NONTRADITIONAL EXPORT CROPS IN GUATEMALA: EFFECTS ON PRODUCTION, INCOME, AND NUTRITION

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Research Report 73
International Food Policy Research Institute
in collaboration with the
Institute of Nutrition of Central America and Panama
May 1989

Library of Congress Cataloging in Publication Data

Von Braun, Joachim, 1950-
Nontraditional export crops in Guatemala: effects on production, income, and nutrition / by Joachim von Braun, David Hotchkiss, Maarten Immink.
p. cm. — (Research report / International Food Policy Research Institute ; 73)
"In collaboration with the Institute of Nutrition of Central America and Panama."
Bibliography: pp. 97-99.
ISBN 0-89629-075-1
1. Vegetable trade—Guatemala. 2. Exports—Guatemala. 3. Farms, Small—Guatemala. 4. Food supply—Guatemala. 5. Agricultural laborers—Guatemala. 6. Household surveys—Guatemala. I. Hotchkiss, David, 1959- . II. Immink, Maarten D. C. (Maarten Dirk Cornelis) III. International Food Policy Research Institute. IV. Institute of Nutrition of Central America and Panama. V. Title. VI. Series: Research report (International Food Policy Research Institute) ; 73.

HD9225.G92V66 1989 89-7412
338.1'75'097281—dc20 CIP

CONTENTS

TABLES

ILLUSTRATIONS

FOREWORD

Modernization of traditional agriculture entails increased participation of the smallholder sector in the exchange economy. The achievement of this participation requires an open trade regime, domestic policies that ensure against market failures, and public policy that effectively permits use of new production technology for sustained growth. To open up these opportunities to small farmers, investment in rural infrastructure is essential, as is investment in education that will enable these farmers to participate as entrepreneurs in the growth process. In order to reach out to the landless and land-scarce households, the growth process must stimulate employment and increased returns to land. Nontraditional vegetables for export have a high labor content and therefore promise to help foster rural modernization.

In this study of nontraditional export crops and traditional smallholder agriculture in Guatemala, Joachim von Braun, David Hotchkiss, and Maarten Immink highlight the potentials and risks of export orientation in smallholder agriculture for food security. The policy implications of the report reach far beyond the study area in Central America. The multidisciplinary team of IFPRI and the Institute of Nutrition of Central America and Panama (INCAP) has gone far toward tracing the critical linkages between economic development and nutritional improvement. Two lessons of the study are of critical importance for policy. First, growth in staple food production, stimulated jointly with diversification into nontraditional crops, is necessary to actually capture the gains from specialization in typically risky market environments. Second, joint operation and development of the health and sanitation infrastructure in rural areas is required in order to translate the growth effects into nutritional welfare effects for the poor.

This study, which is a component of IFPRI's ongoing research effort in the field of commercialization of agriculture for food security and poverty alleviation, provides evidence that the income and employment effects of cash cropping can be considerable and, if accompanied by appropriate public policy, can make a major contribution to eliminating hunger and malnutrition.

John W. Mellor

Washington, D.C.
May 1989

IN MEMORIAM—VICTOR VALVERDE

This research project was jointly designed and its first phase jointly directed with Victor Valverde of INCAP, whose unexpected death in June 1986 came as a shock to his friends and colleagues. This project is one of many research activities stimulated by Victor to improve the understanding of poor people's living conditions and especially of their nutritional situation.

ACKNOWLEDGMENTS

This research project is based on complex sample surveys whose successful execution was made possible by the patient respondents in six Guatemalan villages and careful enumerators under the experienced supervision of INCAP. Mireya Palmieri was instrumental in the design and execution of the survey work. Local support of the research by the Cuatro Pinos cooperative, and in particular by its executive manager, Tulio García, was essential for appropriate implementation of the research and interpretation of results.

Earlier drafts have been constructively reviewed by Nancy Pielemeyer, Judith McGuire, Allen Rosenfeld, Shubh Kumar, Rafael Celis, Shlomo Reutlinger, Per Pinstrup-Andersen, Eileen Kennedy, Harold Alderman, and Graciela Wiegand, as well as anonymous reviewers. Research assistance at INCAP was provided by Jorge Alarcón. We are grateful for the funding of the research by the U.S. Agency for International Development under Grant No. OTR-0096-6-55-4355-00.

1

SUMMARY

Increasing foreign exchange problems and deteriorating prices of traditional export commodities are leading agricultural policymakers to seek diversification in export crop production. Export vegetables, which are nontraditional crops, appear to be a promising option because of their high labor intensity and expanding demand in industrialized countries. This study deals with a case of export vegetable production and its effects on food production, employment, consumption, and nutrition in Guatemala.

Guatemala's agriculture has shifted away from food production to agroindustrial crops. Food crops covered 58 percent of the country's crop area in 1950 compared with 37 percent in 1979. Small farms decreased their basic food crop area from 97 percent to 87 percent in this period.

The focus of this study is the recent introduction of labor-intensive production of vegetables for export in the traditional small-farm sector in the Western Highlands—an area well known for its problems of poverty and malnutrition. Besides considerable research on the "cash cropping-nutrition" issue, the study provides both cross-sectional and longitudinal analyses of effects. The research is based upon two detailed rural household surveys (400 families) that were undertaken in 1983 and 1985. The sample is divided into two groups of households—those who produce the new export vegetables (snow peas, broccoli, cauliflower, and parsley) under a cooperative scheme and those who do not. Differences in duration of participation (one to seven years) in the export crop scheme—the Cuatro Pinos cooperative—characterize the subsample of the export crop growers.

The new export vegetables were rapidly adopted by the smallest farmers (average 0.7 hectare). The model analysis in the study shows that in the early phase of adoption, small farmers with somewhat larger holdings (1-2 hectares) and households that had no reasonably well secured off-farm income source showed a significantly higher probability of adoption. Access to good roads and infrastructure also increased adoption rates.

The new vegetables have certain risks for the small farmers due to possible crop failures, price collapses on the export market, or a breakdown of the marketing institutions. Relative production variability of the new crops is not higher than in the traditional crops, but because the new crops are much more input-intensive the potential loss relative to household income is higher than for the traditional crops. The price variability of the new crops—especially of snow peas, the most important one of them—is extreme. In 1985, prices fluctuated between 0.10 and 2.00 quetzals per pound, but farmers can partially cope with this variability by spreading the growing seasons and having a long harvest period (12 weeks). Recently, in addition to a multinational company and the cooperative, other traders have handled the export channel. Also, local processing and freezing of fresh produce have been initiated. These developments reduce the risk of a sudden collapse of the marketing channel.

Nontraditional export crops are substantially more profitable to farmers than traditional crops. Net returns (gross margins) per unit of land of snow peas are on average 15 times those of maize—the most important traditional crop. Returns of the new crops per unit of family labor were about twice as high as for maize and 60 percent higher than for traditional vegetables produced for local markets in 1985. The input costs per hectare for snow peas, however, are on average about 4 times higher than

for traditional vegetables and 13 times higher than for maize. Short-term financing of inputs poses a problem to small farmers and indicates the importance of rural credit.

Farm households outside the cooperative grow traditional subsistence crops (maize and beans) on 78 percent of their land, whereas participants in the scheme grow those crops on 52 percent of their land. The smallest cooperative farms allocate the highest shares of land to the new export crops.

Nevertheless, most export crop producers tend to have higher amounts of maize available (per capita) for consumption from own produce than other farmers of the same farm size, because cooperative members' maize and bean yields are 30 percent higher on average than nonmembers' yields. A combination of factors is responsible for this increase in yields; fertilizer inputs are increased and cropping practices are more labor-intensive (more weeding labor). Farmers with the most school education were found to have even higher yields at given input levels.

Analysis with the help of a consistent farm household model based on the survey data shows that with new export crops the shadow cost of maize produced for own consumption increased drastically. The difference between the shadow cost and the actual market price (0.29 quetzal in 1985) may be interpreted as an "insurance premium" that farmers are willing to pay for the degree of self-sufficiency they actually maintain.

Nontraditional export crops created local employment directly on farms and indirectly through forward and backward linkages and multiplier effects resulting from increased income spent locally. Combining farm-level employment with the roughly estimated employment created through the input supply and output marketing yields an overall 21 percent increase in agricultural employment in the six communities where the cooperative functions. Labor input in agriculture increased by 45 percent on the farms producing export vegetables. About half of this increase is due to family labor and half to hired labor. A substantial share of the incremental increase in family labor is from women and children. As a consequence of increased on-farm employment, off-farm work and interregional migration of members of export vegetable producers' households are found to be reduced.

The export crop production scheme led to increased income in the participants' households. This increase between the two surveys (1983-1985) was most pronounced in the group of new adopters, in which expenditures—used as an income proxy—increased by 33 percent. The income gains were highest among the adopters on the smallest farms, thus the new export crops had a favorable effect of moving the poorest upward on the income scale.

At same-income levels, export crop-producing farm households spend less of their additional income on food than traditional-crop households. While nonmembers in the lowest quartile on the income scale spend 61 percent of additional income on food, cooperative members in the same income class spend 53 percent. Additional income increases calorie acquisition significantly but at decreasing rates at the margin. Member households in the lowest half of the income scale increase their calorie consumption by 2.8 percent with a 10 percent increase in income, while nonmember households increase theirs by 4.4 percent.

The production- and income-related analysis concluded with favorable effects of the nontraditional crops for food crop productivity, employment, income growth, and income distribution. The expenditure and food consumption analysis found that incremental income earned from the nontraditional crops tends—at same-income levels—to be spent relatively less on food than other income; this is also reflected, although to a lesser extent, in calorie availability. Thus, food expenditures and consumption increased relatively less than expected. Improvement in the nutritional status of children,

most significantly in decreased wasting, is associated with increased income and food consumption in export crop-producing households. The nutritional benefits of economic growth, as shown in this study, are substantial but can be further enhanced by appropriate health- and nutrition-oriented social infrastructure. The effects of health programs conducted by the export crop cooperative in participating communities support this conclusion.

Especially in the late 1970s and early 1980s, steps to alleviate poverty and improve living conditions in Guatemala were constrained by the economic and political environment. The case study shows, however, that with appropriate access to resources and markets and effective assistance in institution-building at the community level, the poor in the Western Highlands can substantially improve their income and welfare.

2

THE RESEARCH ISSUES AND APPROACH

Commercialization of Traditional Agriculture

An increasing number of low-income countries are facing crucial strategic decisions on how to cope with short- and long-run food security problems. At the core of these strategic decisions is the appropriate choice of policies to promote production of export crops, cash crops for the domestic market (food and nonfood), and subsistence food crops.

Many developing countries are encouraging the increased production of export crops as a way to generate foreign-exchange earnings and fiscal revenues, to increase the income of small landholders, and to provide employment for the rural poor. However, critics of policies that advocate cash crop production argue that the potential benefits have never materialized and, more important, that in areas where cash crop production has increased, food consumption and the nutritional status of the poorest households have deteriorated. A comprehensive review of the existing literature and earlier research on the issue shows mixed results (Braun and Kennedy 1986). This is not surprising, given the great variety of cash crops and production conditions in general.

In developing countries, increased market integration of semisubsistence agriculture appears unavoidable. Rapid urbanization, growth of the rural nonagricultural sector, and technological change in agricultural production are the major driving forces of this commercialization process. Urbanization without increased rural-urban market integration would lead to volatile dualistic structures and import dependence.

On the basis of existing research, it is evident that critical relationships that determine food consumption and nutrition are affected by increased commercialization. These effects may be positive or negative. At the macroeconomic level, an issue of concern is whether foreign exchange generated through export cropping is actually used for imports of goods and services that improve the food consumption and nutritional situation of the poor. Foreign-exchange regulations and taxation of export crops, along with import controls by governments, may lead to distortions that prevent the poor, including small farmers in the export sector and other rural households, from having access to the direct and indirect benefits of the specialization.

This study concentrates mainly on the household-level effects of cash cropping in rural areas. At this micro level the outcome depends on changes in real income, income distribution, income composition, and income control (by men or women). How do these factors translate into household food consumption? What are the effects on time allocation (especially for mothers), and on health and sanitary factors? At this point, no clear ranking of factors is possible on the basis of existing research. A number of studies show, however, that the positive effect of increased cash income on calorie consumption may be quite small, even among the poor.[1] This may be a result of changes in income composition and income control within the household.

A crucial question for policy and program design is whether potential adverse effects of increased cash cropping on nutrition are actually observed and, if so, whether they are of a short- or long-term nature. This is not to say that short-term effects for one to

[1] See the review in von Braun and Kennedy 1986, 55-59.

two years should not be an issue of concern. But appropriate and efficient policy measures to balance potential adverse effects are dependent on the time frame of the problem. Whereas short-term problems may be dealt with mainly by adjustments in the timing of project implementation and a combination of measures such as temporary income support, price subsidies, and nutrition education, long-term adverse effects require very different policy instruments that have the potential to improve and stabilize living conditions for the losers in the commercialization process. Employment generation in rural areas would be a major element of these policies.

The uneasiness about the above-mentioned critical relationships between agricultural production and nutrition in the commercialization process suggested a series of detailed studies that are being executed at IFPRI in collaboration with other institutions.

Theoretical Approach and Concept

This study on the commercialization of smallholder agriculture in Guatemala looks into the introduction of nontraditional vegetables for export. It was clear at the outset that this change had substantial effects on agricultural production and employment in the study area. The order of magnitude of these effects and the effects on income, consumption, and nutrition, however, were not clear at all. The precise concern was that expansion of a crop for export in an area with a well-known nutrition problem might have adverse effects on the availability and security of food and might further aggravate the nutrition problem. If the export crop scheme increased employment and income of the poor, a related issue that stimulated the research was the provision of background understanding needed to ensure rapid translation of income growth into improved physical welfare, especially nutrition, in the households.

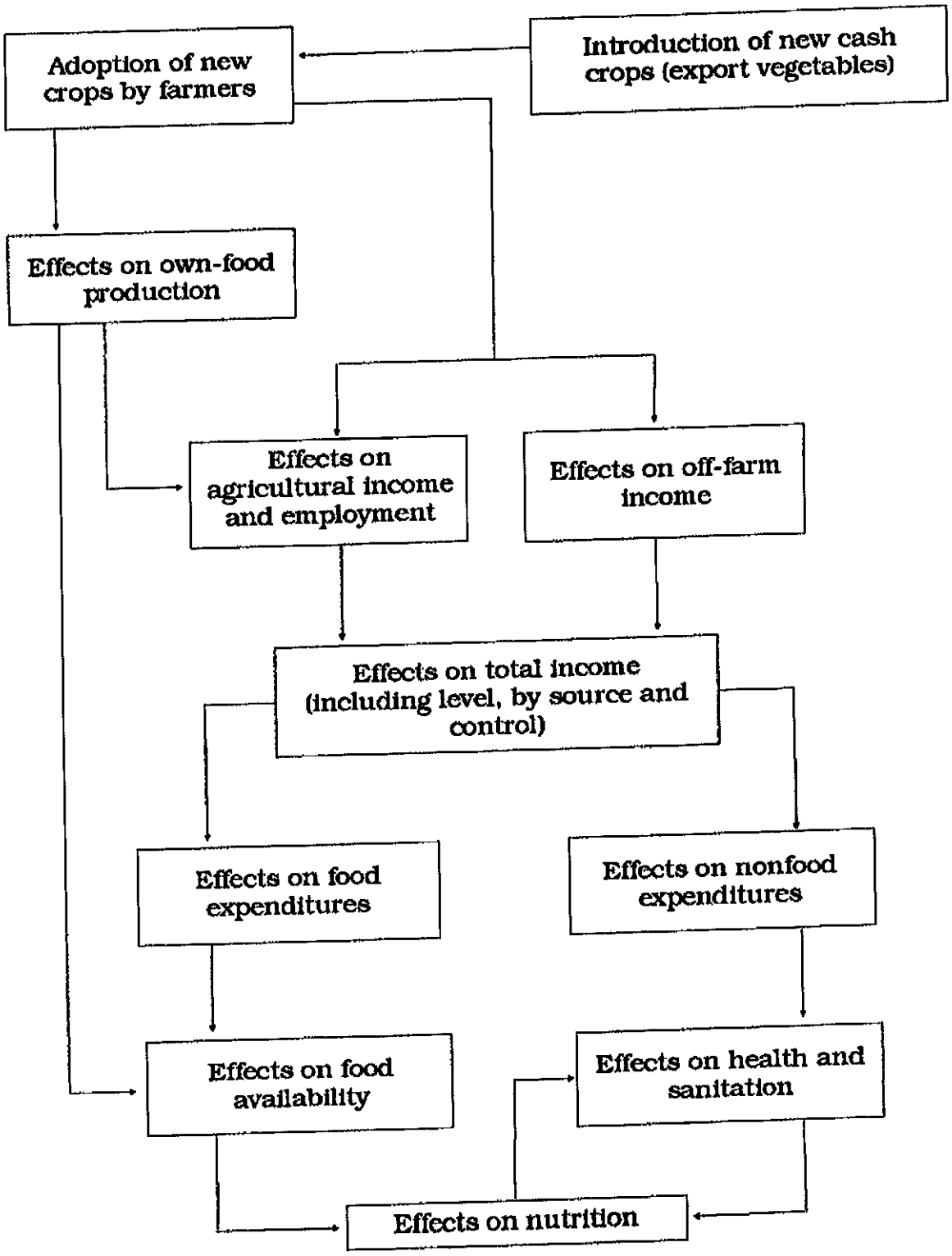
The theoretical concept of the household-level analysis of commercialization effects takes a disaggregated approach to tracing the consequences for different types of households and different groups inside the households. It is not a priori assumed here that incremental employment and income from the new crops leaves household utility functions unchanged. It is now widely recognized that farm households are not necessarily homogeneous units of decisionmaking.[2] Profound changes in the opportunities for income earning on the farm—be it through new technology or new market outlets—may have profound implications for division of labor and for relative control of income shares, which may change budget allocations within the household beyond the pure income effect. This study attempts to trace such effects and to quantify their impact on the consumption and nutrition effects of increased commercialization of traditional agriculture. Understanding these relationships is crucial to identifying policy options that avoid adverse effects of commercialization on consumption and nutrition in poor households and enhance positive ones.

The research focuses on the effects of the commercialization process on household-level food security. Food security, in this context, is understood in the broad sense as the ability of households and their members to acquire sufficient quantities of food over time, whether from own produce or from the market. Related to this, the effects of change in commercialization on the actual nutritional situation of children is assessed. The main relationships studied in this evaluation of increased commercialization are its effects on agricultural production (especially food) and on employment and income (on-farm, off-farm), and the extent to which these translate into effects on food and

[2] See Folbre 1986 and the literature quoted therein.

nonfood expenditures, food consumption, and nutrition. Clearly, these issues are related to each other. A simplified overview of the relationships as affected by commercialization at the household level is provided in Figure 1. This figure also provides an overview of the steps of analysis but does not depict the complex dynamics involved.

Figure 1—Flow of analysis for evaluation of household-level effects of the commercialization process



Overview of the Report

The commercialization process at the micro farm-household level should be understood in the context of the macroeconomic environment and its political economy. A review of commercialization of Guatemala's agriculture is provided at the outset. The introduction of new cash crops is evaluated in its institutional context. This requires a focus on the actual making and operating of the commercialization process; success or failure of a program is largely determined in this sphere, which is much underresearched. Therefore, those who play a role in commercialization are examined before the household-level effects are evaluated.

At the farm-household level, the process and determinants of adoption of the new crops are evaluated. The main questions addressed are who are the (early) adopters and what are their characteristics? In the context of this case study, this leads directly into the issue of competition and complementarity between nontraditional and traditional crops, on-farm and off-farm labor supply, and division of labor in the households. How is food availability from own production affected? Where does the increased labor input on the farm stem from? Who in the household controls the incremental farm income?

From the income effects, the effects for household resource allocation to food and nonfood expenditures are traced. Special focus is on food expenditures and food (calorie) availability. What share of incremental expenditure in export crop-producing households versus other households at same-income levels is spent on food and what types of food? To what extent is food availability in terms of calories improved?

Finally, these effects are traced to the nutritional status of children in the households. How is nutritional status—measured in anthropometric terms (weight, height-for-age)—affected by changes in food availability and the health and sanitation environment of the households?

The study concludes with lessons for policy from this particular case and an attempt to identify generalizable findings.

Survey Methods and Data

The household-level data of this research are based on representative surveys undertaken in 1983 and 1985 in the six villages where the Cuatro Pinos cooperative was active. The sample is based on a census in the villages done in 1983 (INCAP 1985). A roughly equal number of members of the cooperative (n = 195)—that is, growers of the new export crops—and nonmembers (n = 204) were drawn at random by village from the census information. To ensure a reasonable coverage in the smaller villages, the sample was biased toward the four smallest communities among the six villages. This brings the sample closer to the prevailing village pattern in the Western Highlands. The proportional adjustments of the sample by village size led to a coverage of 38-75 percent of the cooperative members in each community (average, 47 percent) and 8-17 percent of nonmember households (average, 11 percent) in these communities (Table 1).

The same households were surveyed in 1983 and 1985. They were visited between November and January of 1983/84 and 1985/86. Conducting both surveys during the same time of the year avoids the seasonality effects that might disturb comparisons between the two rounds.[3]

[3] Seasonality in food consumption, however, does not appear to be very pronounced in Guatemala. See Valverde et al. 1985b.

Table 1—Village-level information: sampling in 1983 and 1985

Category	San Matéo	El Rejón	Santa María Cauqué	Pacul	Pachalí	Santiago	Total
Size of village (number of households, 1983)	195	180	445	95	141	1,250	2,306
Cooperative member households, 1983	21	15	65	32	38	248	419
Nonmember households, 1983	174	165	380	63	103	1,002	1,887
1983 sample							
Cooperative members	13	10	36	24	18	94	195
Sample population as percent of total[a]	(62)	(67)	(55)	(75)	(47)	(38)	(47)
Nonmembers	29	27	32	11	18	87	204
Sample population as percent of total[a]	(17)	(16)	(8)	(17)	(17)	(9)	(11)
1985 sample							
Cooperative members	12	15	31	20	17	84	179
Nonmembers (farmers and nonfarmers)	28	23	37	14	20	100	222
Nonmembers (farmers)	24	23	34	12	16	70	179
Years of cooperative membership in 1985							
Less than 3	5	15	3	7	1	19	50
3–4	7	...	14	4	9	19	53
5–7	...	...	14	9	7	46	76

Sources: Institute of Nutrition of Central America and Panama survey, 1983; and Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[a] The percent figures in parentheses represent the percentage of total population covered in the communities by the sample survey.

The composition of the 1985 sample is affected by changes in household characteristics since the 1983 survey. Some households split when the younger generation started its own households, some cooperative members dropped out of the cooperative, and some nonmembers became members. Also, some households could no longer be interviewed because of long-term absence. Between 1983 and 1985, 9 percent of the member sample left the cooperative and 6 percent of the nonmember sample became members. Taking the stratification of the sample into account, these numbers suggest a net increase of members by 19 percent since 1983. This roughly corresponds to the actual change in the membership statistics of the cooperative between 1983 and 1985.

The sample is spread over early and late adopters. Forty-two percent of the sampled households of the cooperative members have been in the scheme for as long as five to seven years. Newcomers are spread over all six communities, while the early adopters are all in the four founding villages of the cooperative (see Table 1).

The field data collection for the 1983 and 1985 surveys was done by the experienced survey staff of the Institute of Nutrition of Central America and Panama (INCAP).

The household-level information collected includes

1. demographics of the household (employment, schooling);
2. health, anthropometrics of children under 10 years of age, and child-feeding practices;
3. housing conditions;
4. access to services;
5. nonfarm income (by individual, by source);
6. agricultural production (inputs, outputs, labor at field level by crop, size of fields, produce sales, input purchases, animal production, land quality);
7. food expenditures and consumption of own-produced food; and
8. nonfood expenditures.

The various types of information are covered over recall periods specific to the nature of the data. Agricultural production covers the crop years 1982/83 and 1984/85 (May-April), and off-farm income covers the 12 months preceding the surveys (November-October 1982-83 and 1984-85). Food and nonfood expenditures are monthly (October 1983, October 1985), with an annual recall for lump sum nonfood expenditures (especially durable goods) added to the 1985 survey that covers November 1984 to October 1985.

In a subsample of the 1985 survey consisting of 40 households in two communities (El Rejón and Santiago de Sacatepéquez), a detailed assessment of intrahousehold decisionmaking and of sexual division of labor and time allocation of household members was undertaken parallel to the large survey (Nieves 1987).

3

COMMERCIALIZATION OF GUATEMALA'S AGRICULTURE

Guatemala is the third largest in area of the Central American republics, after Nicaragua and Honduras, but its population of about 8.4 million (1984 figure) exceeds that of the latter two countries combined. About two-thirds of the population lives in rural areas; around 60 percent of them are indigenous people who are descendants of the Maya. The indigenous population is mainly concentrated in the Western Highlands of Guatemala where this study was conducted.

The agricultural sector provides about 50 percent of the country's employment and accounts for 25 percent of the gross domestic product (GDP) in the mid-1980s. Agricultural exports hold a share of about 65 percent in total merchandise exports, thus making agriculture the primary foreign-exchange earner of the economy.

Guatemala's highly dualistic agricultural structure is well documented.[4] A modern, export-oriented, large-scale farm sector and a traditional, subsistence-oriented, small-scale sector have long coexisted. The two sectors are not independent but rather are closely linked through the rural labor market. Labor from the traditional sector in the Western Highlands (a sector operating on an agricultural-resource base per household that in most cases cannot support the bare survival requirements of the family) seeks employment through interregional migration either to the areas of the large-scale export crop sector—mainly in the lower altitude regions—or, in recent decades, to the urban services sector.

This pattern of export crop production and its interaction with the subsistence farm sector has been in existence for decades. Its effects on the subsistence farm sector are substantial (Schmid 1968, 33-45). Yet the focus of this research is not to study these indirect effects but the recent changes in the subsistence sector itself, namely, those resulting from the shift into export crop production by small farmers in the Western Highlands. The traditional dualistic pattern of subsistence and export crop sectors, however, must be kept in perspective to assess the implications of the change in commercialization in the small-farm sector. Clearly, this subsector—though mainly subsistence-oriented in crop production—was already "commercialized" by selling a high share of its labor rather than its crops.

Exports from a Dualistic Agricultural Sector

Agricultural exports from Guatemala may be grouped into traditional and nontraditional exports. The traditional ones in their order of share in total agricultural exports are coffee, cotton, sugar, bananas, and beef. These crops account for 76 percent of agricultural exports in the mid-1980s (Table 2). Among the important nontraditional agricultural exports that account for the remaining 24 percent are cardamom, vegetables, flowers and plants, fruits, and sesame seed. Since the mid-1970s the share of agricultural exports in total merchandise exports has remained stable, but the composition of

[4] See Nyrop 1983 and the extensive bibliography in this source; also World Bank 1978.

Table 2—Value of agricultural exports from Guatemala, 1975-84

Export Item	1975	1980	1984
		(US$ million)	
Traditional agricultural exports	164	464	361
Coffee	74	166	72
Cotton	116	69	71
Sugar	35	45	55
Bananas	17	29	13
Beef	406	773	572
Subtotal	(92)	(79)	(76)
(Percent of total agricultural exports)			
Nontraditional agricultural exports	10	56	100
Cardamom	9	68	43
Vegetables, flowers and plants, fruits	15	75	39
Other[a]	34	199	182
Subtotal	(8)	(20)	(24)
(Percent of total agricultural exports)	440	972	754
Total agricultural exports	651	1,520	1,132
Total exports			
(Agricultural exports as percent of total exports)	(67)	(64)	(67)

Source: Based on data from Bank of Guatemala, "Economic Data, 1985" (Bank of Guatemala, Guatemala City, mimeographed).

[a] Includes essential oils, fish, gum, honey, cocoa, cotton seed, sesame seed, cotton lint.

agricultural exports has become more diverse. The share of traditional agricultural exports dropped from 92 percent in 1975 to 76 percent in 1984, although traditional exports grew in absolute dollar terms. Increased diversification of the agricultural export sector is a stated policy objective to reduce instability in foreign-exchange earnings due to price fluctuations—for example, of coffee—in international markets (Banco Interamericano de Desarrollo 1986, 74).

Landownership in Guatemala is extremely skewed. The Gini coefficient, which ranges from zero in a situation of perfect equality to 100 in a situation of maximum inequality, was 85.1 for land distribution in Guatemala in 1979—higher than for all other Latin American countries (Hough et al. 1982, 1). The Gini coefficient increased from 82.4 to 85.1 between 1964 and 1979, indicating further inequality (Hough et al. 1982, 2). Two percent of farmers held 67 percent of the agricultural land—land that is generally of better quality than the land cultivated by small farmers.

For those at the bottom of the land distribution, population growth leads to rapid reduction of average farm size. From 1964 to 1979, the average farm size of those under 1.4 hectares (2 *manzanas*) decreased from 1.0 to 0.7 hectare. Sixty percent of Guatemalan farms fall in this group that cultivates 4 percent of the land (Table 3). Most of the subsistence farm households in the Western Highlands also fall in this group; thus, not surprisingly, more than 90 percent of the sample survey households are part of this farm-size class.

Total agricultural land in use increased by 0.8 percent per year between 1950 and 1979. Expansion into new lands did not provide any significant relief for the land constraint burdening the small-farm sector, nor does it provide a potential solution for this problem (Hough et al. 1982). The obvious solution—agrarian reform with redistribution of land from large-scale farms to small farmers—was attempted by governments in the late 1940s and early 1950s, but the attempts were finally blocked when the government was toppled in a coup in 1954 (Kinzer and Schlesinger 1983).

Table 3—Farm-size distribution in Guatemala, 1950, 1964, and 1979

Farm Size	Share of Farms			Share of Area		
	1950	1964	1979	1950	1964	1979
(hectares)			(percent)			
Less than 1.4	47[a]	44	60	3[a]	3	4
1.4–3.5	29	31	21	6	7	6
3.5–44.5	22	23	17	19	23	23
44.5 or more	2	2	2	72	67	67
Total	100	100	100	100	100	100

Source: Based on data from SEGEPLAN, *Agricultura, Población, y Empleo en Guatemala* (Guatemala City: SEGEPLAN, 1984).

[a] In the 1950 census, farms with less than 0.04 hectare were excluded.

Guatemala's agriculture has continuously and substantially shifted away from staple food production (which includes a large share of subsistence production) to cash crops and production for exports. Basic food crops covered 58.0 percent of agricultural area in 1950 compared with only 37.4 percent in 1979 (Table 4). Cash crops and export crops increased their share in land use from 20.0 to 29.8 percent during the same period. Although this change in cropping patterns mainly took place in the medium-sized farms (3.5-44.5 hectares), the smallest farms are following the same pattern of change. They decreased their basic food crop area from 96.7 to 87.4 percent in this period and increased their area devoted to cash crops.

Since 1979 the area allocated to the major staple foods (maize and beans) has increased somewhat, but yields show a downward trend that has made total staple food production stagnant and reduced the per capita staple food production by a rate of –0.3 percent per year between 1968 and 1982 (FIDA 1985, 57-58).

Table 4—Specialization in crop production, by farm size, 1950, 1964, and 1979

Farm Size	Type of Crops[a]	Land Use in Share of Farm-Size Class		
		1950	1964	1979
(hectares)			(percent)	
Less than 1.4	Basic food crops	96.7	91.1	87.4
	Cash and export crops	3.3	8.5	12.2
	Pasture	. . .	0.4	0.4
1.4–3.5	Basic food crops	93.5	90.1	84.6
	Cash and export crops	6.2	8.4	14.0
	Pasture	0.3	1.5	1.4
3.5–44.5	Basic food crops	84.8	68.0	64.4
	Cash and export crops	10.8	12.6	19.1
	Pasture	4.4	19.4	16.5
44.5 or more	Basic food crops	18.8	14.4	13.7
	Cash and export crops	35.1	32.1	38.4
	Pasture	46.1	53.5	47.9
Total	Basic food crops	58.0	41.3	37.4
	Cash and export crops	20.0	23.1	29.8
	Pasture	22.0	35.6	32.8

Source: Based on data from SEGEPLAN, *Agricultura, Población, y Empleo en Guatemala* (Guatemala City: SEGEPLAN, 1984).

[a] Basic food crops include maize, beans, rice, wheat, potatoes, and traditional vegetables. Cash and export crops include sorghum, cotton, coffee, sugarcane, cardamom, sesame, groundnut, tobacco, rubber, and fruits. Pasture includes permanent pasture and land for fodder crops.

How did overall food availability develop over time against this background of change in production patterns toward exports and the slow growth in domestic food production? Overall per capita staple food availability was stable in the 1960s but declined in the 1970s—from an average of 134 kilograms per capita per year (in wheat equivalent) in 1961-63 to 128 kilograms in 1981-83. In the same period, calories per capita per day increased from 1,937 to 2,080 (FAO, various years). Obviously, relatively more calories come now from nonstaple foods. It should be stressed that such country averages do not really address the food situation properly, especially in countries with such large spreads in income distribution as Guatemala.

Generally, developing countries tend to manage joint growth in the basic food crop and cash crop subsectors or fail to achieve growth in either (von Braun and Kennedy 1986, 27-36). Guatemala, however, appears as an exception to this tendency. Its cash crop sector was growing over the long term while its basic food crop sector stagnated (von Braun and Kennedy 1986, 35). This may be explained by the highly dualistic structure of Guatemala's agricultural sector. This structure does not accommodate positive spillover effects from promotion of traditional export crops through credit, inputs, market infrastructure, and so forth, to the basic food crops, as the two are mainly grown on two very distinct types of farms—large scale versus small scale—as well as in different locations.

The effects of increased commercialization through the introduction of new cash crops for food crop production in the small-farm sector may, however, turn out to be very different from the development path of the isolated expansion of agroindustrial crops in the large-scale farm sector. In principle, positive linkages between new cash crops and the promotion of traditional food crops could be established in this case.

Recent Variations in Agricultural Policy

In the early 1980s Guatemala's substantial export-led economic growth, with low levels of general inflation and an impressively strong currency, experienced a crisis. Between 1982 and 1985, per capita gross national product (GNP) was down by 20.5 percent in real terms (Banco Interamericano de Desarrollo 1986, 5). The Guatemalan quetzal, which was valued at a fixed 1-to-1 rate against the U.S. dollar for more than 40 years, was devalued in 1984 and further devalued in 1985 to about Q3.00-US$1.00 in the parallel market. A product-specific system that allowed differential access to the parallel-market exchange rate and imposed different shares of the export revenue to be converted at the old 1-to-1 rate has led to numerous variable exchange rates—and implicitly to a host of different export tax levels through exchange-rate regulation. For instance, in early 1986, 25 percent of coffee dollars were to be exchanged at the parallel rate and 75 percent at the official rate. Export vegetable dollars got better treatment by an imposed share of 50 percent at the official rate.

This exchange-rate policy induced equivalent distortions on the import side. A policy of using the foreign exchange acquired through the implicit taxation of exports for importation of so-called essential agricultural imports (such as fertilizer and food) at the old exchange rate was largely ineffective. Fertilizer prices roughly doubled from 1985 to 1986. Thus the input-intensive export crops came under pressure from both sides—export taxation through partly maintained overvalued exchange rates, and the full effect of the devaluation of domestic currency on the input price side. During 1980-84, export values declined faster among traditional export crops (–7.3 percent)

than nontraditional crops (–2.2 percent). On the basis of this experience, the government policy for agriculture, as laid out in the 1984-86 National Development Plan, emphasizes both diversification of export-oriented agricultural production and increased production of food commodities.

The causes of the recent economic crisis must be seen in the context of both the country's violent internal conflicts and the external economic factors, especially the deterioration of terms of trade and substantially higher interest rates for capital investments. In a country with a very small public sector and extremely limited public services for the poor, the economic crisis is assumed to have hit particularly hard the low-income stratum of the population, which in Guatemala is a large proportion of the population.

Poverty in Guatemala is predominantly a rural problem and is particularly concentrated in the Western Highlands. A survey in 1980 classified 36.2 percent of the rural population as absolute poor, as their income was too low to purchase an adequate diet. These rural poor constituted 73.5 percent of all poor. Agricultural income per household in the Western Highlands was about 40 percent below the average of other rural areas in the country (Guatemala 1982).

Evolution of Commercial Agriculture in the Large- and Small-Farm Sectors

The dualistic structure of Guatemala's agriculture, with large-scale farms versus *minifundas* (mainly in the hands of indigenous farmers), is largely an inheritance of the structural change introduced by the Spanish during the colonization of the country (Nyrop 1983). With the introduction of coffee cultivation after the 1840s, much of the best land in the highland departments was absorbed into expanding coffee haciendas. The indigenous population who had been farming these lands for generations were forced to move to higher, less fertile lands in order to continue growing their subsistence crops—maize and beans (Hough et al. 1982, 21-24). This change took place mainly between 1870 and 1920.

Another major export-oriented change with long-term consequences, not only for agriculture but also for the political stability of the country, emerged in the 1920s and 1930s when the United Fruit Company acquired large landholdings—mainly for banana plantations in the fertile lowlands. Concessions to the company by the government totaled about 190,000 hectares (Kinzer and Schlesinger 1983).

The basic effect of the traditional export orientation in Guatemala's agriculture was an increased concentration of land in large farms and of the indigenous population in the remaining high-altitude areas with unfavorable land quality. At times, forced labor obligations were imposed on this population to fill the labor demand in the export crop sector (Nyrop 1983). Through reduction of the land-resource base for the indigenous population, the opportunity cost of labor on their own small holdings was reduced, thus assuring a cheap labor supply to the large-scale farmers.

Technological change in the food crop sector was not exceedingly successful in Guatemala (CGIAR 1984). Growth in yields of maize was 1.6 percent per year between 1971-73 and 1981-83. Only a small surplus of the traditional food crops in the small-farm sector is produced for marketing, so these crops have not become a source of cash income. In the typical Western Highlands situation, about 90 percent of the maize grown is retained for own consumption. It is only recently that maize production has increased on large-scale farms.

Export vegetables, the focus of this study, were introduced to Guatemala in the mid-1970s with substantial foreign investment.[5] Originally, the scheme operated with an integrated production-processing (screening, packing, cooling) exportation system in the hands of one company. Soon the economic advantage of contract growing in the smallholdings in the Western Highlands became apparent. Company crop production was phased out and farmers in selected villages were awarded contracts. The main commodities were cauliflower, broccoli, snow peas, and brussels sprouts.

This system continues to operate and the farmers of the Cuatro Pinos cooperative, the focus of this research, were part of this contract system in the early 1980s. Kusterer, Estrada, and Cuxil (1981, 6-9) point out the rather different effects of the contract-growing scheme in different locations of its operation. The access to inputs and to restricted delivery for the contracted amounts of outputs was, at various locations, a problem to farmers. In general, farmers were very eager to join the scheme. In fact, a major short-term problem was that farmers had moved unexpectedly fast into production of some of the vegetables and the marketing and export channel did not keep up with this rapid adoption, thus leading to critical frictions between the contract partners in the cooperative (Kusterer, Estrada, and Cuxil 1981, 17-24).

Export vegetable production is done at the individual farm level in the context of contract growing or independently relying on market middlemen, called *coyotes.* A substantial part of the export vegetable production stems from farmers who have formed cooperatives. The positive attitude of Guatemalan peasants toward cooperation in production with households from the same ethnic group is a good basis for agricultural cooperatives (Bossen 1984). In 1984, 812 cooperatives with more than 143,000 members were registered, of which 382 cooperatives were agricultural ones.[6] More than half of all cooperatives are located in the Western Highlands, the area of this study. Agricultural cooperatives had on average 167 members in 1983—less than half as many as the Cuatro Pinos cooperative had at that time.

[5] A very comprehensive description and evaluation of the early operation is given in Kusterer, Estrada, and Cuxil 1981.

[6] Of the 812 cooperatives, 731 were considered actually active at the end of 1983 according to El Instituto Nacional de Cooperativas (INACOP), as stated in FIDA 1985, 137.

4

INITIATORS AND OPERATORS OF EXPORT CROPPING IN SMALLHOLDER AGRICULTURE: THE CUATRO PINOS COOPERATIVE

Food and agricultural policy plays a key role in shaping the commercialization of traditional agriculture. Commercialization of subsistence agriculture does not simply develop as a result of changes in economic incentives or new technology at the farm level, the processing level, or in marketing. To a large extent, the commercialization process is also influenced and designed by actors at the local level and, especially in case of export crops, by actors who are quite removed from the local farm-production scene. The Cuatro Pinos cooperative is an interesting case in point.

Socioeconomic Environment of Cuatro Pinos at the Outset

Cuatro Pinos is active in six villages in and around the *municipio* (county) Santiago Sacatepéquez, which is located about 35 kilometers west of Guatemala City.[7] Storage and processing facilities for the export vegetables are in Santiago, which is the base of the cooperative. The community is connected to the paved road of the Pan-American Highway, which is 5 kilometers away. The altitude is around 1,900-2,000 meters.

According to a survey carried out in 1977, 10 percent of the cultivated area of the *municipio* was devoted to the production of different vegetables. The remaining 90 percent was for maize and beans (Hintermeister 1986, 10). Between 10 and 15 percent of family heads living in Santiago were working in Guatemala City. In general, they were relatively young and had access to small parcels of land below subsistence levels.

In one of the main villages in which Cuatro Pinos is operating, Santa María Cauqué, a comprehensive longitudinal study on population, agriculture, nutrition, and health depicts the situation before implementation of the cooperative (Mata 1978). Between 1963 and 1971, the population increased at a rate of 3.1 percent per year, while farm size decreased at a rate of 3.5 percent. Since then, population growth has increased at a rate of 3.5 percent per year. This particular village, however, is a rather untypical case. The trend toward cash crops was established even before the establishment of the cooperative, but the cooperative reinforced the trend. This village was more commercialized at the outset than the other five villages of the cooperative, mainly because of its favorable access to transport and communication infrastructure by virtue of its proximity to the Pan-American Highway. In the 1960s the cropping pattern changed gradually, showing a reduced share of subsistence crops. From the early 1970s to 1985, the share dropped from 70 to 50 percent, corresponding to the increased share of new export crops and traditional vegetables (Table 5).

The incidence of severe protein calorie malnutrition (PCM) was found to be considerable in Santa María Cauqué. In a cohort analysis between 1964 and 1969, 13 percent

[7] Since 1987, the cooperative has operated in eight villages.

Table 5—Average farm size, population, and land use pattern in Santa María Cauqué, 1963-85

Item	1963	1967	1971	1985
Farm size (hectares)	1.2	1.1	0.9	0.8
Population	1,071	1,254	1,370	2,225[a]
Land use (percent)				
Maize and beans	78.7	73.2	70.5	49.5
Vegetables and other crops (including export crops)	21.3	26.8	29.5	50.5

Sources: Based on data from L. J. Mata, *The Children of Santa María Cauqué: A Prospective Field Study of Health and Growth* (Cambridge: Massachusetts Institute of Technology Press, 1978), p. 18; and Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[a] Estimated on the basis of a 1983 census done by the Institute of Nutrition of Central America and Panama.

of 1-year-old children, 27 percent of 2-year-old children, and 9 percent of 3-year-old children were found to be affected by PCM (Mata 1978, 298). Most cases of severe PCM occurred in the rainy season (June-September), when infectious diseases—particularly measles, diarrhea, and respiratory infections—are most frequent. In explaining this pattern of the prevalence of PCM, Mata (1978, 302) concludes that "the relationship of food availability, marketing, and cash to malnutrition deserves serious investigation."

At the outset, the general socioeconomic environment and health and nutrition situation in the area of the Cuatro Pinos communities appeared to be not particularly different from the general situation in the Western Highlands. Some special features of the economic environment are, however, noteworthy. Closeness to the capital city and the good infrastructure facilitated market integration with fresh vegetables. Average farm size is below the average in the Western Highlands. Also, there are no big farms in the area. This has two implications: there were no serious conflicts over land—at least in the 1970s—and the influence of nonindigenous farmers on the social organization and economic activities in the *municipio* was small. Thus there was neither an important social force to oppose the local development of the cooperative nor landowners who considered the promotion of the profitable labor-intensive crops as a threat to their control over the labor market (Hintermeister 1986, 11-12).

The Evolution of Export Cropping by Cuatro Pinos Farmers

The adoption of export vegetable production by small farmers in the Western Highlands is determined by long-term changes in economic variables, especially the increased demand for these crops in U.S. and European markets and the growing labor-land ratio on small farms. Both these factors increase the comparative advantage of labor-intensive crops in rural environments where there is increasing (seasonal) underemployment. International development assistance organizations played a catalytic role in the beginning for the rapid use of potential economic benefits from nontraditional export crop production in the Western Highlands. The interaction of four groups of actors finally led to the rapid expansion of export vegetable production.

1. External development assistance organizations were instrumental at two different levels. First, they provided the seed money (loans) to a private company, Alimentos Congelados S.A. (ALCOSA), to open up the export channel (Latin American Agribusiness Corporation S.A. [LAAD] and the U.S. Agency for International Development [AID]

played a role in this). Second, they stimulated the formation of the cooperative, implemented its programs, and assisted in securing access to the export channel through private exporters (Swiss Group, a Swiss nongovernmental organization).

2. An external private company (ALCOSA, a subsidiary of U.S.-based Hanover Brands, Inc.) provided the know-how and the export channel to the U.S. market, including such related infrastructure facilities as cold storage.

3. Guatemalan public institutions provided the know-how on agricultural technology (Instituto de Ciencias y Tecnologias Agrícolas [ICTA]) and farm-level credit (Banco Nacional de Desarrollo Agrícola [BANDESA]). INCAP developed vegetable-processing equipment.

4. Local farmers formed the Cuatro Pinos cooperative, which organizes export vegetable production and provides field-level extension, input supply, produce collection, selection, and storage. Lately the cooperative has organized its own exports independently from the ALCOSA outlet, both to the United States and to Europe.

The interaction of these players in the process of increased commercialization was quite different in the various phases of the process. The following calendar of events that led to the expansion of vegetable production for exports at Cuatro Pinos sheds light on this:

Year	Export Vegetables in Guatemala	Cuatro Pinos Cooperative
1970	LAAD founded (LAAD's Central American subsidiary mainly funded through USAID loans)	
1971	ALCOSA began operations in Guatemala with a LAAD loan (freezing fruits and vegetables)	
1975	ALCOSA purchased by Hanover Brands, Inc., and expanded with new loans from LAAD to export vegetables to United States (okra, broccoli, cauliflower, brussels sprouts)	
1976	Main production of vegetables for export by ALCOSA started on company lands leased by ALCOSA; small experiments with small farmers began	Earthquake in the Western Highlands; death toll about 30,000; Swiss Group comes to rebuild Santiago Sacatepéquez
1977	Buying stations set up to buy cauliflower from small farmers in highlands	Swiss Group's development programs—food aid, literacy courses, along with reconstruction work in villages; formation of groups that later formed the cooperative

1978	Rapid expansion of cauliflower program	Implementation of agricultural programs—maize improvement, traditional vegetables; contract with ALCOSA through Swiss Group for broccoli and cauliflower production in Santiago Sacatepéquez
1980	Production on ALCOSA's own farmland closed; all cold-weather vegetables now from small highland farmers (about 2,000 farmers in purchasing program, delivering to 17 stations); crisis of ALCOSA—contracts were signed for much more broccoli and cauliflower than plant's processing capacity; breakdown of field organization; suspension of purchases; losses to farmers	Construction of buildings for cold storage and packing at cooperative headquarters at Santiago Sacatepéquez; contractual arrangements with fresh snow pea exporters
1981	Expansion of processing capacities of ALCOSA; change in contractual arrangements with farmers	Rapid expansion of cauliflower, broccoli, and snow pea production and direct exports by cooperative to United States
1987	Five companies (Guatemalan) in addition to ALCOSA started frozen-vegetable business	Further expansion of cooperative; construction of own freezing, processing facilities; 20 percent of exports to Europe

Production technology, management, and on-field supervision requirements for export vegetables are well suited to small farms. The early experience of ALCOSA with crop production and procurement clearly indicates that the production of export vegetables (broccoli, cauliflower, snow peas) has rapidly decreasing returns to scale. The production initially started on land leased by ALCOSA where up to 400 people were directly employed by the company. Then ALCOSA contracted middle-sized farms of 20-40 hectares operated by agricultural entrepreneurs and, finally, shifted to small farmers. Although ALCOSA initially intended to depend on its own farming for raw material, it soon began to rely more on its outgrowers (Kusterer, Estrada, and Cuxil 1981, 13). The experience showed that nontraditional commercial farming entrepreneurs on the middle-sized farms were not a satisfactory source of supply.

The small farms' comparative advantage in vegetable production is due not only to the high labor intensity of the work tasks but also to careful on-field management and supervision requirements to meet quality standards that are better fulfilled by the small farmers experienced in traditional vegetable production. These production characteristics are important features for the sustainability of export vegetable production in the hands of small farmers. Along its development path, Cuatro Pinos has benefited from institutional support and soft loans for its investments but not from subsidies for on-farm production. The institutional support and know-how transfer was probably the most important ingredient for the growth of the cooperative.

By 1987, Cuatro Pinos had expanded to 1,150 members, compared with 177 members in 1979. The cooperative farmers were growing nearly 300 hectares of export vegetables in 1985. More than half of this area was devoted to snow peas. The area under these crops has quadrupled since 1980/81 (Table 6). At the cooperative headquarters, about 150 persons—more than half of them women—found employment in screening and packing work.

Sustainability of Export Crop Production by Small Farmers

Export vegetable production is frequently considered risky for small farmers. Various types of risks are distinguished: risk of crop failures (pests, weather), risk of price collapses, and risk of a breakdown of the marketing institutions (the domestic or external part of the channel or both).

The production risk at the farm level will be discussed later on the basis of farm survey data. The two "institutional" risks are addressed in the following sections.

Price Risk and Exchange-Rate Policy

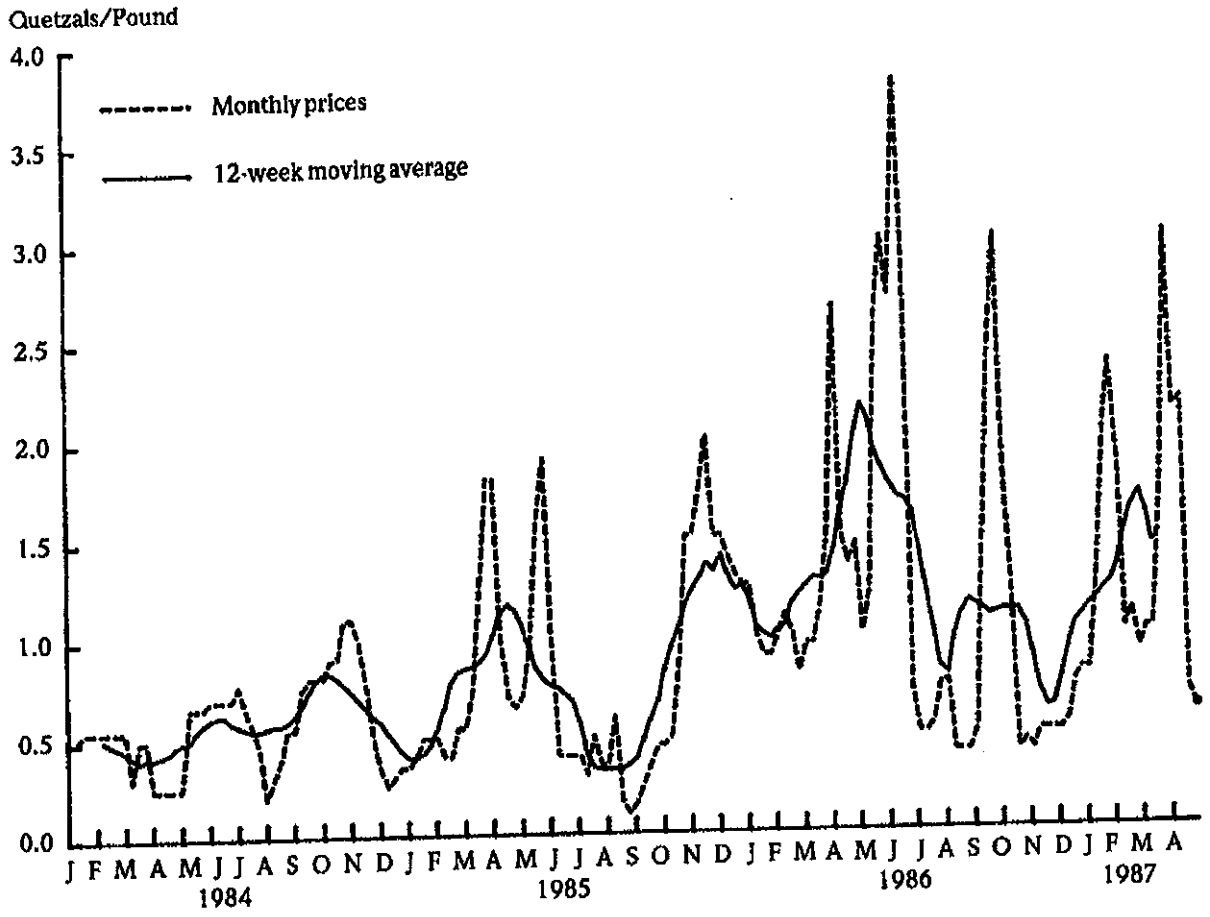
Prices of export vegetables, and those of snow peas in particular, are extremely unstable compared with, say, staple food prices. Highest and lowest prices paid to Cuatro Pinos farmers in 1985 for snow peas of similar quality ranged from Q0.10 to Q2.00 with a median of about Q0.80 per pound (see Figure 2). These fluctuations reflect directly the actual price movements in the export markets (especially the spot markets in Miami, Los Angeles, and London). The fluctuations are the result of short-term supply-and-demand changes. Various regions enter the markets of these products at different times (for example, Mexico, California, and the Dominican Republic). Other types of fresh vegetables probably induce substitution effects on the demand side in various seasons, but little is known about these. However, it is important to note that the high degree of price instability of snow peas from week to week does not translate into a similar instability of returns from the crop. Harvesting of the crop starts 9 weeks after planting and extends over 10 to 12 weeks with three pickings of the crop per week. The grower is thus facing an average price over the whole harvesting period of a field. A farmer who, for example, planted his crop in the beginning of June 1985 and was harvesting in August, September, and October delivered his crop at prices ranging from Q0.10 to Q1.50 per pound with an average—depending on volume at the specific points in time—of about Q0.55 per pound. The price fluctuations listed

Table 6—Area under export vegetable crops marketed by the Cuatro Pinos cooperative, 1980-85

Crop	1980/81[a]	1984/85	1985/86
		(hectares)	
Snow peas	6	90	170
Cauliflower	61	67	67
Broccoli	0	10	45
Parsley	0	2	7
Total	67	169	289

Source: Records of Cuatro Pinos cooperative.
[a] Rough estimate.

Figure 2—Snow pea prices paid to farmers by cooperative, 1984-87



Source: Records of Cuatro Pinos cooperative.

in Figure 2 are thus smoothed out in 12-week moving averages with which they actually translate into gross revenues from the crop. Farmers also can—and actually do—grow the crops in phases on different plots at different points in a year, thus further reducing the price risk.

Such price variability is not necessarily a problem for farmers if it represents a seasonal pattern with predictable ups and downs in prices. For some time it was assumed that snow pea export prices were at a seasonal high during September-December and farmers were accordingly advised to plant for harvest at that time. In recent years, however, no clear seasonal price pattern has occurred, so farmers have been confronted with a high degree of uncertainty. Developments on the supply-and-demand side of the international market for snow peas—for example, increased demand from Western Europe and increased supply in various seasons from other producing regions such as the Dominican Republic, other Central American countries, and California—appear as important factors. Also, little is known about substitution effects of changes in prices of competing types of vegetables on the formation of prices for such luxury vegetables as snow peas. Predicting future crop prices, which is crucial for the sustainability of the export operation, is hardly possible with any acceptable margin of error. Demand in the rich countries of the North appears to be rising. However, as long as new technologies are not developed that would permit the cultivation of the crop with substantially lower labor input in comparable climatic zones, small farmers in the

Guatemalan highlands have a sustained comparative advantage due to the local labor supply situation. Deflated average prices for snow peas paid to cooperative farmers have shown neither a decreasing nor an increasing tendency since 1984: first-quarter averages (January-April in 1984 prices) were Q0.50 per pound in 1984, Q0.36 in 1985, Q0.76 in 1986, and Q0.61 in 1987. The variability of prices also shows no particular tendency in these years.

Comparative advantage of export vegetables at the farm level is directly affected by the exchange-rate policy, which determines changes in the price ratio between traded and nontraded agricultural products and inputs. Recently, exchange-rate policy changes in Guatemala have introduced an additional uncertainty element into the price environment. These policy changes are not predictable for farmers; thus the erratic exchange-rate policy discussed in Chapter 3 establishes one component of the price risk facing the farmer.

The overvalued exchange rate in the early 1980s and the multiple exchange-rate system in place in 1985/86 translate into a changing taxation of the export vegetables. In mid-1985, the exchange-rate system for vegetable exports required 50 percent of the sales value to be exchanged at the official rate (Q1.00 = US$1.00) and permitted the other 50 percent to be exchanged at the parallel rate (about Q1.00 = US$0.27). Even taking into account a common practice of underreporting the sales value, this exchange-rate policy resulted in an export tax of about 25 percent for snow peas (see Table 7). This tax favors production of domestically consumed traditional vegetables and, to some extent, the subsistence crops (maize and beans). It also suggests that returns to farm labor in the small enterprises in the Western Highlands are cut. The export tax for the labor-intensive new vegetables in the Western Highlands had adverse effects on employment and real income of the rural poor.

Table 7—Effect of exchange-rate policy on export vegetable producer price: an example from a snow pea sale by Guatemala to the United States, July 1985

Affected Item	Price and Tax Effects
(1) Actual "return price" of a shipment	US$0.35/pound
(2) Declared "return price" of shipment (lowest price noted on market in reference period of shipping)	US$0.25/pound
(3) 50 percent of declared "return price" at official exchange rate (Q1.00 = US$1.00)	Q0.125/pound
(4) 50 percent of declared "return price" at parallel exchange rate (Q1.00 = US$0.27)	Q0.463/pound
(5) Difference between actual and declared "return price" at parallel exchange rate (Q1.00 = US$0.27)	Q0.407/pound
(6) Actual "return price" in domestic currency (position [3] + [4] + [5])	Q0.995/pound
(7) Tax due to official exchange rate applied to 50 percent of declared "return price" (in position [3])	Q0.338/pound
Tax in percentage of actual "return price" position (1) at parallel exchange rate	25.4 percent

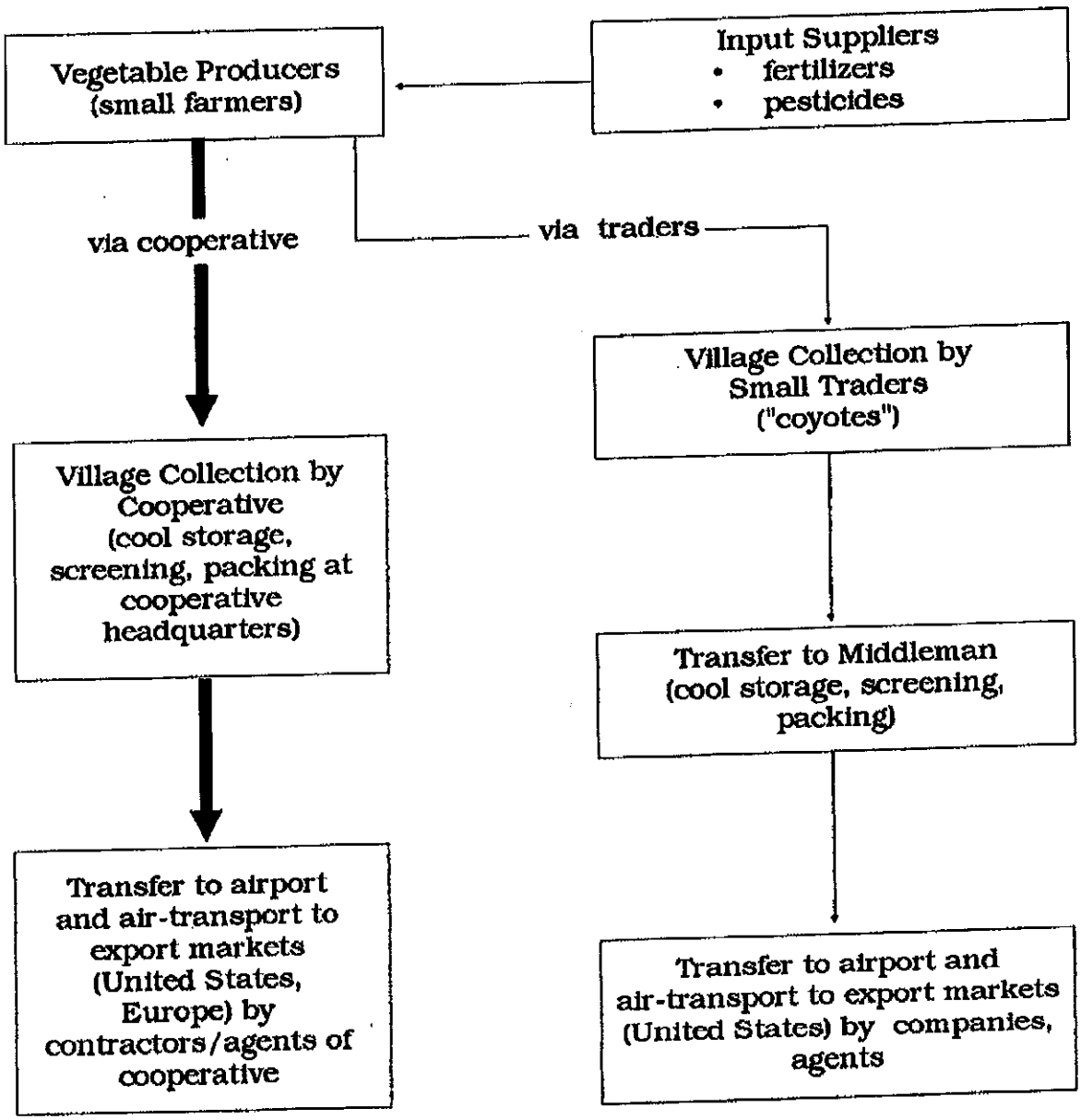
Source: Information from traders in Guatemala.
Note: "Return price" is the net price c.i.f. U.S. market (Miami) after transport and handling costs are deducted. It is "returned" to the exporting cooperative, which passes it on to farmers after deducting local marketing margins.

Risks in the Marketing Institutions

It is obvious that the sustainability of the export operation of a perishable commodity largely depends upon the proper functioning of the marketing channel of inputs and outputs (Figure 3). Input markets of fertilizers and pesticides appear to be well integrated in Guatemala. Domestic prices of inputs are largely determined by international price changes and by the exchange-rate policy.

The output marketing in the study area is largely via the Cuatro Pinos cooperative. The sustainability of this institution is crucial for the profitability of export crop production. Cooperatives in the Western Highlands have a mixed record of success. It has not been uncommon for cooperatives to collapse because of dishonest management practices or political reasons, especially during the period of violent conflicts in the

Figure 3—Marketing channels for fresh export vegetables from Guatemala



late 1970s and early 1980s. The survival and growth of Cuatro Pinos appears as a successful exception to the rule.

The technology required for the operation of the first phase of the export channel within the country is simple and does not require major external inputs or expertise. An important component of the marketing system is the flow of information from the export market to the cooperative and the growers. Increasingly developing its outreach, the cooperative has recently started shipping to European markets. This international flexibility further reduces the risk of dependence that occurred in the early stage of the export vegetable production when ALCOSA was the single buyer. In 1987 five companies besides ALCOSA processed frozen vegetables, and six other companies are operating the fresh vegetable export channel that now provides for a highly competitive market structure. Recently the cooperative has started to process dried vegetables (parsley) in storable form and has begun construction of its own freezing facility.

Also, farmers now have an alternative market outlet for export vegetables, in addition to the cooperative, via small traders who collect at the village level. The quantities acquired by these traders appear to be small in the study region. This competitive outlet reduces the risk to farmers that their access to export markets would break down in case of a collapse of the cooperative.

The marketing costs of fresh vegetables (for example, snow peas) are high. The consumer price in the United States was about five times the producer price paid in Guatemala in 1985 (Table 8). Apart from a 10 percent sales commission to the brokers

Table 8—Marketing costs of a fresh export vegetable (snow peas) from Guatemala to the United States, 1985

Item	Price per Pound	Prices and Marketing Costs in Percent of U.S. Consumer Price
Price paid to farmer	Q0.90[a] (US$0.57)[b]	**19.0**
Cost of marketing		
Local cost at cooperative		
Loss due to final selection	Q0.05	
Packing box	Q0.15	
Labor	Q0.03	
Coding	Q0.02	
Overhead or management	Q0.03	
Subtotal	Q0.28 (US$0.08)[c]	2.7
Cost of exporting to the United States		
(Air) freight to Miami	US$0.30	
Freight to sales place	US$0.03	
Cooling	US$0.02	
Customs	US$0.03	
Commission for broker	US$0.10 (approximate)	
(10 percent of gross sale)	US$0.48	16.0
Subtotal	US$0.56	**18.7**
Total marketing cost	US$1.13	37.7
Total cost of produce c.i.f. Miami	US$1.87	**62.3**
Marketing margin and profit in the United States	US$3.00[d]	**100.0**
Price to U.S. consumer		

Source: Records of Cuatro Pinos cooperative.
[a] Approximate weighted average price for farmers in 1985; actually fluctuated between Q0.15 and Q2.00 per pound.
[b] The weighted split exchange rate 50 percent at parallel (= Q3.65) and 50 percent official (= Q1.00) is used here.
[c] The parallel exchange rate is applied here.
[d] In 1985, this price varied between US$2.00 and US$4.00 per pound.

who arrange the sale in the U.S. market, the marketing costs (c.i.f. Miami) are not affected by the sales value. The marketing costs to Miami were about 18.7 percent of the consumer price, or roughly equal to the producer price. Any fluctuations in the U.S. market price are fully and immediately transmitted to the (Guatemalan) producer. Cutting marketing costs appears to be a desirable approach to benefiting producers and consumers, but in this particular case not much space appears available for cost-cutting measures.

Some interesting conclusions can be drawn from the assessment of "institutional risks" faced by the export crop producer. These risks can be reduced by opening up alternative marketing and processing lines at a level close to the farmers as well as by diversifying the export markets to avoid monopsonistic pressures. Options for diversification in production and processing and in export target markets within the group of export vegetables are substantial and have effectively been exploited as risk-reducing measures. The know-how for this—transferred via an institution such as a cooperative—may be at least as advantageous to farmers' income stability as any attempts to efficiently organize on-field production stability.

It is in the best interest of farmers that cooperatives and merchants not only coexist and compete at the produce-collection level but also operate independent export lines. This has finally been achieved in the area where Cuatro Pinos operates. However, such competitive structures cannot be expected to arise in the earliest phase of new export crop introduction. Monopsonistic patterns and related problems appear more likely, as in the early phase of export vegetable production (see Chapter 2). The export vegetable production of Cuatro Pinos started out as a contract activity with monopsonistic characteristics—a branch of a multinational corporation being the sole buyer in the country. Over a period of five years, the cooperative changed substantially as it began to operate independently and competitively in the regional and international markets, and as other private companies were set up. This development is basic to the reduction of the institutional risk involved in export crop production.

5

EFFECTS OF THE NEW EXPORT CROPS ON AGRICULTURAL PRODUCTION, INCOME, AND EMPLOYMENT

Adoption of Export Crops by Subsistence Farmers

Agriculture in the survey area was formerly dominated by production of maize and beans, with 10 percent of the land devoted to vegetables for the local market. Those farm households who are not members of the export crop cooperative and who live in the more remote sample villages still show this cropping pattern in 1985. In villages such as El Rejón, Pacul, and Pachalí, maize and beans cover 84-96 percent of the crop area of nonmember farms (Table 9).

The important relationship of access to infrastructure and degree of market integration is revealed by the case of Santa María Cauqué, which is located at the highway to Guatemala City. There, even nonmember households plant only 51 percent of their land with subsistence crops.

Cooperative members farm on average 0.94 hectare, while nonmembers farm 0.66 hectare. Comparisons of the two groups, therefore, must take the farm-size difference into account. Accordingly, most agriculture-related information is presented by farm-size classes in this chapter. It is interesting to note that with these holdings and the allocation of 52 percent of land to subsistence crops by members and 78 percent by nonmembers, households in both groups allocate on average about the same land area to subsistence crops (members, 0.49 hectare, versus nonmembers, 0.51 hectare).

Table 9—Farm size and cropping patterns of members and nonmembers of the Cuatro Pinos cooperative, 1985

Farm Size/Crops	San Matéo	El Rejón	Santa María Cauqué	Pacul	Pachalí	Santiago	Total Average
				(hectares)			
Average farm size							
Members	0.82	1.15	0.86	0.61	1.06	0.85	0.94
Nonmembers	0.64	0.95	0.83	0.80	0.58	0.54	0.66
				(percent of area)			
Maize, beans							
Members	48.8	62.6	41.3	45.3	42.4	57.7	51.8
Nonmembers	81.6	83.9	51.0	87.2	95.5	81.9	77.8
New cash crops							
Members	45.9	35.4	38.8	41.8	53.3	35.9	39.3
Nonmembers	4.0	8.0	22.1	3.3	1.5	7.3	8.9
Traditional cash crops							
Members	5.3	2.1	19.9	12.9	4.4	6.4	9.1
Nonmembers	14.5	8.1	26.9	9.5	3.0	10.9	12.8

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Note: Parts may not add to totals because of rounding.

Export crop production is open to every farmer in the six communities where the Cuatro Pinos cooperative is active. Because merchants outside the cooperative have recently begun operation of another marketing channel for the new export crops, the option to grow export vegetables is not entirely tied to membership. However, with the exception of Santa María Cauqué, a centrally located village where many merchants base their operations, only a very small group of nonmember farmers grows the new crops. This means that becoming an export crop farmer is in most villages synonymous with becoming a cooperative member. This decision is a matter of free choice.[8]

The major decisions made in commercial and subsistence agriculture are decisions that are mostly made either exclusively by the male head of household or jointly by men and women but dominated by men. Nieves (1987) finds that the presence of the cooperative seems not to have altered this relation, at least not in the short term. In her case study on 21 households that are a subsample of the INCAP/IFPRI survey in 1985, Nieves found that the decision to become a member was, in all 21 cases, prompted by the male head of the household. In 16 of these cases, the male head asked the wife's opinion before taking any action. There are no legal or statutory barriers to female participation in the cooperative as members in their own right, yet very few women have membership status (5 out of more than 1,000 members in 1987). Nieves states that women in the study area will assume only public, visible roles that are culturally sanctioned. Applying to the local committee for membership would be an example of a public action traditionally not open to women. Cooperative membership is not a status that women feel they can attain, so they do not apply.

Membership in the cooperative is open to crop growers (but not necessarily to landowners) and small farmers by local standards (no member has more than 3 hectares). Members are obliged to participate in scheduled meetings of the organization and to pay a one-time membership fee of Q38. This enrollment fee is not negligible, as it roughly corresponds to 12 days' wages for a farm worker.

To test the determinants of adoption of export cropping, a probit model is estimated in which the dependent variable equals 1 if the household is an export crop grower, and zero otherwise:

$$Y_i^* = \beta' X_i + u_i, \tag{1}$$

where

$$Y = 1 \text{ if } Y_i > 0, \text{ otherwise}$$

$$Y = 0, \text{ and}$$

$$\text{Probability } (Y_i = 1) = \text{Probability } (u_i > \beta' X_i) = 1 - F(-\beta' X_i),$$

where F is the cumulative distribution function for u.[9] The β' are maximum likelihood estimates. The bias toward a higher (nonrepresentative) members' share in the sample is taken into account in estimating the probit model. The true proportion of members versus nonmembers, known from the 1983 census information and the cooperative

[8] For the first time, the cooperative was closed to new members in the fall of 1986, as the rapid expansion of members was considered unmanageable by the cooperative leadership. More members were admitted later, but the cooperative was closed to new members again in 1988.

[9] For a description and discussion of the probit model, see, for example, Maddala 1983, 22-27.

records, is used to weigh the observations.[10] The theoretical concept of the model application is the following: Income potentially earned off-farm determines the opportunity cost of working on-farm. In the long run, earning off-farm income versus increased on-farm work growing the labor-intensive export vegetables is a choice facing farm households. This choice is determined by the off-farm versus on-farm opportunity costs of family labor. Endowment of human capital and established off-farm employment opportunities determine these relationships for a specific household.

It is hypothesized that the choice to become an export crop grower was determined by the expected income increase, which can be assumed to be determined by the resource endowments of the farm (farm size, land quality) on the one hand, and the access to alternative, relatively secure off-farm employment on the other. It should be noted that only a secure (formal) off-farm income source enters here as an exogenous factor, since high substitution of daily wage earnings and occasional trading income versus on-farm work in the new export crop prevails, as is shown later.

It is further hypothesized that household labor force size and composition (women's share) may be a factor for adoption. A larger household labor force may enhance adoption of the labor-intensive crop, and a higher share of women's labor may induce a different balance of preferences and bargaining positions in the household. Since the decision is mainly that of the male head of household, his age, education level, and attitude toward traditional agriculture are other factors of hypothetical impact for the adoption decision.

The access of villages to infrastructure affects adoption of the new crops. This and the stepwise expansion of the cooperative into some of the villages suggest the inclusion of village-specific variables in the model. Based on these hypotheses, the adoption model is specified as follows:

$$EXG = f(FSZHA, WLQ, FOFFY, LAB, RWOMLAB, HHAGE, HHEDUC, HHTRAD, VILLAGE1, \ldots, 5), \quad (2)$$

where

EXG = export crop grower (= 1 if more than 10 percent of area in nontraditional export crops, else = 0),

FSZHA = farm size (hectares),

WLQ = land quality index (1 = best, . . . , 4 = worst),

FOFFY = household income from formal off-farm employment (quetzals per year),

LAB = total labor available in the household (that is, persons of working age), not disabled and not long-term absentees (in man equivalents),

RWOMLAB = share of female labor in total labor of household,

HHAGE = age of head of household (years),

HHEDUC = household head's education (years of schooling),

[10] The approach is described in Manski and McFadden 1982.

HHTRAD = household head's attitude toward maize production being "traditional" (= 1 if stated that most important reason for growing maize was for food *and* that second most important reason was that he grew maize to this extent because he always did so; else = 0), and

VILLAGE 1-5 = dummy variables for villages 1 . . . 5 = 1 each (else = 0); villages as listed in Table 1 from left to right.

The probit estimates are listed in Table 10 and can be used to derive linear probabilities $\hat{\beta}_{LP}$, which can be approximated (see Amemiya 1981) by

Table 10—Probit estimate of export crop adoption

Independent Variable	Coefficient	t-Value	Approximate Probability of Joining Export Crop Production[a]	Mean Value of Variable	Standard Deviation
FSZHA	0.65970	5.105	0.2630000	0.689	0.644
WLQ	−0.19191	−1.109	. . .	2.120	0.456
FOFFY	−0.00021	−2.540	0.0000848	406.600	932.900
LAB	−0.08476	−1.544	. . .	3.780	2.360
RWOMLAB	−1.00440	−2.016	0.4020000	0.466	0.179
HHAGE	−0.00822	−0.833	. . .	38.700	12.400
HHEDUC	0.32280	0.692	. . .	2.930	1.730
HHTRAD	−0.36682	−2.263	−0.1470000	0.545	0.489
VILLAGE 1	−0.54760	−1.953	−0.2190000	0.119	0.324
VILLAGE 2	0.17560	0.692	. . .	0.113	0.317
VILLAGE 3	0.78250	3.632	0.3130000	0.186	0.389
VILLAGE 4	−0.23840	−0.811	. . .	0.076	0.265
VILLAGE 5	−0.16220	−0.558	. . .	0.095	0.287
INTERCEPT	0.72380	1.258	. . .	. . .	. . .

Notes: Dependent variable: Export crop grower (= 1, else = 0). Number of observations: 357. Chi-squared: 108.06.

FSZHA = farm size (hectares),

WLQ = land quality index (1 = best, . . . , 4 = worst),

FOFFY = household income from formal off-farm employment (quetzals per year),

LAB = total labor available in the household (that is, persons of working age) not disabled and not long-term absentees (in man equivalents),

RWOMLAB = share of female labor in total labor of households,

HHAGE = age of head of household (years),

HHEDUC = household head's education (years of schooling),

HHTRAD = household head's attitude toward maize production being "traditional" (= 1 if stated that most important reason for growing maize was for food *and* that second most important reason was that he grew maize to this extent because he always did so; else = 0), and

VILLAGE 1-5 = dummy variables for villages 1 . . . 5 = 1 each (else = 0); villages as listed in Table 1 from left to right.

[a] The values in this column are the $\hat{\beta}_{LP}$ for the parameters estimated with a reasonable degree of statistical significance (above 95 percent level).

$$\hat{\beta}_{LP} = 0.4\,\beta'. \qquad (3)$$

The estimation results indicate that the decision of households to adopt the new export crops is not independent of household and farm characteristics:

1. Although all farms in the sample are small by almost any standard, an increase in size of farm significantly increases the probability of becoming an export cropper. Applying the above-mentioned conversion factor of 0.4 to the parameter estimate (FSZHA in Table 10) suggests that one additional hectare of farm size increases the probability of growing export vegetables by 26 percent. The adoption-farm size relationship is complex. This finding of increased probability of adoption *within* the small-farm sector with rising farm size is not contradictory to the earlier finding that the new export crops moved in a trial-and-error path from production on large-scale exporter enterprises to contract growing on medium-sized farms of 20-30 hectares to the small-farm sector. As the probability of adopting *within* the small-farm sector *increases* with farm size up to a certain level, economies of scale are apparently not linear at the tail end. It is found, however, that those smallest farms that did adopt actually allocated a higher share of their land to the new crop. Adoption and extent of adoption are thus not synonymous.

2. Increased income from formal off-farm employment—that is, relatively secure income from sources other than day labor—decreases the likelihood that households will grow export crops. The estimation result suggests that if this type of relatively secure income increases by Q500 (which is approximately the difference between the mean and standard deviation of FOFFY), the probability of joining the scheme decreases by 4 percent.

3. An increased share of women's labor in total labor significantly reduces the probability of growing export vegetables (RWOMLAB) after controlling for total labor force of the household (LAB). As noted earlier, adoption of the new crop is primarily a male decision, and the model results suggest that households with a female-dominated labor force stay away from the new crop.

4. Traditional motivation to grow maize (HHTRAD) significantly decreases the probability of becoming an export crop grower.

5. For households located in a remote village that has recently been included in the scheme (village 1, San Matéo), the probability of becoming a member appears lower, while it is significantly higher in village 3 (Santa María Cauqué), which is located at the highway.

The statistically nonsignificant results in the probit model are also interesting to note:

1. Differences in land quality of the farm (WLQ) have not significantly affected the choice of becoming an export crop farmer.

2. Availability of household labor does not significantly affect the choice of becoming an export crop grower. The market for hired labor is highly integrated in the region, which suggests this model outcome.

3. The age and level of education of household head, which were assumed in order to indicate human capital endowment of the household, do not significantly affect the adoption probability.

In summary, it may be concluded from these results that the less traditional farmers on the somewhat larger (small) farms and those who do not have access to relatively secure (formal) off-farm employment were most likely to adopt the export crops.[11]

[11] The probit model of the same specification was also estimated for the dependent variable defined as membership/nonmembership in the cooperative (= 1,0). While the results for the farm size and off-farm income variables were similar, the other variables were not statistically significant in that model.

That comparatively larger farms were joining the cooperative becomes clear from the distribution by farm-size class among the member and nonmember groups. Table 11 reveals a tendency often observed in patterns of adoption of "green revolution" technologies in peasant agriculture; more of the early adopters have somewhat larger farms (more than 1 hectare) than adopters who join later.

Profitability and Risks of New Export Crops and Subsistence Crops

For those farmers willing to adopt new export crops, the returns of those crops to factors of production (that is, land and labor) is central. In addition to the average profitability, the stability of returns from these crops is an important factor, as risk may be an issue of concern. Gross margins are used as measures of profitability. The gross margins calculated are based upon the 1985 survey covering the 1984/85 cropping season as expressed in the cropping calendar (Figure 4). Gross margins are the value of output minus the direct costs. Rent for land is not included. To assess the competitiveness of various crops at the farm level, gross margins are expressed per unit of land and per family-labor day.

Since snow peas stand out as the main new crop in the following comparisons, its agronomic characteristics will be mentioned here. The peas are sown in rows. When they are about 20 centimeters high, the plants are tied to ropes that are stretched between sticks along the rows of plants. The plants grow up to about 1-1.3 meters on the continuously added ropes. The main work tasks are weeding, spraying for pest control, and picking the peas. Picking starts after an 8-week growing period and extends over 10-12 weeks. The crop is thus on the field from 18 to 20 weeks. Snow peas are sprayed two times per week over the growing period. The cost of recommended spraying in 1984/85 was Q596 per hectare. Because the devaluation of the quetzal on the parallel market sharply increased this cost (see Chapter 4), the 1986 spraying bill was 310 percent of the 1984/85 bill. The wage bill for snow peas is also considerably higher than for any of the competing crops. The related employment issues will be addressed later.

Being a legume (a variety of *p. sativum*), the snow pea enriches the nitrogen content of the soil, which benefits crops that follow in the rotation.

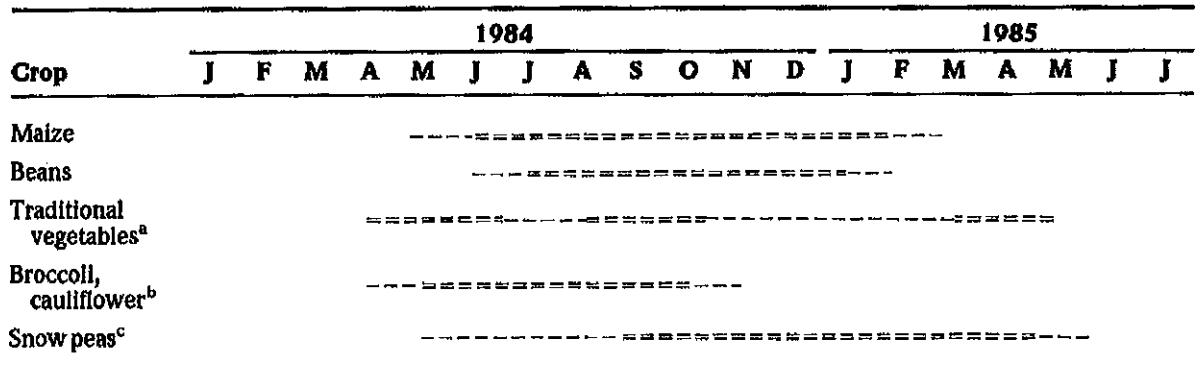
Snow peas yield a gross margin per unit of land 15 times higher than that of the principal subsistence crop, maize, on cooperative member farms (Table 12). Per unit of family labor, the gross margin of snow peas is about twice the margin reported for

Table 11—Farm-size distribution of cooperative members and nonmembers

Farm Size	Nonmembers	Length of Membership		
		2 Years or Less	3–4 Years	5 Years or More
(hectares)	(percent)		(percent)	
Less than 0.25	25.8	5.0	6.1	2.8
0.25–0.50	36.0	20.0	24.5	20.8
0.50–1.00	21.3	47.5	40.8	41.7
1.00 or more	16.9	27.5	28.6	34.7
Total	100.0	100.0	100.0	100.0

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Figure 4—Cropping calendar of subsistence crops, traditional vegetables, and export vegetables in the Western Highlands, 1984/85



Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Note: The double lines show the main periods of planting, growing, and harvesting; the single lines show extended periods during which a minority of farmers engage in these activities.

[a] Cabbage, carrots, radishes, and others.

[b] Main planting season, May-August; main harvest season, June-September.

[c] Main growing period, August-April; main harvest period, October-June.

maize, as snow peas absorb 7 times more family labor per hectare, or 5 times more total labor input in terms of days, than maize. Traditional vegetables are roughly as profitable as broccoli and cauliflower per unit of family labor. Beans are between maize and the above vegetables. The per hectare input costs of snow peas are about 13 times as high as those of maize. These high input costs of snow peas stem from high use of pesticides and from the costs of special production inputs (sticks to bind the plants and ropes to tie the climbing snow pea plants to the sticks).

Cooperative members finance the considerable input costs partly through agricultural credit. Forty-two percent of members had received credit during the previous year. On average the sum borrowed amounted to Q480, which covered the variable input cost for 0.3 hectare of snow peas. Only 3 percent of the nonmembers reported having had access to credit during 1984/85. It is interesting to note that those farmers who grow the new export vegetables under the cooperative scheme have higher returns and lower unit costs of production in the maize crop than other farmers (columns 1 and 2 of Table 12). The input cost and wage bill are higher for members, yet their output per unit of land is further increased, thus leading to this outcome. The relationship of this pattern to the export vegetables is analyzed in detail below.

The ranking of crops by their profitability shows a similar pattern if the sample is disaggregated by farm-size class (Table 13). There is a tendency for maize gross margins per hectare to decrease with increasing farm size, both for export crop producers and other farms, but returns to family labor do not differ a great deal between farm-size classes. Constant returns to family labor and decreased returns to land with increased farm size indicate that larger farms operate at higher cost levels per unit of land or at lower yield levels or both. No general tendency is visible from the tabulations of gross margins of the new export vegetables per unit of land and labor. The apparently negative scale effects for these crops, discussed above in the context of ALCOSA's experience (Chapter 4), may become effective only outside the range of small farm sizes observed in the sample.

Table 12—Cost of production and gross margins of export vegetables and subsistence crops, 1984/85

Item	Non-member Farms, Maize	Cooperative Member Farms				
		Traditional Crops			New Export Crops	
		Maize	Beans[a]	Traditional Vegetables	Broccoli, Cauliflower	Snow Peas
	(quetzals/hectare, mean values of sample)					
Seeds, plants	0.20	0.21	26.55	106.30	85.76	54.87
Fertilizer	100.12	105.60	85.28	158.61	243.82	216.16
Other inputs	13.66	14.85	55.10	167.95	103.88	1,296.13
Total inputs	113.98	120.66	166.93	432.86	433.46	1,567.16
Wages paid	96.22	167.71	133.69	306.06	283.58	552.71
Value of output	353.75	457.80	681.00	1,804.53	1,339.17	4,416.20
Gross margin per hectare[b]	120.43	143.87	362.79	1,065.61	593.37	2,204.15
	(days/hectare, mean values of sample)					
Days of family labor per hectare[c]	63	54	121	299	168	400
Days of total labor per hectare[d]	101	119	172	416	277	613
	(quetzals/day, mean values of sample)					
Gross margin per day of family labor	1.91	2.66	2.99	3.47	3.53	5.51

Source: Computed from data from Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.
Note: The mean values are based on 173 observations on nonmember farms and 160 observations on member farms.
[a] Beans in sole stand.
[b] To compute the gross margin from value of output, wages, and total inputs, interest on the sum of purchased inputs and on the part of the wage bill for nonharvest labor is deducted. The interest rate used is 15 percent adjusted to the duration of the crop's growing period.
[c] Men's, women's, and children's labor days are weighted by 1.0, 1.0, and 0.6, respectively.
[d] This includes hired labor.

Cooperative members on average have higher returns than nonmembers to both land and family labor for the three comparable crops (maize, beans, and traditional vegetables; see totals in Table 13). In general, this pattern is also revealed within the farm-size classes.[12] Thus it appears that the more efficient farmers joined the export crop scheme, as there is no indication of basic differences in land-resource quality between the two groups. Yet, joining the cooperative may also have improved farmers' access to yield-improving technologies—for example, inputs and information. These aspects will be evaluated in more detail below. At this point it is worthwhile to note that export crop producers achieve higher returns to land and family labor from subsistence crops (maize and beans) than do other farmers, although the export crop farmers devote more resources to the new export vegetables.

The gross margin (net return) per day of family labor indicates the level of opportunity cost of family labor in agriculture. The gross margins per family labor day fall in the range of local wage rates, which were Q2.00-2.50 in 1984 and Q3.00-3.50 in 1985

[12] It should be noted that many different crops are aggregated into the group of traditional vegetables. The related gross margin figures vary considerably between farms due to this aggregation.

Table 13—Gross margins of export and traditional crops per hectare and per person-day of family labor, by farm size, 1984/85

Farm Size/Unit	Export Crop Producers					Traditional Crop Producers		
	Maize	Beans	Traditional Vegetables	Broccoli, Cauliflower	Snow Peas	Maize	Beans	Traditional Vegetables
(hectares)				(quetzals)				
Less than 0.25								
Per hectare	(188.00)	...	(407.00)	...	(2,198.00)	127.00	181.00	852.00
Per day[a]	(2.61)	...	(1.00)	...	(3.74)	1.98	3.18	1.64
0.25–0.50								
Per hectare	175.00	(254.00)	(2,654.00)	(365.00)	2,791.00	149.00	191.00	609.00
Per day[a]	3.13	(7.70)	(7.97)	(2.81)	6.10	2.10	3.19	2.14
0.50–1.00								
Per hectare	146.00	187.00	375.00	645.00	1,785.00	85.00	(25.00)	397.00
Per day[a]	2.43	2.25	1.24	3.41	4.52	1.42	(0.32)	1.15
1.00 or more								
Per hectare	117.00	648.00	860.00	624.00	2,398.00	84.00	83.00	935.00
Per day[a]	2.72	5.36	3.54	4.22	6.97	1.83	3.19	4.16
Total								
Per hectare	144.00	363.00	1,066.00	593.00	2,204.00	120.00	130.00	659.00
Per day[a]	2.66	2.99	3.47	3.53	5.51	1.91	1.76	1.96

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Notes: Values computed from 10 observations or fewer are in parentheses. The export crop producers are members of the cooperative; the traditional crop producers are not members.

[a] Children's labor days are weighted with a factor of 0.6; men's and women's labor days are weighted with 1.0 each.

for a man's person-day in the field. Women's wage rates are reported to range from Q0.50 to Q1.00 lower than men's. Returns to family labor on export crop farms exceed these male and female wage rates by a substantial margin. As a result, the labor supply into the local labor market from these farm households has substantially decreased.

Inseparable from the assessment of profitability of new export crops versus traditional crops is their comparative risk. There is a great deal of uncertainty about the new crops' output and input price fluctuations. A long-term longitudinal study would be required to properly address the issue. Moreover, it should be reiterated that new export crops particularly impinge on the off-farm labor supply of small farm households in the Western Highlands. The comparison of risks in reallocating household labor away from the uncertain off-farm labor market into their own uncertain new crop enterprise is as important as the between-crop comparisons, which is the focus of most literature on farm production risk. While this study is not designed to assess this aspect, it should be kept in mind that the between-crop comparisons are of limited relevance for an agricultural system that is as closely integrated into the nonagricultural labor market as is the case with farmers in the Guatemalan highlands.[13]

A first indication of differences in degrees of price risk for crops is given by the variance of prices within a cropping year across the survey area. Clearly, average prices received by farmers for the new export crops vary much more than the maize price but not more than the price of beans and traditional vegetables grown for the local

[13] Increasing labor market participation in case of crop loss is a common risk-adjustment strategy of small farmers in Central America. In a survey in El Salvador, it was found to be the most frequently used strategy. See Walker and Jodha 1985, 17-34.

markets. As shown below, the coefficients of variation of snow pea, broccoli, and cauliflower prices in 1985 tended to be even lower than those for beans and selected traditional vegetables.

Crop	Coefficient of Variation
Maize	0.23
Beans	0.83
Traditional vegetables	
Beets	0.77
Radishes	2.27
Lettuce	0.63
Spinach	1.00
New export crop	
Snow peas	0.58
Cauliflower	0.52
Broccoli	0.24

It should be noted, however, that the intrayear price differences of beans and traditional vegetables may be of a seasonal nature that could be predicted by farmers with a certain probability. Thus the level of uncertainty related to price variability of traditional crops may be less than, say, for snow pea prices, which do not follow a clear seasonal pattern (see discussion in Chapter 4).

A second indication of the risk of new export crops versus traditional crops is given by a comparison of the variation of their respective gross margins per hectare. We find that gross margins of the new export vegetables tend to be less variable across the sample than those of traditional crops.

Relative variability crop-by-crop does matter, but levels of potential losses as a proportion of the asset base (land) are also important for the determination of household risk. Given the high input levels for new export crops, the potential loss from crop failure, output-price depression, or input-price increases may constitute a much higher probability of substantial income loss. To assess this aspect, the frequencies and levels of losses from traditional crops and new export crops are evaluated. Losses are represented in this assessment by negative gross margins, that is, net returns to land and unpaid family labor were negative, as variable costs exceeded the gross value of production. A combination of factors may lead to this outcome; for example, unfavorable input-output ratios, high input or low producer prices, or both. From this comparison, it becomes evident that farmers produced the new export crops at a loss as frequently as the traditional crops in 1985.[14] However, to take the two extreme cases—maize and snow peas—in 24.5 percent of the sample fields, gross returns of maize do not cover the variable costs and, similarly, in 25.1 percent of the fields, gross returns of snow peas do not cover these costs. The absolute loss per unit of land is about 10 times as much in the case of snow peas as it is for maize (Q130 versus Q1,309 per

[14] It should be noted that the percentage levels of negative gross margins might be somewhat overstated due to the usual noisiness of such recall surveys that leads to extended tails of the distribution function of variables. For this analysis, only the *relative* comparison across crops is relevant, and that should not be affected too much by this problem.

hectare). Clearly, this new export vegetable appears quite risky if viewed in isolation on the farm, but most farmers tend to minimize loss by devoting only a fraction of their land to the new crop.

Losses and gains from crops within the farm enterprise may compensate for each other. A comparison between cooperative members and nonmembers shows that the percentage of farms that reported an overall income loss was similar in both groups in 1984/85 (17.8 percent of members and 16.8 percent of nonmembers). The income losses in percentage of total expenditures averaged 7.7 percent in the member households and 5.7 percent in the nonmember households. This suggests that overall income risk does not appear significantly greater among members than nonmembers.

Effects of New Export Crops on Land Use and Land Market

Despite the small absolute differences in farm size, cropping patterns change substantially by farm size. It is particularly interesting to note the case of maize. With increasing farm size, the share of maize in land use increases in member farms but decreases in nonmember farms (Table 14). Snow peas—the principal new export crop—have a relatively higher share in smaller farm-size classes of cooperative members. While the probit model (Table 10) indicated that the choice to become an export cropper is biased toward the somewhat larger farms within the small-farm sector, the relative scale at which new export crops are adopted (once the decision to grow them has been made) appears larger in the smaller farms (or at least the same as in the bigger farms if snow peas and broccoli-cauliflower are viewed together). It is noteworthy that some nonmembers of the cooperative also grow the new crops. They are mainly located in one village close to the Inter-American Highway, where traders have started to pick up export vegetables.

An effort is made in the survey to assess differences in land quality between member and nonmember farms. Farmers were asked to evaluate each of their fields according to a scale of 1 to 4 ("very good," "good," "not so good," "poor") in comparison with

Table 14—Cropping patterns of cooperative members and nonmembers, by farm size, 1985

Farm Size	Maize	Beans	Snow Peas	Broccoli, Cauliflower	Traditional Vegetables	Other
(hectares)			(percent of cropland)			
Members						
Less than 0.25	35.3	3.2	44.9	. . .	14.5	2.1
0.25–0.50	41.4	5.0	28.9	8.4	13.5	2.6
0.50–1.00	45.3	6.6	27.7	13.0	5.2	2.3
1.00 or more	48.4	5.7	25.6	12.5	5.3	2.5
Total	46.7	5.2	28.0	11.1	6.7	2.4
Nonmembers						
Less than 0.25	67.7	13.1	5.8	. . .	12.4	0.5
0.25–0.50	60.0	19.0	4.8	1.8	11.0	3.4
0.50–1.00	60.7	14.2	7.0	4.1	12.7	1.3
1.00 or more	54.0	12.8	15.8	7.0	9.1	1.3
Total	66.1	11.7	6.3	2.5	11.4	1.9

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

the land quality in their community. A variable derived from this subjective evaluation, included in the probit model in Chapter 4, was insignificant for adoption. Although the distribution pattern of the surveyed fields by members and nonmembers (Table 15) underscores that there are no indications of substantial difference in land quality between member and nonmember farms, there is a clear indication that cooperative members grow the new export crops on their better pieces of land. The members planted new export crops on 69.2 percent of their land identified as "very good," but on only 31.6 percent of the land classified as "not so good."

The much higher returns of new export vegetables per unit of land, compared with traditional local vegetables or subsistence food crops, can be expected to impinge on the local land market. Demand for the quality land should increase, thus increasing land prices in the prevailing situation of extreme land scarcity. Given the shortage of cash and limitations of collateral for borrowing substantial amounts of money, the increased demand for land is hypothesized to be largely realized on the land-rental market rather than through land purchases. Yet, as the survey indicates, both the land-rental market and the land-purchase market appear to be stimulated by increased land demand from export crop growers. Cooperative members use a significant share of their rented land (20 percent) for the new cash crops (Table 16). Also, members pay higher rents per hectare of land used for new cash crops than for land rented and used for subsistence crops (rents per hectare are 42 percent higher for export vegetable fields). This may be due to the better land quality demanded for these crops.

Table 15—Relative quality of land of cooperative members and nonmembers and of land used for the new export crops

Land Quality	Share of Parcels in Each Quality Group		Share of Parcels Used by Members for New Export Crops
	Members	Nonmembers	
		(percent)	
Very good	10.2	7.2	69.2
Good	74.3	74.4	55.9
Not so good	14.9	17.6	31.6
Poor	0.6	0.8	0.0

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Table 16—Landownership of parcels and use for new cash crops

Land Status	Cooperative Members		Nonmembers
	Share of All Parcels	Share of Parcels Used for New Cash Crops	Share of All Parcels
		(percent)	
Owned	76	73	77
Rented	17	20	15
Other[a]	7	7	8

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[a] Other forms of land acquisition, that is, temporary reallocations of land among members of a family.

Cooperative members expanded their own total land area during 1984 and 1985. Nonmembers had only a small increase. The reported net increase of members' land is 12.2 percent of the 1985 area compared with a 1.4 percent increase in the nonmember group. Land purchases are more frequent among the members, as 23 percent of the members reported a land purchase during the two years compared with only 8 percent for nonmember households. Usually very small amounts of land are purchased. Cooperative members were paying much higher prices for new land than nonmembers (Q6,272 versus Q3,150 per hectare). As in the case of rented land this may be due to the members' demand for more quality land for expansion of new export crop production versus the nonmembers' acquisition of more land for maize and beans.

Two conclusions are highlighted from this assessment of the effects of new export vegetables on the land market. First, the effective demand for land is increased as export crop producers expand their landholdings through rentals as well as land purchases. This expansion tends to further widen the existing gap in land size within the small-farm sector between export crop producers and other farmers. In the long run, it should be expected that a concentration of quality land will evolve in the sector of new export crop farmers, although currently there is no evidence of such a distinction.

Second, increased land values may be realized by land sales, renting out land, or making use of the increased collateral value of owned land on the capital market. Landowners in the area thus benefit from the increased land values induced by export crop production, regardless of whether they actually are export crop producers. Adversely affected through this effect are farm households that rent in land, especially if they have not taken up export cropping. Maintaining subsistence food levels from own production on rented land has become more expensive. The pressure to either give up rented land or join the export cropping scheme is increased due to the increased cost of land rental.

Effects of New Export Crops on Labor Demand and Employment

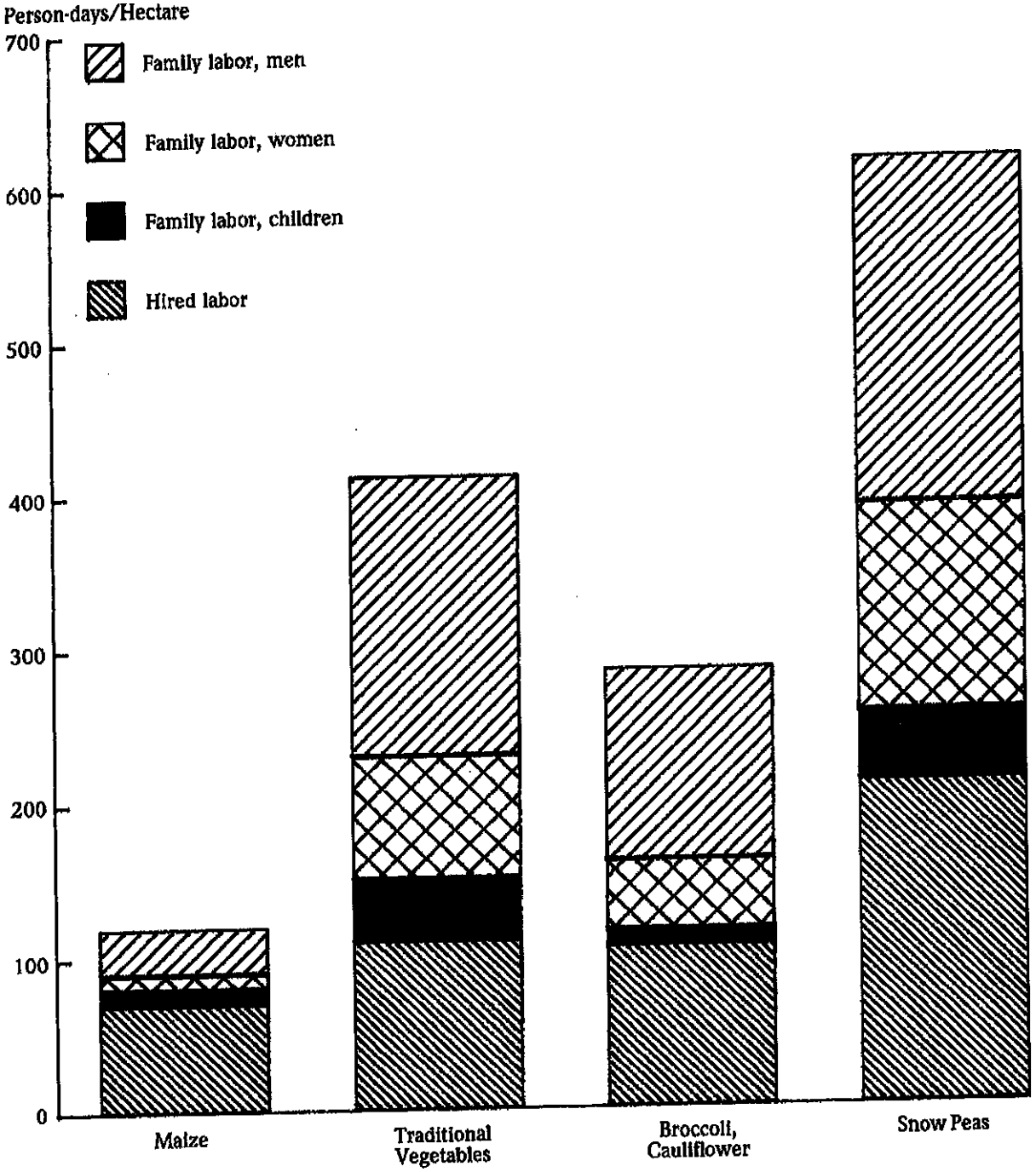
The new export crops create employment directly on the field and through forward and backward linkages, and indirectly through multiplier effects of the related income and employment. Their backward linkages are substantial. These crops have much higher input demands—not only for pesticides and fertilizers, which are not very labor intensive—but also, in the case of snow peas, for the locally manufactured sticks and ropes required for tying plants. Also, forward linkages are significant for employment, as the operation of the first stage of marketing is quite labor-intensive (selection, screening, and packing of produce). There are indirect employment effects from potentially higher income spent on goods and services with a high employment content. The following discussion focuses on the direct employment effects.

The new cash crops require much more labor input per unit of land than maize, the main subsistence crop (Figure 5). Snow peas also require more labor than traditional vegetables. Hired labor input is substantial, not only in the cash crops but also in subsistence maize, as more than half of the total labor input in maize is hired.

Most labor in all crops is provided by men, but this varies by crop type and by farm-size class. Women are responsible for 9 percent of family labor in maize, 25 percent in traditional vegetables, and 31 percent in snow peas (Table 17).

Family labor input per hectare decreases with increasing farm size for maize and traditional vegetables as well as for new export crops (Table 18). This family labor input is combined with increased hired labor inputs. Even in the smallest farm-size

Figure 5—Labor inputs for traditional crops and new export vegetables on cooperative members' farms, 1985



Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Table 17—Shares of men, women, and children in total family labor of cooperative members, by crop

Labor	Maize	Snow Peas	Broccoli, Cauliflower	Traditional Vegetables
		(percent of family labor)		
Men	85	59	70	61
Women	9	31	20	25
Children	6	10	10	14

Source: Computed from Table 18.

classes substantial wage bills per hectare are incurred from new cash crop production (Table 19).

Division of family labor among men, women, and children in the production of new export crops is not uniform across farm size. As shown below, men's share of total family labor remains quite stable across farm-size classes, while women's share declines and children's share increases.

Farm Size	Men	Women	Children
(hectares)		(percent of family labor)	
Less than 0.25	59	39	2
0.25–0.50	59	33	7
0.50–1.00	58	32	10
1.00 or more	58	26	15

With increasing farm size women's labor is relatively replaced by hired labor and child labor. This is not true for men's labor. The high substitution between women's labor and hired labor is a phenomenon observed widely across countries of the Third World (see, for instance, Boserup 1970, 30). It is probably related to the increasing opportunity cost of women's labor in the field when the combined household and farm enterprise expands. Returns to female household labor, including such activities as meal preparation for hired labor, increase and lead to higher degrees of specialization within the farm-household. This still means that absolute levels of family labor input by both men and women may increase with increasing farm size.

The pattern of hired labor use changes with the introduction of new export vegetables. Cooperative members demand more hired labor for the subsistence crop (maize) on a per hectare basis than do nonmembers in the same farm-size class (Table 19). This demand for hired labor is a result of the inability of family labor to meet the increased demand of producing cash crops. The production level of traditional crops is maintained to a certain extent by hiring outside labor for their cultivation.

The direct employment effects of new export crops on farms can be approximately accounted for by tracing the partial effects due to (1) switching land between traditional crops and new crops, (2) the change in labor input per unit of land, and (3) related substitutions between types of labor input, that is, family labor (men, women, children) and hired labor. These changes of allocation of crops and labor differ by farm size. In a given farm-size class (i) the net employment effect (E) is then

Table 18—Average family labor used per hectare by cooperative members and nonmembers, by farm size and crop

Family Labor	Farm Size	Members				Nonmembers	
		Maize	Snow Peas	Broccoli, Cauliflower	Traditional Vegetables	Maize	Traditional Vegetables
	(hectares)	(person-days/hectare)					
Men	Less than 0.25	64	350	...	271	53	399
Women		8	228	...	141	7	68
Children[a]		...	10	...	0	4	53
Total		72	588	...	412	64	520
Men	0.25–0.50	49	272	105	176	60	180
Women		6	152	25	100	6	69
Children[a]		1	34	0	57	5	36
Total		56	458	130	333	71	285
Men	0.50–1.00	50	231	133	181	52	249
Women		6	126	41	61	7	90
Children[a]		4	39	15	61	1	6
Total		60	396	189	303	60	345
Men	1.00 or more	37	200	104	167	42	169
Women		2	91	25	64	2	44
Children[a]		5	53	26	12	2	12
Total		44	344	155	243	46	225
Men	All sizes	45	234	117	181	54	239
Women		5	125	33	76	6	69
Children[a]		3	41	18	42	3	28
Total		53	400	168	299	63	336

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[a] Children's labor input is weighted with 0.6.

$$E_1 = \sum_j [\sum_s (a^*_{ijs} \cdot L^*_{ij} - a_{ijs} \cdot L_{ij}) + w^*_{ij} \cdot L^*_{ij} - w_{ij} \cdot L_{ij}], \quad (4)$$

where

a^*_{ijs}, a_{ijs} = per hectare labor input (days) of family labor types s(s = 1, . . . , 3) in crop j(j = 1, . . . , 6) and farm-size class i(i = 1, . . . , 4) with (a*) and without (a) the new export crops in the production program,

w^*_{ij}, w_{ij} = per hectare wage labor input (days) with (w*) and without (w) the new export crops, and

L^*_{ij}, L_{ij} = land used (hectares) for each crop (j) in farm-size class (i) with (L*) and without (L) the new export crops.

While the situation of new export crops is represented by the situation of land and labor allocation in the cooperative member farms, the "without" situation is represented by nonmember farms of the respective farm-size class that do not grow the new crops. Participation in the scheme was found to be influenced by farm size and secure off-farm employment (see the probit model above). While the farm-size effect is accounted for by the disaggregation into farm-size classes, the effect of off-farm employment is not. One might suspect that cooperative member farmers were growing some of the more labor-intensive traditional vegetables before they switched to export vegetables. This hypothesis, which can be assessed by the small number of farmers who became members between the two surveys, is not supported. Therefore, the cross-sectional evaluation

Table 19—Wages paid for hired farm labor by cooperative members and nonmembers, by farm size and crop

Farm Size	Members				Nonmembers	
	Maize	Snow Peas	Broccoli, Cauliflower	Traditional Vegetables	Maize	Traditional Vegetables
(hectares)	(quetzals/hectare)					
Less than 0.25	135	158	...	...	95	141
0.25–0.50	159	469	149	128	65	73
0.50–1.00	143	618	249	350	122	438
1.00 or more	209	570	368	340	136	358
Average	168	553	284	306	96	165

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

of the employment effects appears reasonable. Table 20 presents the results of the above computations. The main findings are as follows:

1. Labor input in agriculture increases in the export crop-producing farms by 45 percent (81 days per crop season).
2. This increase is equally shared by family labor and hired labor.
3. The increased labor demand results primarily from snow pea production. On average, labor is cut back in maize by 7 days (13 percent), beans by 6 days (43 percent), and traditional vegetables by 12 days (29 percent), but total hired labor input into maize increases somewhat.
4. In the smallest farm-size class virtually all the net increase in labor input comes from family labor. Total labor input on these farms of less than 0.25 hectare more than doubles.
5. With increased farm size more hired labor is covering the increased work load, but in all four farm-size classes family labor input increases by a roughly similar absolute amount.
6. A substantial share of the increased family labor is from women—44 percent in the two smallest farm-size classes and 32 percent in the largest farm-size class.

The farm-level data can be used to extrapolate the employment effects to the six communities where the cooperative is operating. For 1985, the increased labor demand in crop production corresponds to about 15 percent of agricultural employment. When added to the employment in input supply (special input shops in the villages and special production inputs for snow peas) and output marketing (cooperative staff), it yields an increase in agricultural employment of 21 percent.

Clearly, the employment effects are significant and impinge on off-farm employment and interregional migration in the location. Among export crop producers an average of 0.72 persons per household work away, compared with 0.92 family members among the other sample farmers. Also, nonmembers of the cooperative spend more time away over the year (4.2 versus 2.3 months on average).

The increased demand for hired labor in the region spreads the employment effect. Much of the hired labor comes from neighboring communities where export crop production has not been introduced.

Effects of New Export Crops on Staple Food Production

The evaluation above shows that new export vegetables yield higher returns per unit of land and labor than subsistence crops. Yet cooperative members still plant on

Table 20—Direct employment effects of the new export vegetables, by farm size

Farm Size/ Labor	Change in Labor Input Due to Shifts in Crop Area and Reallocation of Labor						
	Maize	Beans	Traditional Vegetables	Other Crops[a]	Broccoli, Cauliflower	Snow Peas	Total
(hectares)	(person-days of work/year/farm)						
Less than 0.25							
Family	−4	−2	−2	+1	. . .	+57	+50
Hired	0	0	−5	0	. . .	+6	+1
Total	−4	−2	−7	+1	. . .	+63	+51
0.25–0.50							
Family	−11	−6	+4	0	+2	+61	+50
Hired	+5	−2	+2	+2	+2	+26	+35
Total	−6	−8	+6	+2	+4	+87	+85
0.50–1.00							
Family	−9	−6	−15	+1	+7	+58	+36
Hired	−4	−1	−1	−4	+1	+42	+33
Total	−13	−7	−16	−3	+8	+100	+69
1.00 or more							
Family	−9	+2	−11	+3	0	+62	+47
Hired	+9	−5	−10	+7	+15	+42	+58
Total	0	−3	−21	+10	+15	+104	+105
All sizes[b]							
Family	−9	−4	−9	+1	+3	+59	+41
Hired	+2	−2	−3	+1	+5	+37	+40
Total	−7	−6	−12	+2	+8	+96	+81

Source: Computed from data from Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[a] Includes tree crops and fruits.

[b] Weighted by the distribution of farm-size classes.

average half of their land with maize and beans. Although this is significantly less than nonmember farmers, it is still a large proportion. No obvious technical reason exists why farmers should not further expand their export vegetable area, as suitable land remains in reserve (Table 15). Hired labor is available in the region to fill increased labor demand. In the smallest farms, underemployed family labor or family labor seeking off-farm employment could be drawn into the export crops, since average returns per workday are much higher than the prevailing market wage rate (Table 13). This production behavior can be hypothesized as driven by the concern of farmers about risk of the new crops (the potentially high absolute losses per unit of land were discussed above) and the household's desire for food security.

A household is in a secure food situation when it always—throughout the seasons and over the years—has the ability to acquire the food needed to maintain the health of all its members. In farm households, household-level food security may be achieved by own food production and related stockholding, or by relying on open-market trading of food and nonfood production to generate income (and savings), or partially by seeking off-farm, income-earning possibilities. The level and mix of these alternatives depend upon a household's resource endowments, including human capital; the type of market integration for agricultural produce, food, and labor; and the extent to which public institutions (intervention schemes) or community-level institutions (villages, extended family) play a role in providing basic levels of food security in view of unforeseeable circumstances. It is obvious that with decreased institutional provision of food security, lower security of off-farm employment opportunities, and more instability of the agricul-

tural produce and food market, the food security burden shifts toward own production and stockholding. The historical record of food security in the Western Highlands suggests that these are the driving forces that lead farm households to maintain high levels of staple food production for direct household consumption. The survey region as a whole is, however, not self-sufficient. About 50 percent of maize consumed in the six survey villages consists of net imports into the region (Table 21). Self-sufficiency in maize is 67.7 percent among cooperative members and 53.4 percent among nonmembers.

Public institutions cannot ensure effective response to household or local crisis situations. The food and agricultural produce markets are very unstable, as is the labor market. It can thus be hypothesized that farm households operating below or at the margin of food security provided from own food production put a risk premium on nonfood income-earning alternatives. This risk premium—or food insurance premium—that farm households are indirectly paying is represented by the difference between the actual market price of staple food and the shadow cost of production of staple food at the margin. Clearly, the shadow cost of staple food production increases when the opportunity costs of land and labor increase as a consequence of introduction of a new cash crop that yields higher returns to land and labor. To what extent this occurs in the case studied here will be evaluated with a farm model later in the chapter. Before this normative aspect is discussed, another question will be addressed: What actually happened to food production when the new export vegetables were introduced?

Practically all export crop producers (94 percent) maintain some maize production. Ninety-seven percent of the other sample farmers grow maize. Farm households were asked in the 1985 survey what the three most important reasons are for them to grow maize. By far the most important reason stated was "to always have food" (Table 22). Differences between export crop producers and other farmers are small in this respect. The second most important reason, tradition ("we always did it like that"), was followed by the perception that "other crops are risky" and the statement that "maize is profitable." Much has been written about traditional and religious motivations of Western Highlands farmers for growing maize.[15] While most farmers do not give up their *milpa* (cornfield) and plant it with something else altogether, their attitude toward maize and its importance in the production program obviously undergoes change. The introduction

Table 21—Consumption of own production and net purchases of maize in cooperative member and nonmember households, 1985

Households	Consumption of Own-Produced Maize[a]	Net Purchases of Maize
	(percent of maize consumption)	
Cooperative members	67.7	32.3
Nonmembers		
Farmers	53.4	46.6
Nonfarm households	...	100.0
Weighted average for the six cooperative villages	50.4	49.6

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[a] Excluding use for animal feed.

[15] A comprehensive piece is, for instance, Bossen 1984; insights are also provided by Gladwin 1983, 146-147.

Table 22—Farmers' attitudes toward growing maize

Stated Reason for Growing Maize	Ranking of Reasons					
	Cooperative Members			Nonmembers		
	Most Important	Second	Third	Most Important	Second	Third
	(percent of responses)					
To always have food	84	10	2	86	11	...
We always did it like that	3	57	15	1	57	19
Other crops are risky	1	7	16	...	8	12
Maize is profitable	...	2	9	...	5	6
Other	9	12	7	11	10	7
Not applicable	3	12	51	2	9	56

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

of new export crops plays a role in this context, and at the same time, the adoption of new crops is affected by these attitudes. This was already apparent in the adoption model (Table 10) and is further revealed when the reasons stated for growing maize are compared for early versus late adopters of new export crops. Long-term members of the cooperative are more concerned about own-produced maize supply than are new members (Table 23). Also, the early adopters have been or have become less traditional in their decisionmaking on production; the importance of tradition decreases with duration of membership in the cooperative. Long-term members also view other crops as less risky than do new members.

This change in attitude patterns does *not* lead to a reduction in maize availability from own production for consumption. In fact, when corrected for farm size, the majority of export crop growers tend to have similar or higher amounts of maize available for consumption from own produce than other farmers (Table 24). Despite reductions in area and labor inputs to maize, household-level production is maintained because of higher yields of the staple food per unit of land. Cooperative members' maize yields are 30 percent higher on average than those of nonmembers (Table 25). However, because of higher shares of land use for beans, the nonmembers have in the aggregate a somewhat greater subsistence-food availability (maize and beans together) than the members.

Table 23—Reasons for growing maize stated by farmers, by duration of cooperative membership

Reason[a]	Years of Membership in Cooperative		
	More than 5 Years	3–5 Years	Less than 3 Years
	(percent)		
To always have food	92	89	82
We always did it like that	51	62	64
Other crops are risky	9	20	23

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[a]One, two, or three reasons could be stated; therefore, the percentages do not add up to 100 (see Table 22).

Table 24—Production of subsistence maize and use for consumption in farm households, 1985

Farm Size	Cooperative Members		Nonmembers	
	Production	Used for Own Consumption[a]	Production	Used for Own Consumption
(hectares)	(kilogram/adult equivalent)[b]			
Less than 0.25	48	41	59	49
0.25–0.50	103	88	95	82
0.50–1.00	131	113	127	97
1.00 or more	182	137	180	138
Average	142	115	109	87

Source: Computed from data from Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[a] Calculated from a complete production and disappearance balance (production minus sales, losses, animal feed, gifts, seed).

[b] Adult equivalents are based on calorie requirements of persons in the household by age and sex.

The two surveys of the same farms permit a comparison of farmers' maize yields once they had moved from nonmember to member status and from recent to long-term members. Maize yields were substantially higher in 1985 than in 1983 in all groups. Climatic conditions played a role in these yields. As shown below, the increase was highest in the group consisting of cooperative members who had joined 3 to 4 years earlier and above average in the group who had joined 5 to 6 years earlier.

Status of Group	1983-85 Change in Kilograms per Hectare
Nonmembers in 1983 and 1985	+ 272
Members since 1984 or 1985	+ 45
Members since 1982 or 1983	+ 456
Members since 1980 or 1981	+ 314

By far the lowest yield increase is in the group of cooperative members who had joined most recently. Their yield increase is even below that of nonmembers. This pattern gives some insights into the dynamics of maize yields in the context of increased export crop production: initially, yields per hectare stagnate or may even drop when the farmer gives much of his attention and resources to the new crops, thus pushing maize onto the more marginal land of his farm. A couple of seasons later, maize yields apparently do catch up. Appropriate program and policy packages that help farmers to speed up in catching potential positive spillover effects from new cash crops to subsistence crops may have high returns and assist in ensuring against household-level food insecurity.

A combination of factors is responsible for the maize yield increases among cooperative members. Fertilizer inputs increased by an average of 6 percent and cropping practices are more labor-intensive among members. Total labor input to staple foods decreases, but labor input per unit of land is increased by 18 percent (mostly for more weeding). Much of the additional weeding labor is hired. Despite increased inputs (fertilizer) and labor, cooperative members produce maize at lower average cost per unit of output. When the cost of family labor is estimated with the prevailing wage rate, members produce a ton of maize for Q189, while nonmembers produce a ton for Q214. Thus, members appear to be more efficient—whether they were so before

Table 25—Yields of subsistence food crops on cooperative member and nonmember farms, 1985

Farm Size	Cooperative Members		Nonmembers	
	Maize	Beans	Maize	Beans
	(metric tons/hectare)			
Less than 0.25	(2.3)	(1.1)	1.8	0.5
0.25–0.50	2.4	(0.7)	1.7	1.5
0.50–1.00	2.1	1.2	1.5	0.6
1.00 or more	2.2	1.8	1.7	0.8
Average	2.2	1.3	1.7	1.0

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.
Note: Figures based on less than 10 observations are in parentheses.

joining the scheme or became more efficient through joining the scheme is an issue addressed in more detail below. Both of the above cost figures come close to the prevailing farmgate selling price of maize, which was Q210 on average in the 1985 sample period. Average costs are not much different from marginal cost in this production system.

A closer look at the subsistence crops-export vegetable interaction is provided in the following production function and a programming-model analysis. The objective of this analysis is to assess *competition and complementarity* between the new crops and the subsistence crop (maize) in particular. The approach will be briefly described at the outset.

Crop production (q) is technically a result of area (a) times yield (y) of a crop (i):

$$q_i = a_i \cdot y_i. \tag{5}$$

Choices on the use of inputs, technology, and the amount and quality of land for a certain crop are joint decisions. Acknowledging the problem of separating these decisions, competition between crops can be built into an area allocation function, while input-output relations may be assessed on a per unit of land basis in a yield function.

$$a_i = b_{ij}X_j, \text{ and} \tag{6}$$

$$y_i = b_0 + b_{im}X_m, \tag{7}$$

where b_{ij} and b_{im} are the parameters of the area allocation and yield function of the respective exogenous variables X_j and X_m. While the X_j in the area allocation model is mainly describing economic environment and depicts the related response of farmers, the X_m in the yield model covers technical input-output relationships.

It is hypothesized that consumption needs (calorie requirements) determine, among other things, that the traditional farm households plant a certain share of their total area with maize. With increased farm size, this "subsistence needs-oriented" determination of the maize area is reduced. The worse the land quality of a farm, the higher the share of land required for maize for subsistence needs, everything else being equal. It is also hypothesized that a more traditional attitude toward maize would lead to an increased share of maize land.

Maize is only to a minor extent a "cash crop," but its area share should be expected to be affected by the relative returns to maize versus new export vegetables after desired subsistence levels are fulfilled along the above-stated hypotheses. It is also expected that membership in the cooperative leads to a decreased maize area share beyond the above-mentioned factors, as the cooperative stimulates the growing of new crops. Finally, village-specific dummy variables are included in the model, since the land-quality variable is based on village-specific comparisons of farmers and not on a generalizable measure.

The estimation results of the area model specified along these hypotheses are in Table 26. The model explains a high share of the variance in maize area allocation (85 percent). The following findings will be highlighted:

1. Production is very much driven by staple food needs; this becomes evident from the highly significant variable representing the calorie requirements of the household (ACU). One additional adult-equivalent unit in the household leads, all else (including farm size) being equal, to an expansion of the maize area share by 6 percentage points. Clearly these semisubsistence households not only (partly) consume what they grow but also base their maize production decisions on consumption requirements.

2. Households with a more traditional attitude toward maize (DMZREAS) have a higher maize area share, but smaller farms plant relatively less area with maize (FSZHA). Both determinants are statistically highly significant.

Table 26—Area allocation to maize and the effects of export vegetable production: regression model

Variable	Parameter	t-Value
DCID5	0.03370	0.647
DCID4	0.09424	1.855
DCID3	−0.03591	−0.892
DCID2	0.12100	2.391
DCID1	0.11986	2.454
RGM	−0.04209	−1.075
MZLANDQ	0.18134	16.542
FSZHA	−0.06416	−2.792
DMZREAS	0.06791	2.238
ACU	0.06005	10.189
MIEM	−0.04272	−1.509
$R^2 = 0.85$, DF = 337		

Notes: Dependent variable: maize area over total farm size.

DCID1 . . . 5 = dummy variables for villages 1 through 5 = 1, else = 0;
RGM = ratio of gross margin of new export crops over gross margin of maize;
MZLANDQ = quality of area under maize (1, . . . , 4; 1 = best);
FSZHA = farm size in hectares;
DMZREAS = traditional attitude toward maize = 1, else = 0; 1 = "we grow maize for own consumption because we always did it like that";
ACU = calorie requirements of households (adult equivalents); and
MIEM = membership in the cooperative = 1, else = 0.

3. The worse the land quality (MZLANDQ) the bigger the area share of maize. This is to be expected, as alternative crops have less comparative advantage on such land and households also have absolute targets of maize supply from own production.

4. Cooperative membership (MIEM) tends to decrease the area allocated to maize as expected; the net effect is about 4 percentage points, thus, all else being the same, maize area decreases from 60 to 56 percent. The respective parameter is not highly significant.

5. The ratios between the gross margins of maize and the new export vegetables do not turn out to be significant (RGM). It is probably only in the long run that their obvious role comes into play significantly.

Maize yield models are estimated for the total sample (model 1) and separately for the cooperative member farmers (model 2). Finally, yield model 2 is modified by including the degree of participation in export crop production to assess its effects on maize yields beyond the common production factors (model 3).

A heuristic approach is taken to specification of the yield models. From increased fertilizer use, higher yields are expected though decreasing at the margin. Increased labor input should have positive yield effects. With better education, farmers are expected to make more efficient use of resources and get higher yields. On smaller farms, it is hypothesized, farmers pay more attention to yields beyond the factors mentioned. Yields are expected to be lower on plots of lower land quality.

The estimation results of the yield models formulated along these hypotheses are in Table 27. The main findings of this analysis are as follows:

Table 27—Maize yields and effects of export vegetable production: regression models

	Total Sample		Cooperative Members Only			
	Model 1		Model 2		Model 3	
Variable	Parameter	t-Value	Parameter	t-Value	Parameter	t-Value
DCID5	382.65000	1.729	621.41000	1.844	505.53500	1.512
DCID4	-65.68800	-0.298	23.72200	0.075	67.34400	0.217
DCID3	-6.77190	-0.039	-48.71030	-0.183	-56.24500	-0.215
DCID2	-824.29200	-3.886	23.72290	0.075	-877.94900	-2.527
DCID1	-40.26500	-0.195	513.74800	1.390	-58.24500	-0.215
MZLANDQ	-136.25200	-2.196	-34.01890	-0.265	68.67100	0.518
HHEDUC	33.77700	0.933	155.39500	2.645	162.74200	2.815
LABDAYS1	2.20680	2.081	4.07790	2.517	3.69015	2.307
RAREA34	...	...	...	...	811.23180	2.506
FSZHA	-17.92300	-0.186	-70.33560	-0.482	35.65770	0.238
INPUT1	9.81776	4.021	9.48170	2.144	8.14740	2.095
SQINPUT1	-0.02326	-2.973	-0.02451	-1.820	-0.02445	-1.848
(constant)	1,256.55000	4.449	834.56600	1.873	383.55100	0.810
	R^2 = 0.19		R^2 = 0.20		R^2 = 0.23	
	F = 7.02		F = 3.40		F = 3.75	
	DF = 326		DF = 148		DF = 147	

Notes: Dependent variable: maize yields in kilogram per hectare, 1985.

DCID5 = dummy variables for villages 1 through 5 = 1, else = 0;
MZLANDQ = quality of area under maize (1, . . . , 4; 1 = best);
FSZHA = farm size in hectares;
HHEDUC = years of schooling of head of household;
LABDAYS1 = total labor days in maize per hectare;
RAREA34 = area under new export vegetables over total area (ratio);
INPUT1 = cost of fertilizer per hectare of maize; and
SQINPUT1 = cost of fertilizer per hectare of maize (squared).

1. Input levels of fertilizer (INPUT1) increase yields as expected, and at decreasing rates as the negative sign of the squared term indicates (SQINPUT1). Fertilizer cost per hectare is used as a proxy for nutrients. Differences between the cooperative members and the total sample are not significant in this respect. One additional quetzal spent on fertilizer yields—calculated at sample means—4.9 kilograms of maize at the margin, which sold for Q0.98-1.23 on the market.[16] This suggests that fertilizer use is in the range of efficient levels.

2. Increased labor inputs (LABDAYS1) have a higher than average positive yield effect on cooperative farms. Although marginal labor productivity in maize is higher among members than for the total sample, marginal returns to labor of Q0.82-1.02 (model 2 with maize price of Q0.20-0.25) in the subsistence crop are at the lowest end of the prevailing wage rates, which were Q2.00-2.50 per day in 1984 for men and Q1.00-2.00 for women.

3. A striking result is that better education significantly shifts the yield function upward in the group of cooperative members but does not do so in general (model 2). Apparently literacy becomes increasingly more relevant for productivity when the farms become more complex with the new export crops included in the production program than it does in general (model 1). This is fully in line with the finding of the specific study on the effects of education on Guatemalan agriculture (Freire 1981, 107-145) that illiterate and literate farmers operate on the same aggregate production function, but literate farmers are technically more efficient than illiterate farmers on more diversified farms.

4. Land quality (MZLANDQ) tends to affect yields as expected; here it becomes clear that separating the area allocation effect from the yield effect of production is useful, as the effect of land quality works in opposite directions in the two functions of the model.

5. A striking effect results from the new export vegetables in the crop production program (RAREA34): the higher the share of new crops in the land use, the higher the maize yields even after accounting for different levels of inputs, labor use, and human capital (model 3). Two explanations for this result come to mind. First, the snow pea crop increases the soil-nitrogen levels, which benefits maize if maize follows in the rotation on that land. Second (and more hypothetical), export crop producers improve crop management, which leads to higher efficiency in input use in maize. This effect is then not captured in the input and labor variables. It is plausible that export vegetable producers, in their desire to increase yields of maize for the purpose of maintaining household food security, eliminate Leibensteinian "x-inefficiencies" tolerated before (Leibenstein 1966). The parameter estimated in the yield function implies that joining the scheme with average allocation of land to the new crops (RAREA34) results in a yield increase by 11 percent above the result from higher fertilizer input and labor use per hectare. The higher yields among cooperative members are to this extent a result of the complementary interaction with the new export crops and not just a result of inherently higher efficiency of members.

To sum up, the analysis on the basis of area and yield functions for the subsistence crop (maize) shows that new export vegetables play a complementary rather than a competitive role in the system. Although maize area is reduced and partly squeezed onto land of lower quality, increased input use (fertilizer and labor), favorable soil-fertility effects of the main new crop (snow peas), and more efficient crop-production practices

[16] Maize prices ranged between Q0.20 and Q0.25 per kilogram in the 1984/85 crop year.

overcompensate for the adverse effects and leave export crop producers with higher yields and total supply levels of the subsistence crop. This finding is in line with findings by Reyes-Hernandez, García, and Campos (1985), who diagnose positive yield-increasing spillover effects for the traditional food crop (maize) in more diversified farm-production systems in the area of Chimaltenango (Western Highlands). In their small sample of farms, maize yields in the diversified systems were about 40 percent higher than in the traditional system.

A Premium for Own-Produced Maize: Model Results

The context in which this interaction between new export vegetables and subsistence crops takes place is not only the field crop operation of the farm enterprise but the farm production-consumption unit. To evaluate the effects of introduction of the new crops on farm households' incentive to provide food security from own production, a linear programming model is constructed.[17] Applying a programming model with a profit-maximizing objective function under constraints does not imply an assumption that the farm households in the Western Highlands are single-minded, short-term profit maximizers. It is recognized that a multitude of objectives exist for farmers that may be only partly captured by the constraints introduced into the model. All evidence from the evaluation of response to crop profitability, however, suggests that small highland farmers are managing their agricultural resources and their own time very efficiently and rationally in an economic sense. Still, opposite conclusions have sometimes been drawn for the highland farmers. Gollas (1977), for instance, concludes (from a Cobb-Douglas production function analysis with results that show a positive marginal productivity of farm labor in view of an assumed general surplus labor situation) that the highland farmers are "poor and inefficient." More careful production function analyses by Marsh, Jameson, and Phillips (1983) and Stein (1982) as well as the assessment of households' flexible response to returns to time inside and outside agriculture by Swetnam (1980) clearly refuted Gollas's "poor and inefficient" conclusion for the traditional farmers of the highlands.

Although only a small proportion of farm households sell subsistence crops (13 percent of all maize producers in the sample sold maize during the year), almost all farm households grow maize for own consumption. The cost of this maize to the farm household is determined by the opportunity cost of the resources used for its production. Obviously the opportunity cost of maize production increased when farmers had the option of growing snow peas. It thus follows that consumption of own-produced maize should have become more costly. To what extent is this actually the case? How did farmers respond to this change in this key shadow price?

The model is based on average data of the 0.50-1.00 hectare farms in the sample. Three versions of a farm model are used for comparative static analysis: model 1 represents the situation before new export crops were introduced; model 2 represents the situation after export crops were introduced, but yield levels and technology in subsistence crops are not changed; and model 3 represents the situation as in model 2, but with actual improved productivity in subsistence crops.

The three model versions are described in the Appendix. The main features of the model are the usual constraints on land and family labor (by season). Inputs (fertilizer, pesticides), hired labor, and input financing are available at exogenously fixed prices.

[17] Average data from the 0.50 hectare and 1.00 hectare farm-size classes are used for the model's coefficients.

Rotational restrictions follow the ones widely accepted by farmers. In all three model versions, household demand for staple food (maize or beans or both) is maintained at the same level as observed in the respective class of sample households. Family labor of men and women—but not children—may also earn income from off-farm employment at a constant wage rate.

In the initial situation (model 1) the shadow cost of maize produced for own consumption is Q0.49 per kilogram (Table 28)—more than twice the average sales price of maize in the respective survey year (Q0.21) and substantially higher than the average purchase price (Q0.26). Clearly, farm households are willing to pay the price in terms of income forgone to have maize from their own fields. The difference between the shadow cost of maize production for own consumption and the actual purchase price of maize can be interpreted as a "food-security insurance premium." In 1985 the premium was Q0.23 per kilogram in farm households that did not grow the new export vegetables. When the new export crops become an option for the farm household, this insurance premium increases drastically—nearly quadrupling, as demonstrated with model 2 versus model 1 (from Q0.23 to Q0.90 per kilogram). Maintaining subsistence production becomes more than twice as costly as before: the shadow cost of maize production increases from Q0.49 to Q1.16 per kilogram. While there was an incentive before, as indicated by the 1985 insurance premium, to bring down the unit cost of production for subsistence, this incentive was much increased by the introduction of competitive export vegetables.

Households have two options in responding to the increased cost of food security provided from own production. They may simply cut back the staple food production or increase its productivity (or a combination of the two). The yield function analysis above demonstrated that they most often choose the latter. This option's effect on the

Table 28—Effects of new export vegetables on shadow cost of subsistence food production and selected other variables

Variable	Model 1	Model 2	Model 3
		After Introduction of New Export Crop	
	Before Introduction of New Export Crop	Without Improved Productivity in Subsistence Crops	With Improved Productivity in Subsistence Crops
Land use (hectares)			
Subsistence crops	0.49	0.49	0.35
Traditional vegetables	0.26	...	...
Snow peas	...	0.26	0.40
Family labor			
On-farm (days in model 1 = 100)	100.00	124.00	165.00
Off-farm (days in model 1 = 100)	100.00	84.00	55.00
Share of family labor on farm (percent)	49.30	59.60	75.00
Working capital			
Over year (quetzals in model 1 = 100)	100.00	304.00	441.00
In percent of cash income	24.50	51.40	58.10
Shadow price of land (quetzals/hectare)	456.00	1,455.00	1,455.00
Shadow cost of maize produced for own consumption (quetzals/kilogram)	0.49	1.16	0.84
Difference to average maize purchase price (quetzals/hectare) ("insurance premium")	0.23	0.90	0.58

Notes: These results of programming model scenarios are for an average 0.75-hectare farm based on 1985 survey of farms from 0.50 to 1.00 hectare. See Appendix for descriptions of the three versions of the model.

insurance premium is traced in model 3. Clearly, the cost of maintaining desired household food security through production of staple food for own consumption can be substantially decreased this way (from 0.90 to 0.58, as shown in Table 26). Still, the insurance premium remains higher than in the situation at the outset. The incentive remains high to further increase productivity in staple food production.

The new crops lead to an increased labor and capital intensity in agricultural production. The new export crops require not only more absolute working capital but also more relative capital in percent of total household cash income. Without new export crops, working capital invested in crop production was about one quarter of total cash income (model 1). With the new crops, it amounts to more than half of cash income (58.1 percent, model 3).

With increased productivity of staple food, overall income increases and land is freed for the new export crop that can generate additional income. The income increase made possible by increased productivity of subsistence crops (going from model 2 to model 3) is about as high as the income effect from the pure introduction of the export vegetables without improved productivity in the staple foods (going from model 1 to model 2). This key role of technological improvement in staple food production of farms that have the option of growing new export crops must be understood in order to maximize both income and employment opportunities.

In summary, the following conclusions are stressed from this analysis of the agricultural production effects:

1. Export crops and subsistence crops are complementary rather than competitive in the case studied.

2. Household-level food security through a high level of subsistence food production was maintained or even expanded when new export crops were introduced. While this is understandable and explainable with market failures—that is, failures in the food market and in the labor market on which many of the small farmers with an excess supply of labor depend—this approach to food security does not appear to be the "first-best" economic solution, as indicated by the high "insurance premiums" paid by farm households for own-produced subsistence food. A policy environment that ensures the functioning of food markets without major disruptions is a precondition for farm households to develop confidence in the market and consequently to make use of the advantages of the exchange economy. It is thus a precondition for first-best economic solutions to food insecurity. Options other than food security based on own-produced food exist for the cost-effective provision of food security; for instance, food-related income transfers or employment-oriented measures targeted toward the absolute poor. Such measures would impinge on the observed resource allocation in agricultural production biased toward staple food only if they were perceived as reliable by the poor.

3. The shadow cost of staple food production for own consumption increases drastically as returns to land and labor of the new export crops increase. In view of the prevailing high preference for having maize from the own field for food security reasons, the increased shadow cost of subsistence production did lead to some reduced area allocation to staple food production. However, variable inputs (labor, fertilizer) per unit of land increased. This and positive yield-increasing effects of the new crops in the rotation permit reduction of staple food crop area along with an increase in food output combined with the favorable income and employment effects of the new crops.

4. The Western Highlands farmers were able to adopt this balanced strategy of crop diversification plus intensification of staple food production because of the availability of yield-increasing measures, related input supply channels (seed, fertilizer), and hired

labor. In the absence of these conditions, farmers with strong preferences for subsistence crops will not adopt the export crop. The policy conclusion is obvious: if gains from diversification and export crop production are to be achieved through rapid adoption by small farmers without diminishing their food security in an environment of market failures, farmers must have access to technology to enhance food crop productivity per unit of land.[18]

Effects of New Export Crops on Off-Farm Income

The previous chapters concerned production and related income effects. As stated earlier, agricultural income is very much complemented by income from other sources in these communities of the Western Highlands. In fact, it is often the other way around: off-farm income is complemented by farm income in many households.

Patterns concerning sources of income differ by cooperative status (Table 29). In general, nonmembers earn more income as agricultural day laborers and nonagricultural workers than do members. Member households are also active in such off-farm income-earning activities during the year, but they work fewer days off-farm, which explains their lower absolute income from these sources. In addition, income from transfers and remittances is not only higher on average in member households but also more widely distributed. Seventy-five percent of the households reported transfers.

The distribution pattern of income by source suggests that export crop producers withdraw from the off-farm labor market and spend more of their time in agricultural production on their own fields (see also employment effects in Table 20). This reduces

Table 29—Percentage of households receiving income from off-farm activities, by farm size and cooperative membership

	Source of Off-Farm Income			
Farm Size/ Membership	Agricultural Day Labor	Nonagricultural Wages	Nonagricultural Merchant	Transfer Income, Remittances
(hectares)	(percent of households in farm-size group)			
Less than 0.25				
Members	25.0	50.0	12.5	62.5
Nonmembers	53.2	48.9	10.6	55.3
0.25–0.50				
Members	25.0	33.3	13.9	75.0
Nonmembers	40.6	48.4	17.2	57.8
0.50–1.00				
Members	17.8	27.5	19.2	76.7
Nonmembers	13.2	34.2	28.9	57.9
1.00 or more				
Members	7.5	28.3	11.3	75.5
Nonmembers	30.0	20.0	6.7	36.7
All sizes				
Members	16.5	30.0	15.3	75.3
Nonmembers	36.3	40.8	16.2	53.6

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[18] Similarly, in labor-scarce, land-rich environments, such as parts of Africa, productivity of labor in food production must increase to achieve this desired development effect.

their off-farm earnings. Numerous intervening variables determine the extent to which this actually happens. The following model sheds some light on this.

It is hypothesized that household earnings are determined by available labor; demographic structure; the farm's resource base in relation to household labor force, which determines the opportunity cost of off-farm work; and human capital, which may impinge on the off-farm income-earning possibilities. Local-level labor market conditions, including location of village, may further differentiate the effect of the various factors. An off-farm income-earning function (r) may thus be specified for i households as

$$r_i = a_0 + b_j X_{ij} + b_k X_{ik} + u_i, \tag{8}$$

where

a = intercept,

b_j = the parameters of X_{ij} variables describing the off-farm income-earning potentials,

b_k = the parameters of X_{ik} variables depicting the on-farm income-earning potential, and

u_i = error term.

The results of the model specified along the above-stated hypotheses underscore that off-farm income-earning by farm households is reduced with an increased resource base for agricultural income-earning on the own farm (RFMLAB) (Table 30). The opportunity to grow the new export vegetables with rising returns per unit of family labor can be interpreted as an expansion of the resource base per unit of family labor. Returns to family labor more than doubled those of traditional crop producers and export crop producers (for instance, maize, beans, and traditional vegetables of traditional farmers versus snow peas, broccoli, and cauliflower of export crop producers shown in Table 13). A doubling of the resource base (land per family labor, RFMLAB) would reduce off-farm income-earning by 11 percent at sample means.

Table 30—Determinants of off-farm income: regression model

Variable	Parameter	t-Value	Mean of Variable
RFMLAB	-362.947	-1.71	0.231
HHEDUC	184.600	5.68	3.003
RWOMLAB	-689.430	-2.04	0.463
DCID5	411.807	2.00	0.092
DCID4	100.564	0.48	0.089
DCID3	-327.380	-2.04	0.186
DCID2	-480.957	-2.43	0.102
DCID1	-288.961	-1.44	0.097
(Constant)	683.016	3.58	...

$\bar{R}^2 = 0.12$, $F = 6.50$, degrees of freedom = 3.62.

Notes: Dependent variable: total nonfarm income per capita per year (quetzals).

RFMLAB = farm size per person of working age available for farm work (in hectares per person),
HHEDUC = household education (years of school),
RWOMLAB = share of female labor in total household labor, and
DCID1 ... 5 = village dummy variables.

The model only implicitly addresses the complex issue of the value of human time and its effect on substitution between off-farm versus on-farm work. People may derive utility from spending less time searching and traveling for off-farm work. Also, the search cost for off-farm employment reduces the net income from such sources. An indication for this is that nonmembers of the cooperative spend relatively and absolutely more on transportation. One quetzal of gross income from off-farm work may therefore be worth less to the household than one quetzal of discounted present value earned on the own farm.

Most important and significant is the influence of education levels on off-farm earnings (HHEDUC). Thirty percent of the explained variance is a result of this variable. In the simple model specification, the parameter estimate suggests that one additional year of schooling of the household head raises off-farm income, all else being equal, by 25 percent. It should be recalled that higher levels of human capital were also found to raise labor productivity in agriculture once the production system becomes more complex with new technologies and the new cash crops (see Table 27). Investment in human capital is thus shown here to shift both the agricultural and the nonagricultural income-earning capacities.

Although more available labor per unit of land increases a household's per capita off-farm earnings, an increased share of female labor (RWOMLAB) decreases it. Off-farm income-earning opportunities are less favorable for women in the area, and women's wages tend to be lower than men's in agricultural work by 20 to 30 percent.

The village dummy variables test for the difference with Santiago, which is the largest community and provides the most opportunities. As expected, most of the village dummy variables for the other communities are significantly negative.

The result of this analysis suggests that the net increase in farm income from the new export crops is not identical with the net increase in total income. The increase in total income is diminished by reduced off-farm income, since households withdraw partly from off-farm income earning once they adopt the new export vegetables, for which they allocate more of their time to on-farm work.

6

EFFECTS OF THE NEW EXPORT CROPS ON EXPENDITURES, CONSUMPTION, AND NUTRITION

Surveys on income—especially direct approaches to income assessment rather than indirect ones via disaggregated accounting of costs and returns, as in this study for agricultural income—suffer from both inaccuracy and high intertemporal fluctuations that do not represent the long-term standard of living of households. This is particularly true in the Western Highlands, where high shares of off-farm income may have significant fluctuations over time. Expenditures on food and nonfood, including the value of home-produced food, represent a more stable indicator of households' permanent income standard.

The following analysis of expenditures has two main purposes: first, to evaluate the effects of the new export crop production on levels of expenditures (using total expenditures as an income proxy); and second, to assess the effects of changes in income levels and the nature of the income stream on the composition of expenditures. Of special interest are questions such as, What happens to the composition of the diet once households earn more income from the export crop? or, Do poor households increase their spending on "luxury items" when they earn more cash income from cash crops than in-kind income from increased subsistence food production?

This analysis is based on the complete expenditure surveys on all food and nonfood items for September 1983 and September 1985. Only the 1985 survey includes foods consumed from own production and an annual expenditure survey on durables and less-frequent expenditures, such as for housing, education, health, feasts, and clothes. The following comparative evaluation between 1983 and 1985 is based on the strictly comparable monthly cash expenditure surveys. Analysis based only on the 1985 survey draws on the full expenditure survey, including own-produced food consumed in the household and items from the annual expenditure survey. This approach was taken to use a maximum of information from the longitudinal comparisons, while presenting the complete picture from the more detailed 1985 survey.[19]

Income Effects in Relation to Farm Size and Income Distribution

As shown in the table below, the 1985 cross-sectional comparison suggests that export crop production increases relative income the most in the smallest farm-size classes and thus contributes to a more equal income distribution among the poor. Farm households with more than 1 hectare and who depend more on hired labor for additional labor input actually capture comparatively less benefit from new export vegetable production.

[19] This explains the difference between the 1985 figures in the comparative tables and the 1983 data below versus the 1985 figures in the other tables.

Farm Size	Difference in per Capita Expenditure of Members Versus Nonmembers
Less than 0.25	+59.8
0.25–0.50	+33.1
0.50–1.00	+20.2
1.00 or more	+3.4

During the two-year period between the surveys, the distribution pattern of expenditures changed only slightly. This does not mean, however, that the situation of households in poverty in the area is a static one. To what extent did the same households remain static or move upward or downward in terms of real per capita income and what is the role of new export vegetables in this respect? The per capita expenditures from 1983 are, for the purpose of this comparison, expressed in 1985 prices.[20]

Household transitions from one expenditure class to another inside and outside the export crop scheme provide interesting results (Figure 6). For cooperative members among the poorest tercile in terms of per capita expenditures, only 38.0 percent remained in this position from 1983 to 1985, compared with 55.0 percent for nonmembers. A much higher percentage of members moved upward in the expenditure classes and a much lower percentage moved downward. This holds true for the middle and high income terciles. For instance, among members, 30.4 percent dropped from the middle tercile to the lower and 37.5 percent moved to the higher tercile; among the nonmembers in the middle tercile in 1983, 36.7 percent dropped to the lower and 25.0 percent moved to the higher tercile. The whole spectrum of households moved relatively more upward among members than among nonmembers.

Effects on Expenditure Patterns

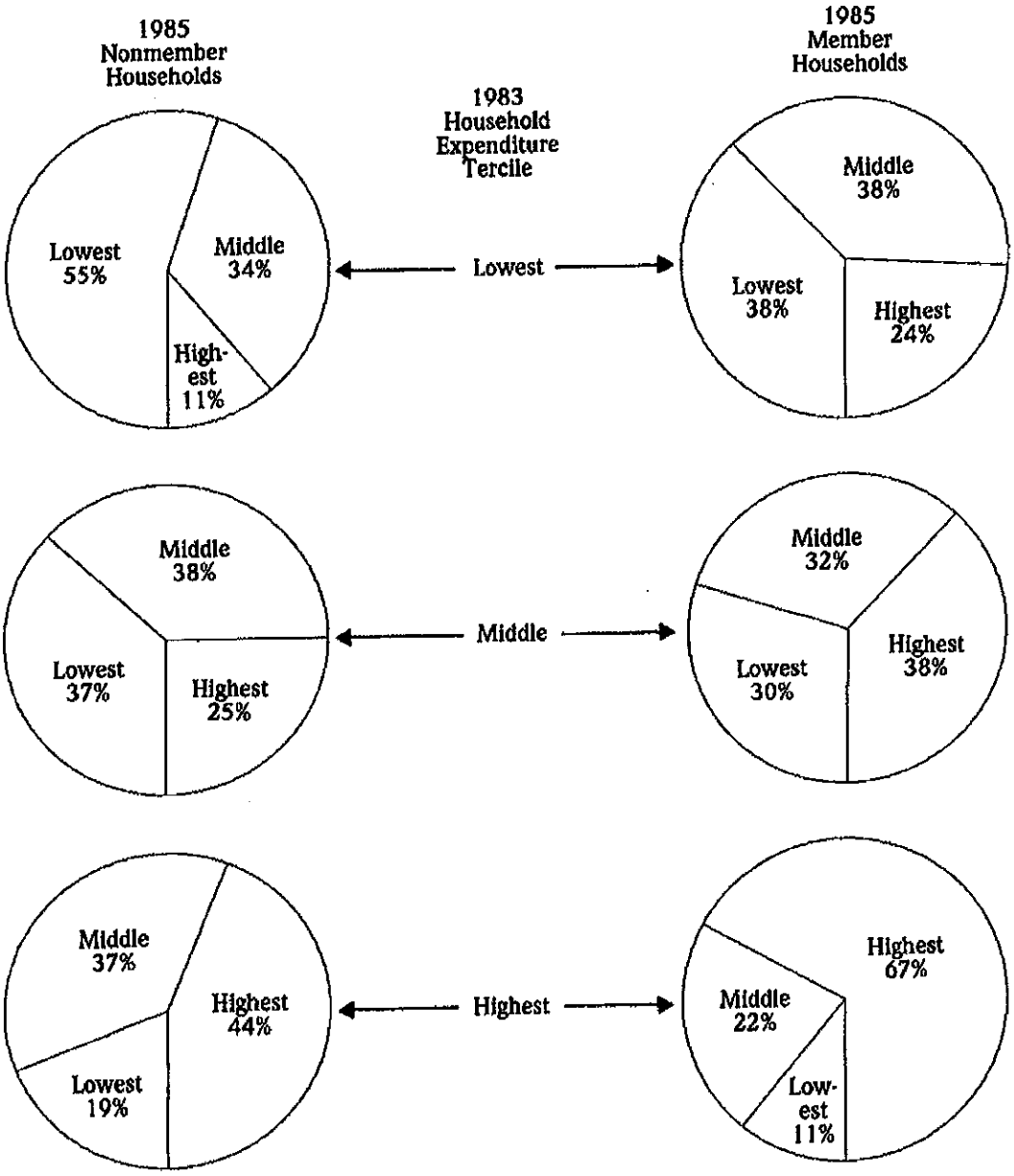
The total expenditures of cooperative members are 20 percent higher than those of nonmembers. The cash expenditures of members on both food and nonfood items and the value of their own-produced food for home consumption are higher. Members' nonfood expenditures are 32 percent higher and the imputed value of the own-produced food for home consumption is 8 percent higher. Even after controlling for farm size, food purchases of members are higher than those of nonmembers. For example, member households with farms of 0.5-1.0 hectare spend 15 percent more per capita on purchased food than nonmembers in the same farm-size group.

Although the absolute food expenditures of cooperative members are greater than those of nonmembers, the share of the budget that members devote to food items is lower. Members spend on average 64 percent of total expenditures on food compared with 67 percent among nonmembers (Table 31).

A more detailed breakdown of household expenditure patterns reveals that relative differences between export crop producers and other farm households are not substantial (Tables 32 and 33). For food items other than meat, eggs, and fish, cooperative members spend relatively less than nonmembers. This implies that income elasticities

[20] The reported general inflation rate in Guatemala was 4 percent in 1984, 19 percent in 1985, and 23 percent in 1986. The inflation rate measured in the noncooperative households, which are the majority of households at the location, was used to derive the location-specific inflation rate (33.6 percent over the two-year period).

Figure 6—Transition of cooperative member and nonmember households between expenditure terciles from 1983 to 1985



Sources: Institute of Nutrition of Central America and Panama survey, 1983; and Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.
Note: Expenditures are in constant 1985 prices.

for meat, eggs, and fish are above unity and for other food items are below unity. For some of the main staple foods—for example, maize and beans—members also spend absolutely less. It should be noted that this may partly reflect price differences rather than quantity differences. This issue is further addressed later in the food consumption analysis. Also, in 1983, the simple comparison of expenditure patterns of the two groups does not reveal striking differences (Table 34). The direction and magnitude of the differences between item-specific budget shares of members and nonmembers are as expected.

Table 31—Expenditures on foods (purchased and own-produced) and nonfoods, by farm size and duration of cooperative membership, 1985

Group	Food, Purchased		Food, Own-Produced		Nonfood		Total Expenditures	
	(quetzals)	(percent)	(quetzals)	(percent)	(quetzals)	(percent)	(quetzals)	(percent)
By farm size (hectares)								
Members								
Less than 0.25	267.76[a]	55.5	36.30[a]	7.5	178.92[a]	37.0	482.97[a]	100.0
0.25–0.50	239.86	59.7	37.71	9.4	124.12	30.9	401.69	100.0
0.50–1.00	240.30	49.8	57.08	11.9	184.85	38.3	482.24	100.0
1.00 or more	221.36	48.1	53.07	11.5	185.84	40.4	460.27	100.0
Total average	233.77	52.7	50.06	11.3	159.59	36.0	443.42	100.0
Nonmembers								
Less than 0.25	185.64	61.4	22.77	7.5	93.87	31.1	302.27	100.0
0.25–0.50	182.08	60.2	31.90	10.5	88.53	29.3	302.51	100.0
0.50–1.00	208.83	52.0	52.92	13.2	139.64	34.8	401.39	100.0
1.00 or more	212.89	47.8	55.05	12.3	177.92	39.9	445.87	100.0
Total average	204.82	57.0	35.05	9.8	119.45	33.2	359.32	100.0
By years of membership								
Less than 2 years	237.97	51.4	44.07	9.5	181.36	39.1	463.41	100.0
2–4 years	222.17	53.4	54.30	13.0	140.02	33.6	416.49	100.0
5–6 years	244.99	50.4	52.11	10.7	188.94	38.9	486.05	100.0
Total average	233.77	52.7	50.06	11.3	159.56	36.0	443.42	100.0

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.
Note: Parts may not add to totals because of rounding.
[a] There are only 6 observations in this group; in all other groups, at least 25 observations are the basis of the mean values listed.

Between 1983 and 1985, total expenditures at 1985 constant prices for all purchased items (excluding own-produced food) increased by nearly the same rate in member and nonmember households (5.1 and 5.0 percent, respectively). (See Tables 35 and 36.) However, cooperative members spend substantially more on housing and land purchases, which cannot be included in this comparison, as the 1983 baseline does not exist. The annual recall for 1985 showed 84 percent higher spending for land purchases by member households, which may be indicative of a higher savings rate in those households. This expenditure-savings pattern may also be a reason for the higher increase in expenditures among the recent export crop producers versus households that have been in the scheme longer. The introduction of new export vegetables leads to increased consumption of food and nonfood expenditures, especially in the first years of membership. Total expenditures of new members who entered the scheme between the two surveys increased by 33.1 percent and food expenditures went up by 13.8 percent. For members in the scheme longer, consumption expenditures either increased less substantially, or in the case of medium-term members (3-4 years), even dropped in real terms. This pattern is a function of the one-time reallocation of resources to export vegetables and higher returns to land and labor. Once this specialization effect is achieved, further growth is constrained by resource endowments and lack of new technology.

It is noteworthy that landless households' total expenditures dropped in real terms by 1.3 percent (Table 36). Contraction in overall employment in Guatemala and reduced real wage rates during the economic crisis in the mid-1980s greatly affected this group. The favorable employment effects from export vegetables in the cooperative area have

Table 32—Food (including own-produced) and nonfood expenditures of cooperative members, 1985

Commodities, Other Items	Value of Purchases per Capita per Year		Value of Consumed Own Produce per Capita per Year		Total per Capita per Year	
	(quetzals)	(percent)	(quetzals)	(percent)	(quetzals)	(percent)
Maize	15.59	4.0	26.93	53.8	42.52	9.6
Other cereals, bread	39.76	10.1	...	...	39.76	9.0
Pulses	15.72	4.0	6.80	13.6	22.52	5.1
Sugar	14.67	3.7	...	...	14.67	3.3
Roots, tubers, bananas	10.73	2.7	1.11	2.2	11.85	2.7
Vegetables, fruits	27.45	7.0	9.86	19.7	37.31	8.4
Milk products	9.01	2.3	2.33	4.7	11.33	2.6
Meat, eggs, fish	73.23	18.6	2.91	5.8	76.13	17.2
Fat, oil	6.26	1.6	0.12	0.2	6.38	1.4
Other foods	3.34	0.8	...	...	3.34	0.8
Nonnutritious foods, beverages	18.01	4.6	...	...	18.01	4.1
Total food	233.77	59.4	50.06	100.0	283.83	64.0
Fuel, energy	26.30	6.7	...	...	26.30	5.9
Clothing	22.76	5.8	...	...	22.76	5.1
Home articles	11.62	2.9	...	...	11.62	2.6
Hygiene, cosmetics	24.18	6.2	...	...	24.18	5.5
Education	0.55	0.1	...	...	0.55	0.1
Health	13.19	3.4	...	...	13.19	3.0
Transportation	20.27	5.2	...	...	20.27	4.6
Entertainment	3.15	0.8	...	...	3.15	0.7
Loans, transfers, donations	11.16	2.8	...	...	11.16	2.5
Other services	26.42	6.7	...	...	26.42	6.0
Total nonfood	159.59	40.6	...	...	159.59	36.0
Total expenditures	393.36	100.0	50.06	100.0	443.42	100.0

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.
Notes: Data are based on one-month recall, September 1985. Parts may not add to totals because of rounding.

apparently not counterbalanced these effects for the landless in the sample but certainly reduced the adverse effects of the economic crisis.

A number of factors determine how scarce resources are allocated by poor households to food consumption versus other consumer goods. To test the extent to which the source of income along with other factors impinges on the budget share allocated to food, a model is specified for estimation of Engel curves that includes relevant sources of income (their relative shares) as explanatory variables together with the level of income. Also, household size is controlled for to account for potential scale effects. Three sources of income are distinguished—income earned from the new export crops, male income earned off-farm, and female income earned off-farm. The hypotheses to be tested are that income earned under men's control (off-farm and from the new export vegetables) is relatively less spent on food than farm income in general, and female-controlled income earned off-farm is relatively more spent on food than general household income. Total expenditure is used as a proxy for expected permanent income in this analysis. It is noted that this is not entirely satisfactory because of the simplistic assumptions regarding savings.

Three different models are specified to evaluate the hypotheses. The first model includes members and nonmembers and tests whether the cooperative has an institutional effect after controlling for the relative income-share effect from the new crops. Institutional arrangements such as cash payment schemes, savings opportunities, and

Table 33—Food (including own-produced) and nonfood expenditures of nonmembers of cooperative, 1985

Commodities, Other Items	Value of Purchases per Capita per Year		Value of Consumed Own Produce per Capita per Year		Total per Capita per Year	
	(quetzals)	(percent)	(quetzals)	(percent)	(quetzals)	(percent)
Maize	22.90	7.1	21.18	60.4	44.08	12.3
Other cereals, bread	31.63	9.7	0.01	0.0	31.65	8.8
Pulses	18.13	5.6	3.72	10.6	21.85	6.1
Sugar	12.16	3.7	...	...	12.16	3.4
Roots, tubers, bananas	9.25	2.9	0.60	1.7	9.85	2.8
Vegetables, fruits	23.43	7.2	7.06	20.2	30.49	8.5
Milk products	8.00	2.5	0.48	1.4	8.48	2.4
Meat, eggs, fish	56.68	17.5	1.95	5.6	58.63	16.3
Fat, oil	5.25	1.6	0.05	0.1	5.30	1.5
Other foods	1.92	0.6	...	...	1.92	0.5
Nonnutritious foods, beverages	15.47	4.8	...	...	15.47	4.3
Total food	204.82	63.2	35.05	100.0	239.87	66.8
Fuel, energy	22.36	6.9	...	...	22.36	6.2
Clothing	15.29	4.7	...	...	15.29	4.3
Home articles	5.01	1.5	...	...	5.01	1.4
Hygiene, cosmetics	22.76	7.0	...	...	22.76	6.3
Education	0.56	0.2	...	...	0.56	0.2
Health	10.45	3.2	...	...	10.45	2.9
Transportation	22.76	7.0	...	...	22.76	6.3
Entertainment	3.77	1.2	...	...	3.77	1.0
Loans, transfers, donations	0.98	0.3	...	...	0.98	0.3
Other services	15.52	4.8	...	...	15.52	4.3
Total nonfood	119.45	36.8	...	...	119.45	33.2
Total expenditures	324.27	100.0	35.05	100.0	359.32	100.0

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Notes: Data are based on one-month recall, September 1985. Parts may not add to totals because of rounding.

household extension activities may have an effect on the budget share allocated to food. The same model is then estimated separately for members and nonmembers to test for additional differences in spending behavior between the two groups. The results of this analysis are in Table 37.

Food expenditures as a proportion of total expenditures decrease significantly, but not rapidly, with increased income. At total sample mean, a 10 percent increase in total expenditure decreases the budget share to food by only 0.21 percent (computed from Table 37). The dummy variable for separating the cooperative members (MIEM), which is included in the model for the total sample, is not statistically significant. Thus, once income levels and sources are controlled for, membership does not seem to have a distinct effect on shifting the budget share for food. At the margin at higher income levels, however, the budget share to food decreases more rapidly with rising income in member households than in nonmember households (see LTEXPCSQ in the three models, Table 37).

There are indications from anthropological research in the study area that male-controlled income is spent more according to men's preferences than women's and more food may not rank high among men (Nieves 1987, 32). The variables related to income source indicate in this analysis that an increased share of income from new export vegetables (RCASH) decreases the budget share to food beyond the total income effect in cooperative member households. The effect is, however, not highly statistically

Table 34—Food (excluding own-produced) and nonfood expenditures of cooperative members and nonmembers, 1983

Item	Annual per Capita Value of Purchases			
	Members		Nonmembers	
	(quetzals)	(percent)	(quetzals)	(percent)
Maize	13.71	4.9	14.76	6.4
Other cereals, bread	40.68	14.5	38.32	16.6
Pulses	10.11	3.9	7.95	3.4
Sugar	12.61	4.5	11.19	4.8
Roots, tubers, bananas	8.36	3.0	7.16	3.1
Vegetables, fruits	14.56	5.2	10.92	4.7
Milk products	6.05	2.2	5.76	2.5
Meat, eggs, fish	43.55	15.5	37.85	16.4
Fat, oil	4.35	1.6	3.71	1.6
Other foods	3.15	1.1	2.90	1.3
Nonnutritious foods, beverages	14.33	5.1	11.31	4.9
Total food	171.46	61.2	151.85	65.7
Fuel, energy	15.32	5.5	12.65	5.5
Clothing	33.09	11.8	13.37	5.8
Home articles	6.74	2.4	3.94	1.7
Hygiene, cosmetics	12.69	4.5	11.76	5.1
Education	0.42	0.1	0.00	0.0
Health	7.44	2.7	6.91	3.0
Transportation	7.79	2.8	14.24	6.1
Entertainment	1.08	0.4	1.24	0.5
Loans, transfers, donations	4.23	1.5	0.00	0.0
Other services	19.81	7.1	15.13	6.5
Total nonfood	108.61	38.8	79.24	34.3
Total expenditures	280.07	100.0	231.09	100.0

Source: Institute of Nutrition of Central America and Panama survey, 1983.
Notes: Data are based on one-month recall, September 1983. Parts may not add to totals because of rounding.

significant. If, for instance, the income share from new cash crops increases from 0 to 50 percent, the food budget share is reduced by 1.2 percentage points, holding income constant.

This analysis also shows that the net effect for the food budget share of an increased income share of new export crops is very similar to the net effect of an increased share of male nonagricultural income (see the parameters for RCASH in the cooperative member model and for RMNAGINC in the nonmember model in Table 37). On the other hand, women's share in total off-farm income (RFNAGINC) does not appear to have an effect on the budget share to food beyond total income.

Of Q100 of incremental income, cooperative members in the lowest income quartile spend Q52.7 on food, but nonmembers spend Q61.0 on food (Table 38). The estimates of the marginal food expenditures within expenditure quartiles by members and nonmembers show generally lower values for the members within the same expenditure groups. These estimates also point to an interesting relationship between income (total expenditure) and marginal food expenditures. In the poorest quartiles, both members and nonmembers spend less of incremental income on food than the second quartile (in the case of members, even less than the third quartile). Apparently, the poorest households have a high propensity to spend on goods and services other than food at the margin. This expenditure pattern may originate from fixed expenditure obligations for nonfood necessities. As shown in Chapter 7, this expenditure behavior may still be consistent with a high income elasticity of calorie consumption among the poor.

Table 35—Food and nonfood per capita expenditures of cooperative members and nonmembers, 1983 and 1985

Group	Expenditures per Capita					
	Food		Nonfood		Total	
	(quetzals)	(percent)	(quetzals)	(percent)	(quetzals)	(percent)
			1983			
Landless	257.30	54.8	212.00	45.2	469.30	100.0
Members by years of membership[a]						
2 or less	209.87	66.3	106.84	33.7	316.71	100.0
3–4	225.08	60.7	145.94	39.3	371.02	100.0
5–6	248.16	58.7	174.33	41.3	422.49	100.0
Total average for members	229.07	61.2	145.10	38.8	374.17	100.0
Total average for nonmembers	202.87	65.7	105.86	34.3	308.73	100.0
			1985			
Landless	270.83	58.5	192.15	41.5	462.93	100.0
Members by years of membership[a]						
2 or less	238.76	56.6	182.86	43.4	421.63	100.0
3–4	222.17	66.1	113.77	33.9	335.94	100.0
5–6	246.29	57.1	184.96	42.9	431.25	100.0
Total average for members	233.77	59.4	159.59	40.6	393.36	100.0
Total average for nonmembers	204.82	63.2	119.45	36.8	324.27	100.0

Sources: Institute of Nutrition of Central America and Panama survey, 1983; and Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Notes: Data exclude own-produced food consumed in the household, as the 1983 survey does not include related information. All data are in 1985 prices. Parts may not add to totals because of rounding.

[a] Years of membership in the cooperative as of 1985.

Table 36—Change in per capita expenditures, by cooperative membership and duration of membership, 1983-85

Category	Cooperative Members		Nonmembers	
	Change in Total Expenditures	Change in Food Expenditures	Change in Total Expenditures	Change in Food Expenditures
		(percent)		
Landless	. . .	. . .	−1.3	+5.3
Cooperative members by years of membership				
2 or less[a]	+33.1	+13.8	. . .	. . .
3–4	−9.5	−1.3	. . .	. . .
5–6	+2.1	−0.8	. . .	. . .
Total average	+5.1	+2.1	+5.0	+1.0

Sources: Institute of Nutrition of Central America and Panama survey, 1983; and Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Notes: Value of own-produced food is not included here, as the 1983 survey did not include these items. In 1985 the value of own-produced food was 13 percent of total household expenditures for cooperative members and 11 percent for nonmembers.

[a] This group became members in the cooperative two years or less before 1985; thus they entered the cooperative after the 1983 survey.

Table 37—Determinants of budget shares to food in cooperative member and nonmember households, 1985: regression model

Variable	Total Sample		Nonmembers		Members	
	Parameter	t-Value	Parameter	t-Value	Parameter	t-Value
HHSZ	0.003765	1.424	0.005195	1.462	0.002795	0.704
RCASH	−0.023010	−1.691	−0.018140	−1.047	−0.038070	−1.655
RFNAGINC	0.009191	0.261	0.018070	−0.411	−0.007464	−0.104
RMNAGINC	−0.023100	−1.706	−0.033500	−2.263	0.020290	0.578
MIEM	0.010550	0.797	...	...	...	...
LTEXPC	0.279710	1.861	0.156420	0.913	0.579280	1.821
LTEXPCSQ	−0.035270	−2.809	−0.024610	−1.694	−0.060220	−2.314
(Constant)	0.248630	0.557	0.596770	1.193	−0.630700	−0.650
	R^2 = 0.34 DF = 342 F = 25.6		R^2 = 0.37 DF = 178 F = 17.7		R^2 = 0.33 DF = 158 F = 12.8	

Notes: Dependent variable: budget share to food.

HHSZ = household size (number of persons);

RCASH = ratio of income from new export vegetables over total income (total expenditure is used as proxy for expected total income);

RFNAGINC, RMNAGINC = ratio of female (male) nonagricultural off-farm income over total income (total expenditure is used as proxy for expected total income);

MIEM = membership in cooperative (1 = members, else = 0);

LTEXPC = log of per capita total expenditures serving as a proxy for expected (permanent) income; and

LTEXPCSQ = LTEXPC squared.

Effects on Calorie Consumption

The problem of protein-energy deficiency of the rural poor in Guatemala is well researched (see, for example, Balderston et al. 1981; Mata 1978). It is, therefore, not the objective of this research to comprehensively evaluate the nature and prevalence of food deficiencies and malnutrition but to assess the direction and magnitude of changes in consumption and nutrition due to increased export crop production in smallholder households.

Differences in food availability in the Western Highlands households are closely related to income. This is to be expected at such low levels of income. If the sample is grouped into four equal groups by total expenditure per capita (including the value of home-produced food consumed), the lowest quartile had less than two-thirds of calories per adult equivalent unit as the highest quartile (Table 39). Within the Western Highlands, the degree of poverty as reflected in levels of food availability in households indicates a considerable degree of inequality among the poor. It should be noted that calorie availability for this assessment is based on monthly purchases of food and food from own production used for home consumption. This rough approach to food consumption is likely to result in higher calorie per capita figures than an accounting of actual food intake, since losses in storage and processing and losses due to waste are not included. Ideally, actual food intake of individual family members would be preferred in view of findings from earlier research in Guatemala that suggest the income-food intake relationship (calories) is more pronounced among children (preschoolers) than

Table 38—Incremental expenditure on food by cooperative member and nonmember households, by expenditure quartile, 1985

Expenditure Quartile	Share of Incremental Expenditure on Food	
	Members	Nonmembers
	(percent)	
Lowest	52.7	61.0
Second	70.4	76.6
Third	58.1	57.0
Highest	31.9	44.5

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Notes: The estimates of the presented marginal shares of food expenditures are based upon the following regression model estimated separately for each of the groups and quartiles: food expenditure per capita = f(HHSZ, LTEXPC, RCASH, RFNAGINC, RMNAGINC),

where

HHSZ = household size (number of persons);

LTEXPC = log of per capita total expenditures serving as a proxy for expected (permanent) income;

RCASH = ratio of income from new export vegetables over total income (total expenditure is used as proxy for expected total income); and

RFNAGINC, RMNAGINC = ratio of female (male) nonagricultural off-farm income over total income (total expenditure is used as proxy for expected total income).

Table 39—Food availability and composition of food consumption by expenditure quartiles (mean values) in the sample, 1985

Category	Lowest Quartile	Second Quartile	Third Quartile	Highest Quartile
		(per capita)		
Average of 1985 expenditures (quetzals)[a]	186	283	410	771
Calorie availability per adult equivalent per day				
Cooperative members	2,214	2,563	3,088	3,446
Nonmembers	2,122	2,680	3,101	3,401
Total average	2,153	2,628	3,094	3,429
Percent of total calories[b]				
Maize	57.2	57.0	54.6	49.4
Other cereals	6.1	7.4	5.7	6.8
Pulses	9.0	8.3	8.2	7.3
Sugar	13.7	11.7	10.7	11.8
Meat, eggs, fish	4.8	5.6	6.5	7.4
All other foods and beverages	9.2	10.0	14.3	17.3
Total (percent)	100.0	100.0	100.0	100.0

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

[a] Includes the value of own-produced food consumed by the household.

[b] Average of total sample.

for the household as a whole (Flores 1975, 10). To the extent that Flores's finding based on survey data from the 1960s is still valid, the household income-calorie consumption relationship for preschoolers is assumed to be even higher than the total household averages presented here.

More than half of the available calories in households are from maize, but this share decreases with increasing income (Table 39). Also, the calorie share of pulses (mainly beans) decreases, while the share of meat, eggs, fish, and other food calories increases with higher income. Accordingly, the price per calorie increases with rising income as the diet becomes more diversified. Cooperative members spend an average Q0.265 per 1,000 calories, while nonmembers spend Q0.240 per 1,000 calories, or 10 percent less.

Comparison of food availability between export vegetable-producing households (cooperative members) and other households shows that the latter acquire, on average, about 7 percent fewer calories per capita. Members acquire a lower share of maize calories, but the absolute amount of calories per capita from maize is still 4.4 percent higher than in nonmember households (Table 40).

The diet composition of cooperative members and nonmembers is not significantly different. Members have a slightly larger share of calories from sugar, starchy roots, vegetables, meat products, fats, and other processed foods (Table 40). These differences between averages of members' and nonmembers' consumption appear to be largely determined by the differences in income levels and distribution. As shown in Table 39, per capita calorie consumption of members within the same expenditure quartile as nonmembers is sometimes slightly higher (for example, in the lowest and highest quartiles) and sometimes slightly lower (for example, in the two middle quartiles). More refined approaches are used below to test for the significance of these differences.

The basis for the concept of this analysis of the effects of increased export crop production on food consumption is that the principal relationships between change in prices and levels of income and food consumption are well established. Since real income increased in households that adopted new export crops, the hypothesis is that food consumption levels increased, too. Less clear are hypotheses related to the effects

Table 40—Food availability and composition of food consumption in cooperative member and nonmember households, 1985

Category	Members	Nonmembers
Calorie availability per adult equivalent per day	2,931	2,733
Percentage of total calories		
Maize	53.8	55.3
Other cereals	6.2	6.8
Pulses	8.1	8.3
Sugar	12.1	11.8
Starchy roots, bananas	2.7	2.5
Vegetables, fruits	5.6	5.4
Milk	0.5	0.4
Meat, eggs, fish	6.4	5.8
Fats and oils	1.3	1.0
Other foods and beverages, meals outside home	3.3	2.7
Total (percent)	100.0	100.0

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

of income-source changes, control over household income, and the form and frequency of income. (For a review of evidence on this issue, see Braun and Kennedy 1986, 55-59.) Export vegetable production impinges on all of these jointly with its favorable effect on the overall real income. The net effect of export vegetable production on household food consumption may thus be smaller or larger than the "pure" income effect suggests. These factors will be evaluated in the following model, which attempts to explain aggregate household-level food availability in the form of calories (c_i):

$$c_i = f(I_i, I_i^2, S_{ji}, D_{ni}, P_{mi}, M_{qi}), \tag{9}$$

where

I_i = per capita income of household i (total expenditure is used as income proxy),

S_j = a set of j variables describing sources of income (from new cash crops, off-farm women's income),

D_n = a set of n variables describing household size and composition,

P_m = a set of m variables depicting food prices that respective households face, and

M_q = a set of q variables describing the membership and its duration in the cooperative for export vegetable production.

The model is estimated both for the total sample and separately for the lowest 50 percent of income groups among members and nonmembers. The actual specifications of the model along the above-formulated hypothesis and the estimation results are presented in Table 41.

The estimated response of calorie availability to changes in levels of income is highly significant. Additional income increases calorie consumption (LTEXPC), but at decreasing rates at the margin (LTEXPCSQ). The elasticity of calorie consumption with respect to income is 0.306 at the total sample mean. Since the new export crops increased household per capita income, a positive effect for calorie consumption in cooperative member households is to be expected according to these parameter estimates.

Since the food expenditure analysis in the previous section suggested that export crop income is spent less than other income for food at the margin, the extent to which this translates into calorie consumption is tested. It is hypothesized that membership in the cooperative reduced women's off-farm income and increased shares of cash income from new crops, which are controlled by men (see, for example, Tinker 1979).

Most purchased food items in Guatemalan households are actually acquired by women. Maize is the only food that is purchased in a significant amount by men (Table 42). In this environment, women's income levels may have a particularly positive effect on levels of food acquisition over and above total income of the household. This hypothesis, tested by the variable RFNAGINC—share of (off-farm) income earned by women in total income—in Table 41, does not find statistical support. Income earned by women off-farm does not significantly change calorie acquisition after controlling for total income, although it was found earlier in the expenditure analysis that an increased share of female-controlled off-farm income increased the budget share to food beyond the income effect. The explanation for this difference may be that the

Table 41—Availability of calories in households and export vegetable production: regression model

Variable	Total Sample		Lowest Two Quartiles			
			Cooperative Members		Nonmembers	
	Parameter	t-Value	Parameter	t-Value	Parameter	t-Value
LTEXPC	20,446.410	2.663	3,928.210	1.218	6,289.810	3.794
LTEXPCSQ	−1,328.330	−2.072	. . .	. . .	. . .	. . .
RFNAGINC	−1,685.120	−0.971	−1,096.170	−0.437	−1,675.740	−0.606
RCASH	57.254	0.082	553.030	0.438	173.124	0.194
HHSZ	1,747.343	13.021	1,244.150	5.075	1,510.410	6.629
RCHILD	−6,627.550	−3.106	−4,957.520	−1.088	−4,923.010	−1.230
MPRICE	−82,424.880	−5,774	−46,732.990	−1.821	−54,545.190	−1.648
BFPRICE	505.477	1.020	949.183	0.826	1,139.320	1.168
MIEM	−829.710	−1.218	. . .	. . .	. . .	. . .
(Constant)	−47,623.400	−2.060	−6,841.310	−0.394	−18,424.900	−1.417
	R^2 = 0.41 F = 26.6 DF = 340		R^2 = 0.33 F = 4.20 DF = 60		R^2 = 0.64 F = 9.60 DF = 98	

Notes: Dependent variable: calories available for consumption per day in the household (from purchases and consumed from own production, 1985).

LTEXPC = log of total expenditures per capita per year in quetzals (as a proxy for permanent income);

LTEXPCSQ = LTEXPC squared;

RFNAGINC = ratio of female off-farm income over total income (total expenditure is used as proxy for permanent income in the ratio);

RCASH = ratio of income from new cash crops over total income (total expenditure is used as proxy for permanent income in the ratio);

HHSZ = number of persons in the household;

RCHILD = ratio of number of children under 5 over number of persons in the household;

MPRICE, BFPRICE = price of maize, beef; and

MIEM = membership in the cooperative (1, else = 0).

Table 42—Purchasers of food items in household transactions

Food Item	Husband	Wife	Other Person
		(percent)	
Milk	8	87	5
Eggs	1	92	7
Pork	2	95	3
Sausage	2	90	8
Maize	24	76	. . .
Beans	2	93	5

Source: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Note: Data are based on one-month recall.

usual off-farm work in trading and services takes women away from home from morning till sunset even if temporary migration is not involved, and that more expensive time-saving foods may enter the budget of such households. Obviously, generalizations of the relationships between women's income and food acquisition are risky if the interactions with mode of income earning are not taken into account. The issue of the actual value of human time discussed above and the possibly different utility derived by households from on-farm versus off-farm work at equal returns per unit of time is also relevant here.

An increased share of income from new export crops (RCASH) does not have a significant effect on calorie acquisition beyond the income-level effect. The respective parameters of this variable are not statistically significant in any of the three models (Table 41). That is, income from the new export vegetables translates into calorie availability no differently than income in general.

The model for the total sample tests whether membership in the cooperative (MIEM) and the share of income from export crops (RCASH) affect calorie acquisition beyond the absolute income effect. The respective parameter estimate of cooperative membership suggests a marginally significant negative effect on calorie availability (the parameter of MIEM is not statistically significant; see column 1, Table 41). Although this appears as the general picture, the situation seems different at low-income levels, as shown by the separate estimates of the calorie consumption functions for members and nonmembers in the lowest income half of the joint income distribution (Table 41). Nonmembers show a significant positive response in calorie acquisition with rising income but members do not. Calculated at the identical income level at the mean of the joint sample—not at the differing means of the two separate samples, which would distort the picture—cooperative members increase their calorie acquisition by 2.8 percent with 10 percent more income, but nonmembers increase theirs by 4.4 percent. (This income elasticity of calorie acquisition among members is based on a parameter estimate that is statistically not significant—see Table 41.) The households in the area are clearly price-responsive in their calorie acquisition. Understandably, the maize price (MPRICE) is most prominent in this respect, as about 50 percent of calories come from maize.[21] The estimated (maize) price elasticity of calorie consumption is high; −1.15 among the lowest income half of nonmembers and 0.95 among the members in that income group, which means that a 10 percent increase in the maize price reduces calorie availability by 9.5 percent at the household level. If increased export vegetable production were to shift farm households from net sellers or self-sufficiency to net purchasers, or shift whole village communities in the Western Highlands to net importers, the related price effect could have a significant effect on calorie consumption.

In the final assessment, the effects of increased export crop production on food acquisition are on average positive in terms of calorie availability to the households, supporting further the conclusion drawn from the agricultural production and income assessments that household-level food security seems to have improved. Yet the change in the source of income-earning reduces the positive gross-income effect for calorie acquisition from an expected increase of 7.2 percent to an overall net effect of 1.9 percent in a typical farm household that joined the cooperative (based on model in column 1, Table 41). The following section traces these effects to the nutritional status of children.

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[21] Price variability in the cross-sectional sample results from local price differences and the fact that households face in varying degrees a c.i.f. price if they are purchasing or an f.o.b. price if they are selling. To households that are only consuming their own-produced maize, the local f.o.b. price was assigned to represent the shadow price of maize consumption.

Effects on Nutrition

The nutrition problem in the Western Highlands is a syndrome that stems from poverty. The health and sanitation environment along with the ability to acquire food—be it from own production or market—and employment, especially of mothers, are important interrelated factors that determine the nutritional performance of children (Balderston et al. 1981). The new export vegetable production scheme directly or indirectly impinges on all of these variables.

Patterns of Malnutrition in the Region and Sample Population

In a number of social indicators, cooperative member households appear to have a better standard of living than nonmembers. Many of these indicators may be directly or indirectly linked to increased income of members, but other indicators may reflect their desire and ability to change their living standards as compared with others in the communities. In general, members have higher education levels, better housing and water supply conditions, and higher-quality health services (clinics). Basic health services, such as vaccination, are used similarly by the two groups. Although they are generally less poor, the percentage of members obtaining food aid tends to be higher than among nonmembers (see indicators, Table 43).

As found in the above analyses, both real household income and food from own production increased due to export vegetables. Women's on-farm employment increased, leading to less off-farm work. Employment in the six communities also increased due to export cropping; this should be beneficial to the local landless and smallest farmers, who depend more on off-farm work. However, the country went through a period of general economic decline in the mid-1980s that adversely affected economic opportunities of the poor. Thus it is an open question whether the nutritional situation in the six communities generally improved. This question will be evaluated using nutritional status indicators of children—weight-for-age, height-for-age, and weight-for-

Table 43—Selected social indicators for cooperative members and nonmembers

Indicator	Members	Nonmembers
	(average)	
Household size (persons)	6.7	6.4
Literate heads of household (percent)	61.7	55.4
Electricity in the house (percent)	60.3	47.7
Housing conditions		
Houses with mud floor (percent)	41.7	56.5
Houses with corrugated iron (percent)	69.7	49.8
Own water tap or own well (percent)	79.6	61.9
Use of health services (percent)		
At clinics	45.6	33.4
At pharmacy or other services	50.1	60.6
Vaccination of children under 5 years (percent)		
Measles	68.6	65.1
BCG	70.8	67.1
DPT (3 or 4 doses)	50.0	46.6
Polio (3 or 4 doses)	48.8	45.3
Food aid received in		
1983 (percent of households)	53.2	45.8
1985 (percent of households)	45.0	42.8

Source: Institute of Nutrition of Central America and Panama survey, 1983; and Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

height. In this analysis, the respective indicators are normalized for age differences by expressing them in terms of their deviation from the age-specific standards over the standard deviation (Z-scores).[22]

The general nutritional situation in the study area, as represented by children in households not participating in the cooperative, is not very different from other parts of the highlands despite the accessibility of the survey villages to Guatemala City and to infrastructure (Table 44). Also, prevalence rates of malnutrition in these communities (especially height-for-age) are at similar levels to, or even higher than, the rates found in more remote parts of the Western Highlands (Table 45).

Comparing the Guatemalan data with comparable data from Africa, significant differences are found. For instance, average Z-scores for growth retardation of about −1.4 were found in a comparable survey in The Gambia (von Braun, Puetz, and Webb 1989). However, a straight comparison of average Z-scores of anthropometric indicators across populations may not be fully justified because of ethnic differences between populations. Therefore, the focus is mainly on relative changes rather than absolute levels of anthropometric status as a nutritional indicator in this analysis.

A comparison of the 1983 and 1985 prevalence rates does not indicate a general improvement in nutritional status (Table 45). However, this tendency should not be generalized to local developments. During these years, Guatemala was going through a severe economic crisis, which may be the reason for this general pattern of development. Desired information on change over time in anthropometric indicators from other Guatemalan locations in the early 1980s is not available. Comparison of cooperative members with nonmembers shows that children of members tend to be better off in terms of weight-for-age and height-for-age and about the same in terms of weight-for-height.

Table 46 presents an analysis of the prevalence of wasting and stunting among the children of families who are members versus nonmembers. Two cutoff points are used for both the weight-for-height and height-for-age standards. The commonly used cutoff point to classify wasting is children below 80 percent weight-for-height, and for stunting, below 90 percent height-for-age standards. Only children 6-60 months of age are included. By the above standards, 66.7 percent of children of members and 75.7

Table 44—Nutritional status of children under 60 months in the study area and other locations in Guatemala

Area	Weight-for-Age	Height-for-Age	Weight-for-Height
		(average Z-scores)	
Study area, 1985[a]	−1.89	−3.27	0.11
A study area in four villages in Patulúl area, 1984	−1.98	−3.26	0.00
A study area of coffee plantations, 1984	−1.65	−2.61	−0.05

Sources: Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985; and data from Victor Valverde, Hernán Delgado, Rafael Flores, and Ricardo Sibrián, "Minimum Wage Law and Nutritional Status in Guatemala," Institute of Nutrition of Central America and Panama, Guatemala City, 1985, (mimeographed).

[a] Children aged 6-60 months of the nonmembers of the cooperative.

[22] The National Center for Health Statistics standards were used for Z- scores. Z-scores are standard deviation scores. For any value X_i, the Z-score is $(X_i - \bar{X})/S$, where $\bar{X}$ is the median and S is the standard deviation of the reference population. A negative (positive) Z-score means the specific value X_i is "Z" standard deviations below (above) the median of the reference population.

Table 45—Prevalence of malnutrition in the Western Highlands of Guatemala

Area	Children Below −2 Z-Scores		
	Weight-for-Age	Height-for-Age	Weight-for-Height
	(percent)		
Study area, 1983[a]	43.2	82.1	1.7
Study area, 1985[a]	42.4	89.2	1.3
Western Highlands (north)	36.8	67.6	1.7
1983[b]	36.8	67.6	1.7
1987[c]	58.3	66.2	8.2
1987[d]	51.7	81.8	4.2

Sources: Based on data from USPADA/INCAP/UCPRODA, *Resultados del Análisis de las Encuestas de Base Agroeconómica, Dieta y Estado de Nutrición Infantil,* Project MAGA-AID 520-T-034/0255, 1983 (Guatemala City: INCAP, 1986); Cooperación Guatemalteca-Alemana Alimentos, *Informe Final, Baseline Survey, Análisis del Grupo Meta (Población Rural de los Departamentos El Quiché-Sur y Totonicapán),* vol. 2 (Guatemala City: COOGAT, 1987); and Institute of Nutrition of Central America and Panama, *Informe de los Resultados de las Encuestas de Consumo de Alimentos y Estado Nutricional,* Project MAGA-AID 520-T-034/0255, 1987 (Guatemala City: INCAP, 1988).

[a] Children aged 6-60 months of the nonmembers of the cooperative.
[b] Six departments: Huehuetenango, Quetzaltenango, San Marcos, Totonicapán, El Quiché, and Sololá; children aged 0-60 month(s).
[c] Two departments: Totonicapán and El Quiché; children aged 0-71 month(s).
[d] Six departments as in note (b): children aged 12-60 months.

percent of children of nonmembers were stunted in 1985. This reflects an increase in both groups, although somewhat higher in the nonmember group. Severe stunting (below 80 percent) hardly prevails among children of members (0.6 percent) but affects children of nonmembers (5.8 percent). Severe wasting, which represents an indicator of short-term nutrition problems, is practically nonexistent in both groups. In 1985, 0.6 percent of children of members and 1.0 percent of children of nonmembers were affected.

Table 46—Prevalence of malnutrition among children of cooperative members and nonmembers, aged 6-60 months, 1983 and 1985

Year	Members[a]		Nonmembers[a]	
	Weight-for-Height	Height-for-Age	Weight-for-Height	Height-for-Age
	(percent of children below 90 percent of reference standard)[b]			
	(stunted)			(stunted)
1983	15.1	59.3	10.2	65.1
1985	6.8	66.7	7.8	75.7
	(percent of children below 80 percent of reference standard)[b]			
	(wasted)		(wasted)	
1983	2.3	0.6	0.9	4.2
1985	0.6	0.6	1.0	5.8

Source: Institute of Nutrition of Central America and Panama survey, 1983; and Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.
[a] Number of children: 1983 = 172 members, 215 nonmembers; 1985 = 177 members, 206 nonmembers.
[b] The standards used are the National Center for Health Services standards.

In both groups, children who have been moderately underweight substantially improved, relatively more among cooperative members. Between 1983 and 1985, the percentage of children below 90 percent of the weight-for-height standard decreased from 15.1 to 6.8 percent among children of members, and from 10.2 to 7.8 percent among children of nonmembers.

Income and Nutritional Improvement

The straightforward comparisons of mean values and prevalence rates of malnutrition provide limited insights, since the earlier analysis showed that members of the cooperative have higher incomes than nonmembers. The sample is therefore broken into three income classes, using expenditure per capita as an income proxy. For children 6-120 months of age, there is a generally positive but weak relationship between income and nutritional status (Table 47). While children in the middle and highest terciles showed a slight improvement in their weight-for-age Z-scores, children from households in the lowest group appear to have worsened between the two rounds. The prevalence of stunting (height-for-age) increased among children from households in the bottom and middle terciles, while it decreased among the highest income group. The higher prevalence of stunting may be related to the worsening of the general socioeconomic conditions during the first half of the 1980s, when real per capita GDP decreased by 20.5 percent (1981-85) in Guatemala.

Because of increases in real income, available food from own production, and women's on-farm employment, as well as overall employment in the six communities, which is beneficial to the landless and the smallest farmers, it is hypothesized that the nutritional situation improved for both members and nonmembers of the cooperative. The following model is a reduced form of income-nutrition relationships. At higher

Table 47—Income levels and prevalence of malnutrition among children of cooperative members and nonmembers, 1983 and 1985

Measure	Year	Number in Sample	Children Below −2 Z-Scores		
			Lowest Income Tercile	Middle Income Tercile	Highest Income Tercile
			(percent of children 6-120 months)		
Weight-for-age	1983	755	41.6	38.9	36.8
	1985	824	43.0	36.5	32.2
Height-for-age	1983	755	77.4	75.0	77.7
	1985	824	83.4	87.4	74.4
Weight-for-height	1983	755	1.9	0.8	2.1
	1985	824	1.9	0.7	0.8
			(percent of children 6-60 months)		
Weight-for-age	1983	406	46.2	38.0	39.7
	1985	394	48.3	38.2	34.1
Height-for-age	1983	406	78.7	78.5	83.6
	1985	394	84.8	95.8	81.1
Weight-for-height	1983	406	2.4	1.7	0.9
	1985	394	1.7	1.4	0.8

Source: Institute of Nutrition of Central America and Panama survey, 1983; and Institute of Nutrition of Central America and Panama/International Food Policy Research Institute survey, 1985.

Note: Income levels refer to expenditures of respective year in per capita terms as income proxy (excluding value of own-produced food consumed, which was not collected in 1983 survey).

income levels, reduced marginal effects of increased income for nutritional improvement are expected. It is further hypothesized that an increased share of male nonagricultural income or export crops has a negative effect on child welfare, holding household income constant. If a disproportional share of income is spent on luxuries, children's nutritional status would deteriorate at a given income level. On the other hand, it is hypothesized that an increased share of female-controlled income leads to increased child welfare-related spending and nutritional improvement. Subsistence food income is included in the total household income variable in this reduced-form model, which has the following formula:

$$S_{ij} = f(DEM_{ij}, INCOME_j, INCOMP_j), \quad (10)$$

where

S_{ij} = nutritional status of child (i) in household (j) in 1985;

DEM_{ij} = demographic variables of child (sex, age in months—level and squared—birth order);

$INCOME_j$ = household (j) income per capita per year (and the respective squared term); and

$INCOMP_j$ = composition and sources of income (shares from new export crops, male- or female-earned nonagricultural income).

The results indicate that the level of income is highly significant for the weight-for-age, height-for-age, and weight-for-height indicators (Table 48). At higher levels of

Table 48—Effects of income and income source and composition on nutritional status: multivariate analysis for children aged 6-120 months

Explanatory Variable	Weight-for-Age Z-Scores		Height-for-Age Z-Scores		Weight-for-Height Z-Scores	
	Estimated Parameter	t-Value	Estimated Parameter	t-Value	Estimated Parameter	t-Value
Age in months	−3.489E−03	−0.85	−0.0156	−3.03	−9.485E−03	−2.28
Age squared	3.497E−05	1.14	1.397E−04	3.64	1.053E−04	3.39
Birth order[a]	1.706E−04	0.01	−0.0240	−1.37	0.0220	1.55
Sex (male = 1, female = 2)	7.083E−03	0.12	0.0379	0.52	−0.0562	−0.96
Duration of breastfeeding[b]	9.663E−05	2.03	1.894E−04	3.17	−3.063E−05	−0.63
Income per capita[c]	8.231E−04	3.20	7.807E−04	2.41	5.162E−04	1.98
Income squared[c]	−3.930E−07	−2.74	−3.489E−07	−1.93	−2.625E−07	−1.80
Share of male nonagricultural income	0.1613	2.00	0.3291	3.24	−0.0531	−0.67
Share of female nonagricultural income	0.4953	2.20	0.4895	1.73	0.3140	1.37
Share of income from export crops	0.1569	1.88	0.1958	1.81	0.0640	0.73
Constant	−2.1165	−12.89	−3.110	−15.08	0.0549	0.33
R^2	0.032	...	0.073	...	0.028	...
F-value	3.590	...	7.280	...	3.290	...
Degrees of freedom	785	...	785	...	785	...

[a] First-born child = 1, second = 2, and so forth.
[b] Variable only for children above 24 months of age (else = 0).
[c] Expenditure per capita per year is used as a proxy for income.

income, the marginal effect is reduced as hypothesized, indicated by the negative sign for the squared income term. Thus the effect of marginal income on nutrition is greater in poor households than the sample means indicate. At sample mean, a 10 percent increase in income increases the weight-for-age Z-score by 1.5 percent, the height-for-age Z-score by 0.9 percent, and the weight-for-height Z-score by 9.7 percent. The high income elasticity of short-term nutritional improvement (weight-for-height) suggests that even marginal income growth among the poor leads to significant short-term weight gains of children. It thus can be inferred that increased real income due to the export crops has a particularly significant effect in this respect. To reduce stunting substantially, however, would require a major increase in income.

Higher shares of either male or female off-farm nonagricultural income improve the nutritional status of children. Although this is contrary to the study hypothesis concerning male-controlled income, the respective parameter values indicate different levels of impact. In the weight-for-age model, women's income always had a greater impact on nutritional status than men's income. In the height-for-age model, which depicts long-term effects, the differential effect between male- and female-controlled income is less pronounced; for short-term nutritional status (weight-for-height), income control within the household does not appear to be an issue (the parameters are not statistically significant).

A higher share of income from the new export crops has a low positive effect on nutrition after controlling for income in the weight-for-age and height-for-age models but is not significant in the weight-for-height model. The hypothesis that income from new cash crops, which is largely male-controlled, would be disproportionately used for nonfood and luxury items that would adversely affect nutrition of children in the household does not find support in this analysis.

Social Programs

The commercialization process studied in this case is inseparable from the Cuatro Pinos cooperative scheme. The cooperative has developed and implemented three types of social programs: productive, educational, and medical. These programs may improve the health status of children and have a long-term effect on nutritional improvement beyond the income-consumption effect of the new export crops.

Productive programs include a rabbit project that was started in March 1986 for women. This project consists of providing credit for acquisition of a rabbit pen and three rabbits—credit that must be repaid in one year. Furthermore, participants are trained in rabbit growing, maintenance, and slaughtering techniques. As of April 1987, 105 women had participated in the project. It is estimated that 50 percent of the rabbit meat production is for own consumption, and the remainder is sold to supermarkets in Guatemala City.

By statute, 10 percent of the cooperative's profits are earmarked for its educational fund. The first program (initiated in Santiago in 1978) was an adult education program for members and nonmembers, with primary education and literacy classes. In 1983 the program was expanded to three communities and was taught by three teachers directly employed by the cooperative. In 1986, 132 adults (36 nonmembers) finished the primary education subprogram and 66 (12 nonmembers) finished the literacy subprogram.

In 1980, with funds from the Swiss Group, a nongovernmental development organization, several children began to receive study scholarships. The scholarship program was formally organized in 1985, and scholarships are provided for secondary education and vocational training and normally cover tuition and books. The education committee

of the cooperative reviews and approves scholarship applications. In 1987, 47 scholarship applications were approved.

An institution providing secondary education has been established in Santiago and receives financial assistance from the cooperative, thus benefiting some members indirectly. Additional educational programs for schoolchildren were started in 1985 in production techniques related to vegetables and aspects of cooperativism, and in 1986 cooperative education courses were organized for members, their spouses, schoolchildren, and cooperative officials. Technical training in such fields as administration and accounting was initiated in 1987 for personnel of the cooperative.

In 1984 the cooperative organized a food and nutrition program for spouses of members. As of mid-1987, 225 women have participated in this program, whose contents center on different ways of preparing vegetables (particularly broccoli, snow peas, and cauliflower) and their nutritive values, in order to stimulate more own consumption of these foods. The program is conducted by two home extension workers who are employees of the cooperative and were partially trained by INCAP.

The medical services program consists of several subprograms: maternal-infant, pre- and post-natal care, outpatient consultations, and deworming. The program is currently carried out in all communities from which the cooperative draws members. The staff consists of a full-time doctor (as of August 1986) who is an employee of the cooperative. The doctor spends four afternoons a week in the health clinic in Santiago and divides the remainder of the time among the other communities. This is in addition to a full-time health promoter who, among other things, prescribes medicines. From 1982 to August 1986, a medical doctor provided services two mornings a week in Santiago and Pacul. In January 1987 the cooperative established a pharmacy in Santiago that also supplies medicines to the other communities.

Food Consumption and Health-Based Model of Nutritional Improvement

To assess the effects of increased commercialization on the nutritional status of children, it is hypothesized that the related income effects—identified in the reduced-form model above—can be traced to nutrition through increased food consumption and improved health and sanitary conditions. Such further separation of the elements of the growth and development process traced to nutritional effects is desirable for policy and program design.

The model, unlike the reduced-form, income-based model in the previous section, is a cohort-specific analysis of determinants of change in nutritional status. The model for the identical children aged 6-60 months in 1983 and 30-84 months in 1985 has the following form:

$$dS_{ij}^{(1983-1985)} = f(DEM_{ij}, CAL_j, BRE_{ij}, SAN_j, EDU_j, PER_j, S_{ij}^{(1983)}), \quad (11)$$

where

$dS_{ij} = S_{ij}^{(1985)} - S_{ij}^{(1983)}$;

DEM_{ij} = demographic variables of child (sex, age in months—level and squared—birth order);

CAL_j = household-level calorie consumption per adult equivalent (level and squared);

BRE_{ij} = breastfeeding duration (children over 24 months);

SAN_j = sanitary environment (latrine);

EDU_j = education of head of household (years of schooling);

PER_j = years of cooperative membership; and

S_{ij} = nutritional status of child$_{(i)}$ in household$_{(j)}$ in 1985 (weight- or height-for-age, or weight-for-height Z-scores).

In this model of the determinants of change in nutritional status, household calorie availability is included as a proxy variable for household food consumption. Household food availability may not be a satisfactory indicator of child food consumption. The hypothesis is that children capture a share of incremental household calories. Additional indicators related specifically to breastfeeding duration are also introduced.

Poor latrine facility is used as a proxy for sanitation environment. It is further hypothesized that households with better education have the ability to make better use of available resources to improve the health and nutrition of their children. Finally, the duration of membership in the cooperative is evaluated for its effect, beyond the income-consumption effect, on children's health and nutritional status. Beneficial effects from cooperative membership may come from participation in the social programs, such as literacy classes, food and nutrition education of women, and improved information exchange among communities. Adverse effects might result from changes in income control not captured fully by the food consumption variables and women's time constraints for child-nurturing activities.

Inclusions of an individual child's nutritional status indicator (1983) before the period during which change is measured (1983-85) take account of individual characteristics. This increases the overall explanatory power of the models as compared with the purely cross-sectional, income-based models. The lower the Z-score at the outset (1983), the greater the reduction in weight deficiencies during the two years of observation.

For instance, children who were underweight at −2 Z-scores in 1983 tended to catch up by one Z-score over the period (-0.5004×-2, see Table 49). This points out that a high proportion of malnutrition—reflected in weight deficiency—is of an episodic nature. These serial episodes of weight loss then create the long-term nutritional problem reflected in growth deficiency (see, for example, Balderston et al. 1981). Although significantly increasing, too, catch-up growth from a stunted position at the outset occurs much less often than catching up on weight. It should be noted that age of the child is controlled for in this analysis and seasonality is eliminated, as the sample surveys were done at the same time of the two years.

Other results of the regression models presented in Table 49 relate to the effects of food consumption: household-level calorie availability does have a strong positive effect—though decreasing at the margin—on the more short-term indicator of nutritional status (weight-for-height). Current calorie consumption would be an unsatisfactory indicator for the food availability history to which the children were exposed. For this reason, in the long-term model of nutritional status (height-for-age), current calorie

Table 49—Determinants of change in nutritional status and the role of export crop production: multivariate analyses for cohort of children

Explanatory Variable	Change in Weight-for-Age Z-Scores		Change in Height-for-Age Z-Scores		Change in Weight-for-Height Z-Scores	
	Estimated Parameter	t-Value	Estimated Parameter	t-Value	Estimated Parameter	t-Value
Age in months	0.0296	1.60	0.0140	0.74	0.0366	1.79
Age in months squared	−2.548E−04	−1.62	−4.248E−05	−0.27	−3.132E−04	−1.81
Birth order[a]	0.0482	2.72	0.0144	0.82	0.0689	3.54
Sex (male = 1, female = 2)	−0.0226	−0.32	−0.1009	−1.39	0.04133	0.52
Calories per day per adult equivalent, 1985	5.249E−05	0.73	...[b]	...	2.2029E−04	2.78
Calories squared	−5.586E−09	−0.69	...[b]	...	−2.491E−08	−2.76
Breastfeeding[c]	0.2662	1.64	0.1351	0.82	0.3169	1.77
Unsuitable latrine (= 1, else = 0)	−1.212	−0.68	−0.3459	−1.91	0.0556	0.28
Education of household head (years in school)	0.0261	1.28	0.0188	0.92	0.0217	0.97
Z-score of weight-for-age, 1983	−0.5004	−13.48	...	...	...	...
Z-score of height-for-age, 1983	...	...	−0.2672	−7.90	...	...
Z-score of weight-for-height, 1983	...	...	...	...	−0.6984	−17.34
Duration of membership in cooperative (years)	7.694E−03	3.37	0.01237	5.36	1.774E−03	0.70
Constant	−2.278	−3.88	−1.784	−3.10	−1.914	−2.95
R^2	0.360	...	0.229	...	0.469	...
F-value	20.400	...	13.500	...	31.500	...
Degrees of freedom	369	...	371	...	369	...

Note: These analyses are based on a cohort of children who were aged 6-60 months in 1983 and 30-84 months in 1985.

[a] First-born child = 1, second = 2, and so forth.

[b] The variable is not included in this model because it is not assumed to have an effect on the long-term measure of nutritional status.

[c] If child was breastfed = 1 (else = 0).

availability was not included as a variable. To the extent that the new export vegetables increased income, and thus increased household food availability, these results show that the nutritional status of children is likely to be improved, at least in the short run.

7

POLICY CONCLUSIONS AND GENERALIZATIONS

This study of export crop production in smallholder agriculture is based on experience with a scheme that relies for success on particular conditions described earlier in the report. Clearly the Cuatro Pinos cooperative is an exceptional case of agricultural and rural development and is not typical in Guatemala. However, it is precisely because the cooperative stands out favorably in an environment of numerous failures of agricultural modernization with farmers' participation in Central America that it is possible to arrive at important policy conclusions.

Mellor and Desai (1985, 209) stress that disparities in the distribution of assets and power, which are often based on the social as well as the economic structure, must be recognized. "The need for radical institutional changes may have been overstated in recent years vis-à-vis technological change in agriculture but the necessity for such change must always be examined." Also, their emphasis that "state-sponsored dualism must be guarded against" and that "a full attack must be made on all discriminatory practices that restrain the poor" is of great relevance for this case study.

In studying the effects of increased commercialization of traditional smallholder agriculture in Guatemala, the broader context of the "agrarian crisis" in Latin America, which provides the political and economic environment of this study, should be kept in mind. As de Janvry (1981, 3) puts it, the agrarian crisis in Latin America is characterized by sharply uneven development among farms, crops, and regions, and by massive rural poverty and political tensions. In contrast to the poverty issue in much of Africa, poverty is not a separate phenomenon but is to be seen in terms of its functionality (de Janvry 1981, 149). Low productivity in the traditional sector, unemployment, and regressive income distribution patterns may be identified as direct causes of poverty but are, at the same time, a function of the political-economic systems. As a consequence, de Janvry (1981, 150) points out, policy recommendations regarding poverty run the risk of assuming a reality separate from the functioning of the economic system when they are only directed by idealistic and humanitarian concerns.

Clearly, political and economic structures should be kept in focus when policy conclusions are derived from the case studied here. When the implications of the new export crop production are evaluated here in the context of the existing political-economic system, this is not intended to imply that the effects of this type of export crop scheme are independent of the political system. In a drastic way, this was made clear by the violent repressions that peasant organizations, such as cooperatives, suffered in some parts of Central America in the early 1980s (Williams 1986).

Using Adelman's (1975) term, Guatemala may be a case for "redistribution before growth." Taking a pragmatic evolutionary approach to the problem leads to the derivation of criteria for rural change that work in a desirable direction. Two issues are essential in this respect. The first is the identification of policies that make use of the opportunities for agricultural trade to sustain, not oppose, the relation between growth and distribution. The second is the question classified by de Janvry (1981, 265) as probably the most important one in this context, "whether growth itself is articulating." Does growth through the creation of employment, and hence domestic demand for

wage goods, lead to gradual changes in the production structure that result in "social articulation" of the poor, that is, expressed demand for services, infrastructure, education, and participation in decisionmaking and priority-setting in the development process?

Concerning the first issue—trade opportunities and distribution—the production of export vegetables has worked in the right direction in this study. Some peculiarities of the new crops and the conditions at the location have produced this outcome. Because of their diseconomies of scale in production, nontraditional crops ended up on the smallest farms in the poorest area of the country, creating employment for the small farmers and local landless, substantially increasing real income, and favorably affecting food security and consumption. The favorable effect of the nontraditional crops for small farmers largely depends upon the crops' characteristics, which are very different from those of such traditional export products as cotton, coffee, and beef. These products have apparently positive returns to scale in production and are produced more efficiently on the other end of the dual spectrum of Guatemala's agriculture—the large-scale farm enterprises.

As for the second issue—social articulation—the study finds that institutional changes combined with the expansion of export crop production in a cooperative scheme are forces leading toward social articulation. Noteworthy are the strengthening of cooperation among farmers, increased interaction between village communities, development of local trading and entrepreneurship due to the new crops, and related buildup of economic power in the rural areas by the small-farmer-based economic growth. An earlier discussion (Chapter 4) showed that development assistance can and actually has played a catalytic role in this process. The economic costs of terminating this process are now higher, especially in light of the country's severe foreign exchange problem, which nontraditional export vegetable production plays an important role in alleviating.

No general automation between growth and social articulation of the poor that could lead to development can be postulated based on this study. The study demonstrates the existence of niches in the system that provide this potential and also highlights the specific conditions under which it may work. Central to these conditions are the diseconomies to scale in producing the export vegetables and the ecological conditions in the Western Highlands along with the labor market situation.

The sustainability and expansion potentials of the program depend on the functioning of the marketing channels, domestically and internationally, for both inputs and outputs. The implicit taxation of small farmers through overvalued exchange rates for outputs is a matter of concern. The riskiness of the new crops due to potential disturbances in the marketing chain needs to be a matter of constant attention.

For maximum gains from specialization, policies that ensure efficiently functioning food, labor, and financial markets are the first-best solution. Market imperfections are the worst enemies of sustainable market integration of the subsistence farm sector. As long as market failures cannot be excluded and small farmers' perception of their potential occurrence remains due to past experience (and this may change only slowly), second-best options for policy must be considered. Therefore, the deep-rooted desire for food security achieved by high levels of self-sufficiency at the household level in the Western Highlands can best be accommodated by rapid technological improvements in the traditional subsistence crops—maize and beans—along with expansion of the new export vegetables. This is also a condition for adoption of the new crops and, as observed in this study, small farmers manage to achieve complementarity between growth in the subsistence crops and the new crops.

Accelerated growth in food production alone would have little effect on the general poverty situation in the Western Highlands. Single-minded focus on nontraditional export crops would be risky for small farmers' food security and would be constrained by the adoption problem if food crops did not move jointly.

To cope with production risk and to finance the adoption of the input-intensive new crops, a functioning rural capital market is essential. Rural credit and banking schemes that open up outlets for rural savings are essential for long-term growth. Otherwise, savings find their way into the form of assets—that is, land—with obvious efficiency losses to the initiated development and potential adverse distributional effects at the micro level.

Modest, though statistically highly significant, improvements in nutrition via the favorable income and consumption effects of the program may be expected, as shown by the analysis. This suggests that rapid employment and income growth will make a difference that can be translated into nutritional improvement at the low levels of poverty. The research further suggests that the income-growth effect needs to be supported by appropriate health- and nutrition-oriented social infrastructure. This requires sustained government commitment and community-based actions rather than short-term charity. Development assistance can play an important role if the objective is seen as building up the human capital of the poor.

Given the important role of nonagricultural rural employment in the Western Highlands, the productivity of the growing landless population group depends upon improved human capital, with education and training playing crucial roles. Increasing the human capital stock is also a prerequisite for agricultural productivity to grow in a sustainable way. It is hardly by chance that the early leadership of the export crop cooperative—which the study mainly found to be a success story in the difficult political and economic environment of Guatemala—emerged from intensive primary school courses provided by a local project.

APPENDIX: PROGRAMMING MODEL

Model 1: Precooperative situation

				NET REVENUES	1 MPRD ha 1 -5.000	2 BPRD ha 1 -57.000	3 VPRD ha 1 -128.000	4 MSAL kg 1 0.210	5 BSAL kg 1 0.170	6 VSAL kg 1 0.120	7 FPUR kg1 -0.340	8 SPUR kg1 -4.500	9 FL13 dy 1 0.000	10 FL46 dy 1 0.000	11 FL712 dy 1 0.000
1 LAND	HA	0.750	>	1.000	1.000	1.000	.	.	.	.	.	.	.	.	.
2 MYLD	KG	0.000	>-1500.000	.	.	.	1.000	.	.	.	.	.	.	.	.
3 BYLD	KG	0.000	>	.	-600.000	.	.	1.000	.	1.000	.	.	.	.	.
4 VYLD	KG	0.000	>	.	.	-12760.000	.	.	.	.	-1.000	.	.	.	.
5 FERT	KG	0.000	>	271.000	182.000	494.000	.	.	.	.	.	-1.000	.	.	.
6 SPRY	KG	0.000	>	.	.	15.000	.	.	.	.	.	.	-1.000	.	.
7 LA13	DY	0.000	>	31.000	74.000	43.000	.	.	.	.	.	.	.	-1.000	.
8 LA46	DY	0.000	>	45.000	51.000	175.000	.	.	.	.	.	.	1.000	.	-1.000
9 LA712	DY	0.000	>	40.000	13.000	229.000	.	.	.	.	.	.	.	1.000	.
10 FX13	DY	105.000	>	.	.	.	.	.	.	.	.	.	.	.	1.000
11 FX46	DY	105.000	>	.	.	.	.	.	.	.	.	.	.	.	.
12 FX712	DY	210.000	>	.	.	.	.	.	.	.	.	.	.	.	.
13 CREDIT	QZ	0.000	>	5.000	57.000	128.000	.	.	.	.	0.340	4.500	.	.	.
14 CRMAX	QZ	1583.000	>	.	.	.	.	.	.	.	.	.	.	.	.
15 STAPL	KG	736.000	<	1500.000	600.000	.	-1.000	-1.000	.	.	.	.	.	.	.
16 ROTAT	HA	0.000	<	1.000	1.000	-1.500	.	.	.	.	.	.	.	.	.

		12 HL13 dy 1 -2.600	13 HL46 dy 1 -2.600	14 HL712 dy 1 -2.600	15 OF13 dy 1 2.000	16 OF46 dy 1 2.000	17 OF712 dy 1 2.000	18 FIN qz 1 -0.200
1 LAND	HA	.	.	.	.	.	.	.
2 MYLD	KG	.	.	.	.	.	.	.
3 BYLD	KG	.	.	.	.	.	.	.
4 VYLD	KG	.	.	.	.	.	.	.
5 FERT	KG	.	.	.	.	.	.	.
6 SPRY	KG	.	.	.	.	.	.	.
7 LA13	DY	-1.000	.	.	.	.	.	.
8 LA46	DY	.	-1.000	.	.	.	.	.
9 LA712	DY	.	.	-1.000	.	.	.	.
10 FX13	DY	.	.	.	1.400	.	.	.
11 FX46	DY	.	.	.	.	1.400	.	.
12 FX712	DY	.	.	.	.	.	1.400	.
13 CREDIT	QZ	2.600	2.600	2.600	.	.	.	-1.000
14 CRMAX	QZ	.	.	.	.	.	.	1.000
15 STAPL	KG	.	.	.	.	.	.	.
16 ROTAT	HA	.	.	.	.	.	.	.

Model 2: Postcooperative, without improved productivity in subsistence crops

		NET REVENUES	1 MPRD ha 1 -5.000	2 SPRD ha 1 -57.000	3 VPRD ha 1 -128.000	4 MSAL kg 1 0.210	5 BSAL kg 1 0.170	6 VSAL kg 1 0.120	7 FPUR kg1 -0.340	8 SPUR kg1 -4.500	9 FL13 dy 1 0.000	10 FL46 dy 1 0.000	11 FL712 dy 1 0.000
1 LAND	HA	0.750 >	1.000	1.000	1.000	.	.	.	.	.	.	.	.
2 MYLD	KG	0.000 >=	-1500.000	.	.	1.000	.	.	.	.	.	.	.
3 BYLD	KG	0.000 >	.	-600.000	.	.	1.000	.	.	.	.	.	.
4 SYLD	KG	0.000 >	.	.	.	.	.	.	.	.	.	.	.
5 VYLD	KG	0.000 >	.	.	-12760.000	.	.	1.000	.	.	.	.	.
6 FERT	KG	0.000 >	271.000	182.000	494.000	.	.	.	-1.000	.	.	.	.
7 SPRY	KG	0.000 >	.	.	15.000	.	.	.	.	-1.000	.	.	.
8 LA13	DY	0.000 >	31.000	74.000	43.000	.	.	.	.	.	-1.000	.	.
9 LA46	DY	0.000 >	45.000	51.000	175.000	.	.	.	.	.	.	-1.000	.
10 LA712	DY	0.000 >	40.000	13.000	229.000	.	.	.	.	.	1.000	.	.
11 FX13	DY	105.000 >	.	.	.	.	.	.	.	.	.	1.000	.
12 FX46	DY	105.000 >	.	.	.	.	.	.	.	.	.	.	1.000
13 FX712	DY	210.000 >	.	.	.	.	.	.	.	.	.	.	.
14 CREDIT	QZ	0.000 >	5.000	57.000	128.000	.	.	.	0.340	4.500	.	.	.
15 CRMAX	QZ	1583.000 >	.	.	.	.	.	.	.	.	.	.	.
16 STAPL	KG	736.000 <	1500.000	600.000	.	-1.000	-1.000	.	.	.	.	.	.
17 ROTAT	HA	0.000 <	1.000	1.000	-1.500	.	.	.	.	.	.	.	.

		12 HL13 dy 1 -2.600	13 HL46 dy 1 -2.600	14 HL712 dy 1 -2.600	15 OF13 dy 1 2.000	16 OF46 dy 1 2.000	17 OF712 dy 1 2.000	18 FIN qz 1 -0.200	19 SPRD ha1 -481.000	20 SSAL kg 0.960
1 LAND	HA	.	.	.	.	.	.	.	1.000	.
2 MYLD	KG	.	.	.	.	.	.	.	.	.
3 BYLD	KG	.	.	.	.	.	.	.	-4256.000	1.000
4 SYLD	KG	.	.	.	.	.	.	.	.	.
5 VYLD	KG	.	.	.	.	.	.	.	865.000	.
6 FERT	KG	.	.	.	.	.	.	.	171.000	.
7 SPRY	KG	.	.	.	.	.	.	.	165.000	.
8 LA13	DY	-1.000	.	.	.	.	.	.	99.000	.
9 LA46	DY	.	-1.000	.	.	.	.	.	337.000	.
10 LA712	DY	.	.	-1.000	.	.	.	.	.	.
11 FX13	DY	.	.	.	1.400	.	.	.	.	.
12 FX46	DY	.	.	.	.	1.400	.	.	.	.
13 FX712	DY	.	.	.	.	.	1.400	.	.	.
14 CREDIT	QZ	2.600	2.000	2.600	.	.	.	-1.000	481.000	.
15 CRMAX	QZ	.	.	.	.	.	.	1.000	.	.
16 STPAL	KG	.	.	.	.	.	.	.	-0.500	.
17 ROTAT	HA	.	.	.	.	.	.	.	.	.

Model 3: Postcooperative, with improved productivity in subsistence crops

			NET REVENUES	1 MPRD ha 1	2 SPRD ha 1	3 VPRD ha 1	4 MSAL kg 1	5 BSAL kg 1	6 VSAL kg 1	7 FPUR kg1	8 SPUR kg1	9 FL13 dy 1	10 FL46 dy 1	11 FL712 dy 1
			-5.000	-101.000	-128.000	0.210	0.170	0.120	-0.340	-4.500	0.000	0.000	0.000	
1 LAND	HA	0.750 >		1.000	1.000	1.000								
2 MYLD	KG	0.000 >	-2100.000				1.000							
3 BYLD	KG	0.000 >			-1171.000			1.000						
4 SYLD	KG	0.000 >												
5 VYLD	KG	0.000 >				-12760.000			1.000					
6 FERT	KG	0.000 >		287.000	298.000	494.000				-1.000				
7 SPRY	KG	0.000 >				15.000					-1.000			
8 LA13	DY	0.000 >		31.000	83.000	43.000						-1.000		
9 LA46	DY	0.000 >		52.000	57.000	175.000							-1.000	
10 LA712	DY	0.000 >		40.000	15.000	229.000					1.000			
11 FX13	DY	105.000 >										1.000		
12 FX46	DY	105.000 >											1.000	
13 FX712	DY	210.000 >								0.340	4.500			
14 CREDIT	QZ	0.000 >		5.000	57.000	128.000								
15 CRMAX	QZ	1583.000 >												
16 STAPL	KG	736.000 <	2100.000	1171.000			-1.000	-1.000						
17 ROTAT	HA	0.000 <	1.000	1.000	-1.500									

			12 HL13 dy 1 -2.600	13 HL46 dy 1 -2.600	14 HL712 dy 1 -2.600	15 OF13 dy 1 2.000	16 OF46 dy 1 2.000	17 OF712 dy 1 2.000	18 FIN qz 1 -0.200	19 SPRD ha 1 -481.000	20 SSAL kg 1 0.960
1 LAND	HA									1.000	
2 MYLD	KG										
3 BYLD	KG									-4256.000	1.000
4 SYLD	KG										
5 VYLD	KG									865.000	
6 FERT	KG									171.000	
7 SPRY	KG									165.000	
8 LA13	DY		-1.000							99.000	
9 LA46	DY			-1.000						337.000	
10 LA712	DY				-1.000						
11 FX13	DY					1.400					
12 FX46	DY						1.400				
13 FX712	DY							1.400			
14 CREDIT	QZ		2.600	2.600	2.600				-1.000	481.000	
15 CRMAX	QZ								1.000		
16 STPAL	KG									-0.500	
17 ROTAT	HA										

Notes: 1) The opportunity cost of land is computed on the basis of fixed land supply. Land rental is not allowed for in the model. The model is simply built for the "average" farm as described by the sample survey data. A more refined approach would certainly entail modeling the farm interactions in the study area between coop and noncoop farmers and the related land and labor market effects.

2) The programming model was solved using the following package: Wye College micro-linear programming package, version 4.0, May 1985, developed by J. P. G. Webster, B. J. George, and P. A. Kentish.

Variables in the Programming Model

Activities

MPRD	=	production of maize
BPRD	=	production of beans
VPRD	=	production of vegetables (traditional)
SPRD	=	production of snowpeas
MSAL	=	sales of maize
BSAL	=	sales of beans
VSAL	=	sales of vegetables (traditional)
SSAL	=	sales of snowpeas
FPUR	=	purchase of fertilizer
SPUR	=	purchase of chemicals for spraying
FL13	=	use of family labor on farm in January-March
FL46	=	use of family labor on farm in April-June
FL712	=	use of family labor on farm in July-December
HL13	=	hiring in of labor in January-March
HL46	=	hiring in of labor in April-June
HL712	=	hiring in of labor in July-December
OF13	=	off-farm work of family labor in January-March
OF46	=	off-farm work of family labor in April-June
OF712	=	off-farm work of family labor in July-December
FIN	=	financing input acquisition and hired labor

Constraints

LAND	=	farm size
MYLD	=	yield of maize
BYLD	=	yield of beans
SYLD	=	yield of snowpeas
VYLD	=	yield of vegetables (traditional)
FERT	=	fertilizer use required
SPRY	=	spraying material use required
LA13	=	labor required in January-March
LA46	=	labor required in April-June
LA712	=	labor required in July-December
FX13	=	family labor available in January-March
FX46	=	family labor available in April-June
FX712	=	family labor available in July-December
CREDIT	=	financing requirement
CRMAX	=	collateral upper limit
STAPL	=	staple food for consumption from own production desired
ROTAT	=	rotational constraints

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