretaria de Estado de Agricultura, Departamento de Economia Agropecuaria, *Diagnostico del Sector Agropecuario* 1997, May 1998.

SEA, Secretaria de Estado de Agricultura, Departamento de Economia Agropecuaria, *Estadisticas del Sector Agropecuario* 1998, May 1999.

SEA, Secretaria de Estado de Agricultura, Departamento de Economia Agropecuaria, *Costos Estimados de Produccion de Cultivos Temporeros y Permanentes*, 1997, January 1998.

SEA, Departamento de Semillas, San Cristobal, Memorias Anuales, 1993-98, and an interview with the director.

INESPRE, Instituto de Estabilizacion de Precios, Santo Domingo, Memorias Anuales, 1983-1998.

Scobie, Grant and Rafael Posada, "The Impact of Technical Change on Income Distribution," *Agricultural Development in the Third World*, ed. Carl Eicher and John Staatz, Johns Hopkins University Press, pp. 400-415, 1990.

Shaffer, James D., "On the Concept of Sub-Sector Studies," *American Journal of Agricultural Economics* 55: 333-335, 1973.

Sterling Diaz, Noe, Economist, Secretaria de Estado de Agricultura, Departamento de Economia Agropecuaria, discussions in August, 1998.

UEPA, Unidad de Estudios de Precios Agropecuarios, Proyecto Analysis de Politica Agropecuaria, "Analysis de Precios de la Habichuela Roja: Estacionalidad y Tendencia," Santo Domingo, 1991.

Valdes, Alberto and Barry Schaeffer, in collaboration with Jesus de los Santos, "Surveillance of Agricultural Prices and Trade: A Handbook for the Dominican Republic," World Bank Technical Paper No. 267, August 1995, IBRD.

Williamson, Oliver, *The Economic Institutions of Capitalism*, Free Press, 1985.

World Bank, Country Assistance Strategy for the Dominican Republic, April 1995.

World Bank, *World Development Indicators 1997*, 1997.