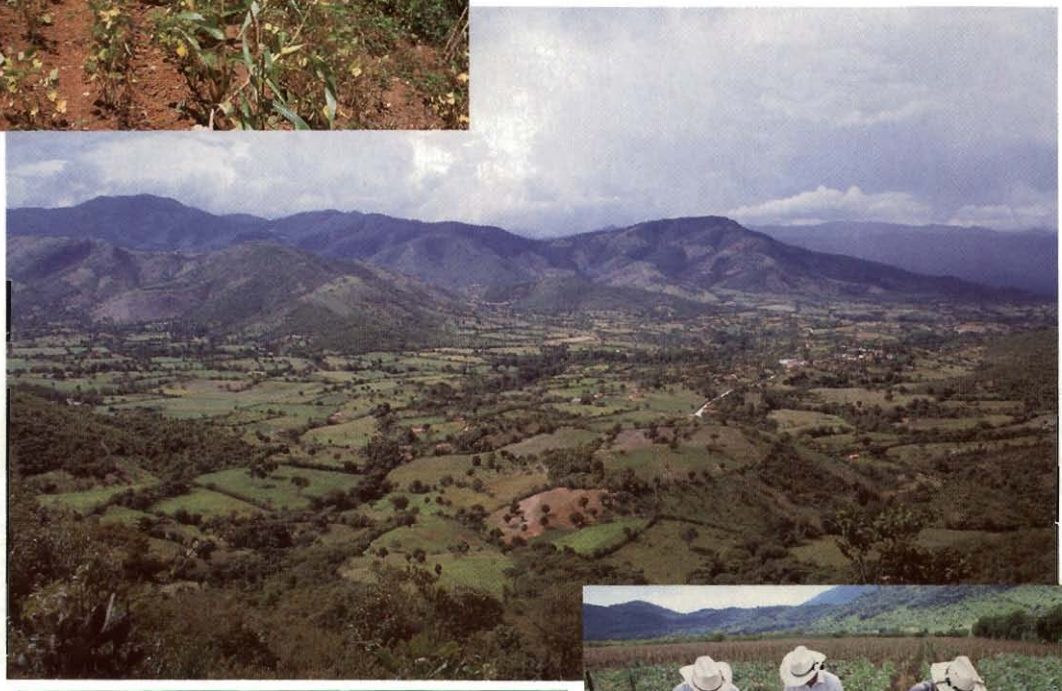
The socioeconomic and environmental impact of non-traditional cropping systems



on small farming communities in the department of Baja Verapaz, Guatemala

sco J. Morales, José A. Sierra, René Ruano, Mairor Osorio,
duardo Landaverri, José L. Ordóñez, Abelardo Viana
CIAT - ICTA- PROFRIJOL - DANIDA

Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture
Apartado Aéreo 6713
Cali, Colombia

CIAT Working Document No. 183
Press run: 200
December 2000

Morales, Francisco José
The socioeconomic and environmental impact of non-traditional cropping systems on small farming communities in the department of Baja Verapaz, Guatemala / Francisco J. Morales, José A. Sierra, René Ruano, Mairor Osorio, Eduardo Landaverri, José L. Ordóñez, Abelardo Viana. -- Cali, Colombia : Centro Internacional de Agricultura Tropical, 2000.
35 p. (Working document ; no. 183)

1. Cropping systems. 2. Small farms. 3. Socioeconomic environment. 4. Environment. 5. *Phaseolus vulgaris*. 6. *Bemisia tabaci*. 7. Case studies. 8 Economic analysis. I Sierra, José A. II. Ruano, René. III. Osorio, Mairor IV. Landaverri, Eduardo. V. Ordóñez, José L. VI. Viana, Abelardo. VII. Title. VIII. Ser

Principal subject category: F08 (Cropping patterns and systems)
Secondary categories: E50 (Rural sociology)
P01 (Nature conservation and land resources)

LC classification: S 602 .5 M6

Working Document No. 183

The socioeconomic and environmental impact of non-traditional cropping systems on small farming communities in the department of Baja Verapaz, Guatemala

Francisco J. Morales, José A. Sierra, René Ruano, Mairor Osorio, Eduardo Landaverri, José L. Ordóñez, Abelardo Viana
CIAT - ICTA- PROFRIJOL - DANIDA

CONTENTS

ACKNOWLEDGMENTS

The authors acknowledge the financial support of the Danish International Development Assistance (DANIDA) during the planning, execution, and publication of this case study. We are also grateful to Dr. Pamela K. Anderson for reviewing the original manuscript, and to Mr. James García and Carlos A. Moreno for technical support in the area of data processing. We acknowledge the initial guidance of Dr. Maria C. Amézquita in the design of similar questionnaires for this type of survey, and the clerical help of Mrs. Patricia Zamorano. Special thanks are due to Mr. Guillermo Guzmán for his help in the preparation of the final draft of this publication. Finally, we are indebted to all the farmers in the municipalities of San Miguel Chicaj and San Jerónimo, who took time off their numerous daily tasks to share their invaluable knowledge with us.

FOREWORD

Since 1997, the CGIAR Systemwide Program for Integrated Pest Management has sponsored the project on Sustainable Integrated Management of Whiteflies as Pests and Vectors of Plant Viruses in the Tropics, commonly known as the CGIAR Global Whitefly IPM Project. This Project, coordinated by the International Center for Tropical Agriculture (CIAT), initially defined its goal to improve living conditions of rural families through effective management of whiteflies, resulting in increased crop production and a safer environment.

From this case study on the socio-economic and environmental impact of non-traditional agriculture in Guatemala, we have learned several important lessons. It is clear that *Bemisia tabaci* and one of the most important viruses that this whitefly transmits, *Bean golden yellow mosaic virus* (BGYMV), continue to be limiting factors to bean production in Guatemala. Thus, we must develop cost-effective vector management programs that complement the existing BGYMV-resistant bean germplasm. Also, the fact that more than 50% of tomato production costs correspond to pesticide applications and that almost 75% of the expected income is lost when tomato production exceeds market demands, argues for IPM interventions that increase income by reducing pesticide use and costs, as opposed to interventions that will increase tomato production *per se*. A pesticide/cost-reduction focus would simultaneously achieve an increase in income and a reduction in the pesticide abuse that threatens human and ecosystem health. Finally, it is apparent that the common bean remains a profitable and important food staple that needs to be investigated within the context of more complex cropping systems, which include an ever-increasing number of non-traditional cash crops adopted by small-scale farmers, to improve their wellbeing.

This case study represents an important step forward in our understanding of farmers' perceptions of the production problems and economic factors that drive their decision-making processes. We wish to express our appreciation to our donor partner, the Danish International Development Assistance (Danida), for their contributions to this work.

Pamela Anderson
Coordinator, CGIAR Global Whitefly IPM Project
CIAT
Cali, Colombia

The socioeconomic and environmental impact of non-traditional cropping systems on small farming communities in the department of Baja Verapaz, Guatemala

Francisco J. Morales[1], José A. Sierra[2], René Ruano[2], Mairor Osorio[2], Eduardo Landaverri[2], José L. Ordoñez[2], and Abelardo Viana[3]

[1] Centro Internacional de Agricultura Tropical (CIAT), Colombia; [2] Instituto de Ciencia y Tecnología Agrícolas (ICTA), Guatemala; [3] Programa Cooperativo Regional de Frijol para Centroamérica, México y el Caribe (PROFRIJOL), Guatemala.

Introduction

The common bean (*Phaseolus vulgaris*) and maize (*Zea mays*) have been two of the most important food commodities in the Americas since pre-Columbian times (Vlahos, 1970). The common bean is an important source of protein in Latin America, where this legume supplies up to a third of the daily protein intake of the lower socio-economic strata in rural and urban communities. In Latin America, common bean and maize occupy over 8.5 and 30 million hectares, respectively (FAO, 1998).

However, the economic crisis of the 1980s, which affected Latin America in general, led to the implementation of agricultural policies that favored the production of non-traditional export crops (NTECs) to generate foreign income (Thrupp et al., 1995). As a result, traditional food crops have been gradually displaced from the main agricultural regions, into marginal areas throughout Latin America. The rapid expansion of NTECs, such as melon (*Cucumis melo*), tomato (*Lycopersicon esculentum*), chili peppers (*Capsicum* spp.), and other horticultural crops, has caused severe outbreaks of pests and new diseases that affect both NTECs and traditional food crops.

Undoubtedly, the most damaging of the emerging pests, has been the whitefly *Bemisia tabaci*, a polyphagous insect and vector of many plant viruses that affect common bean and many other food and cash crops, including tomato, chili pepper, squash, and melon. The emergence of these crop production problems, at a time when most national agricultural research institutions had been drastically downsized, left farmers without viable pest and disease control measures other than the frequent use of agrochemicals. As a consequence, *Bemisia tabaci* developed resistance to most of the insecticides applied; and has caused millions of dollars in yield losses, both as a direct pest and insect vector of plant viruses (Brown and Bird, 1992). Additionally, pesticide abuse has had a negative impact on the environment and health of rural communities and consumers of heavily treated farm products throughout Latin America. Despite the significant crop losses caused by these biotic problems, and the rejection of pesticide-contaminated produce in

international markets, many NTEC growers have not returned to traditional food crop production. Instead, they have found regional markets with lower quality standards and no facilities for monitoring pesticide residues in agricultural food products.

As a result, Latin America has become a net importer of basic grains, including beans and maize, and a consumer of pesticide-contaminated foodstuffs. In Central America, one of the most affected regions, bean productivity and consumption have significantly dropped (approximately 300 kg/ha and 5 kg/yr/*per capita*, respectively) raising concerns over malnutrition and food security issues.

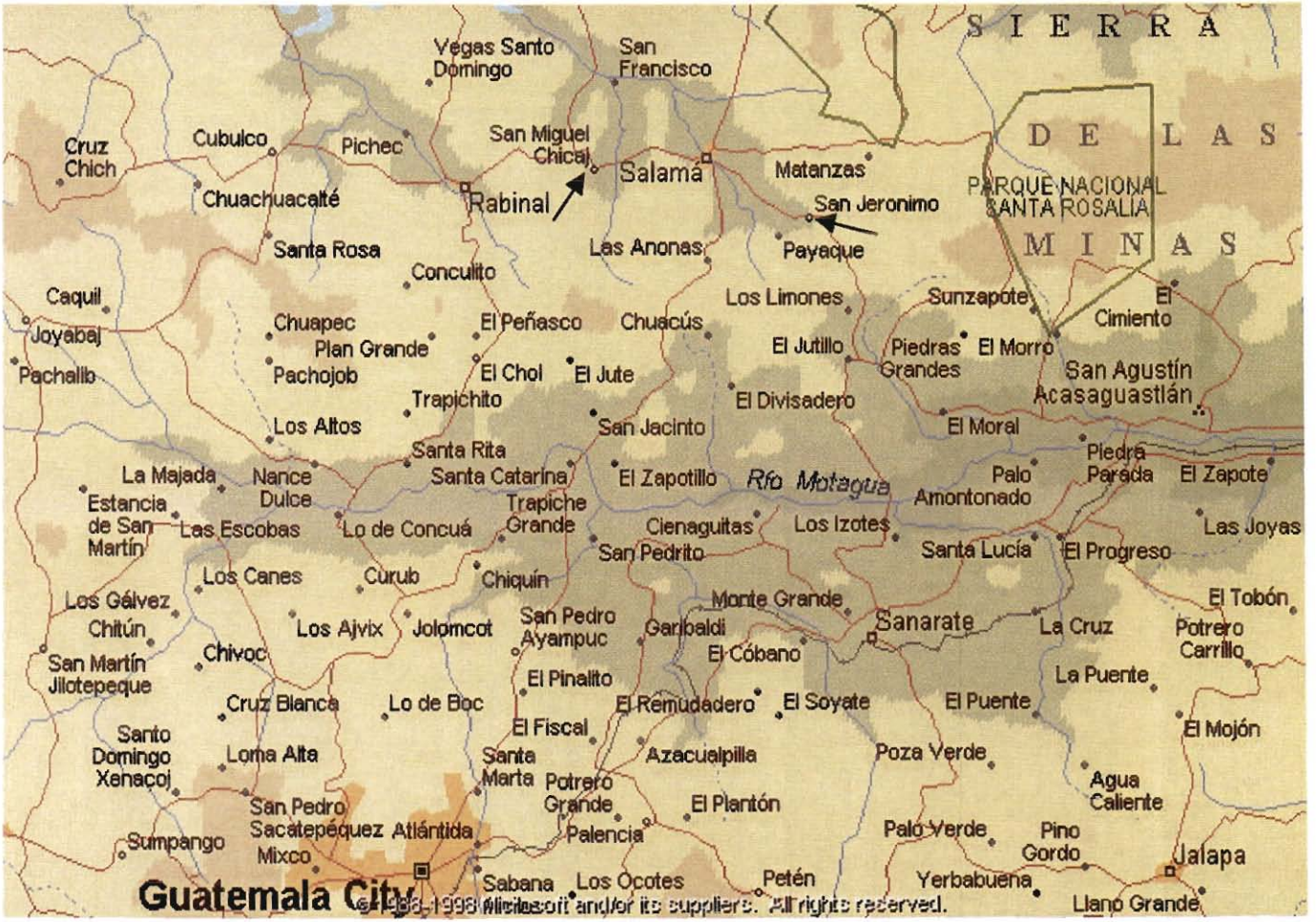
The case study discussed here was undertaken to conduct a preliminary analysis of the biological and socio-economic impact of introducing non-traditional cash crops on the production of basic food crops, in a small farming community of Guatemala, Central America.

Materials and methods

The main criteria for selecting the study area were the identification of an agricultural region where common bean, other traditional food crops, and non-traditional cash crops were cultivated. Further selection criteria included the presence of the whitefly *Bemisia tabaci* and viruses transmitted by this insect vector in the study area, to assess their socioeconomic impact.

Based on a recent study on the impact of whitefly-transmitted viruses in mixed cropping systems in Mexico, Central America, and the Caribbean, financed by the Danish International Development Assistance (Danida), Guatemala was chosen as the country to conduct the study. Of the different agricultural regions of Guatemala that satisfied the selection criteria mentioned above, the southern region of the department of Baja Verapaz was identified as a potential study site by Guatemalan national program (ICTA) scientists. A preliminary survey was conducted in the municipalities of Cubulco, Rabinal, San Miguel Chicaj, Salamá and San Jerónimo to further define the target area. The survey included the identification of crops grown and detection of whitefly-transmitted viruses. Based on the preliminary survey, 18 villages located in the municipalities of San Miguel Chicaj and San Jerónimo (**Map 1**) were selected in this case study.

The community of San Miguel Chicaj is composed of a predominantly indigenous population (approximately 17,250 inhabitants) of post-Mayan (Nahua) descent, belonging to the linguistic group Achí. The neighboring community of San Jerónimo (approximately 12,200 inhabitants) is predominantly made up of 'ladinos', defined as people who have never been or are not anymore part of an indigenous community. However, the ladinos of San Jerónimo include many 'mestizos', descendants of the 'Pipiles' of Nahua (Central Mexico) origin. The municipality of San Miguel Chicaj has a higher population density and 39% more inhabitants in the rural areas than the municipality of San Jerónimo.



Map 1 Geographical location of the localities of San Miguel Chicaj and San Jerónimo in the department of Baja Verapaz, Guatemala

San Miguel Chicaj is located 940 meters above sea level (masl), about N 15° 06' 12" and W 90° 16' 00", with a mean temperature of 22.5 C° and annual precipitation of 1000 mm. Agriculture constitutes the main activity in this municipality, followed by the manufacturing of handcrafts. Approximately 50% of the inhabitants in this municipality are illiterate.

San Jerónimo is located at 1000 masl, about N 15° 04' 00" and W 90° 14' 00", with a mean temperature of 21.3 C° and precipitation of 1000 mm. The main economic activity is commercial agriculture, followed by manufacturing of handcrafts. Historically, San Jerónimo was one of the main Spanish haciendas devoted to the production of export commodities, such as sugar and the 'cochinilla' (mealybug) dye, during colonial times (ca. 1540). The national agricultural program (ICTA) has an experiment station in this municipality. Approximately, 25% of the population of San Jerónimo is illiterate.

Considering the need to conduct a limited but detailed examination of a relatively small number of persons in each community, a "case study" approach was chosen. The "geographical area of coverage" was each of the 18 villages selected for this study (**Table 1**). At the community level, the number of respondents is usually less than 100, and the subjects of the study are individuals. The frequency of enumeration was a single visit to each respondent, and data was collected through individual interviews (Casley and Lury, 1989). The total number of respondents was 127, the majority (97) being from San Miguel Chicaj, due to the higher number of people living in the rural areas of this municipality.

The questionnaire was designed to collect only basic information, selecting the common bean as a reference food crop. The questionnaire had 40 questions, including 10 questions that were dependent upon the presence or absence of the reference crop (common bean) and was designed to be completed in approximately 20-30 minutes. Questions were coded to facilitate data entry using Microsoft® Access 97, and data processing using Microsoft® Excel 97. The original questionnaire is included here as **Appendix 1**. A SAS® analysis was also conducted with the data collected.

Results

I. Basic survey data

Table 1 shows the villages surveyed and the number of respondents in each village selected in the region of Baja Verapaz. A total of 127 farmers were individually interviewed, 84.1% (106) of whom, owned the land. The rest of the farmers were either renting the land (8.7%); associated with the owner of the land (3.2%); or working as laborers (4.0%). Approximately 93.0%, 69.0%, and 14.8% of the farmers interviewed had been working in the area, longer than 5, 10, and 30 years, respectively.

Table 1.Villages surveyed in the case study conducted in Baja Verapaz, Guatemála, and number of respondents (NR).

San Miguel Chicaj	NR	San Jerónimo	NR
Bramadero	2	Cañas Viejas	3
Chilajón	6	El Cacao	4
Chixolop	15	El Coyolito	4
El Progreso	12	Los Jocotes	3
El Tempisque	2	Los Limones	3
Las Minas	11	Los Molinos	3
Quiaté	5	Los Pinos	3
San Gabriel	25	Pueblo Nuevo	3
San Francisco	19	San Juan	4
Total	**97**	**Total**	**30**

II. Cropping systems

Table 2 shows the different crops grown in the study region, according to the total area occupied by each crop in each of the villages surveyed. **Table 3** shows the average areas (1.0 and 0.7 ha) devoted to maize production in the villages surveyed in San Miguel Chicaj and San Jerónimo, respectively. As observed in Table 3, 98% of the respondents in San Miguel Chicaj, and 68% of the respondents in San Jerónimo, cultivated maize. This crop occupied the largest portion of farm land in both municipalities, whereas common bean occupied the second largest area only in San Miguel Chicaj, followed by sorghum, peanut and tomato. In San Jerónimo, the second largest crop was tomato, followed by bean, chili pepper, and sweet corn (**Figures 1** and **2**).

Table 4 shows the average size (0.6 ha) of bean plantings in both municipalities, and the lower proportion of bean farmers in San Jerónimo (23%) relative to the percentage of bean farmers among respondents from San Miguel Chicaj. **Figures 3** and **4** show the crop frequency distribution for San Miguel Chicaj and San Jerónimo, where the two main cash crops, tomato and cucumber, have displaced bean as the second major crop in San Jerónimo. Chili pepper, an important NTEC in other Middle American countries, has not been significantly exploited in this region of Baja Verapaz.

Table 2. Main crops in survey region according to area* declared by respondents					
Village	**Crop 1**	**Crop 2**	**Crop 3**	**Crop 4**	**Crop 5**
	Municipality of San Miguel Chicaj				
Chixolop	Maize	Bean	Sorghum	Peanut	
Las Minas	Maize	Bean	Sorghum		
San Gabriel	Maize	Bean	Sorghum	Peanut	
Quiaté	Bean	Maize	Peanut		
El Tempisque	Maize	Bean			
Chilajón	Maize	Bean	Peanut		
El Progreso	Maize	Bean	Peanut	Sorghum	
San Francisco	Maize	Bean	Tomato	Peanut	Sorghum
Bramadero	Maize	Peanut			
	Municipality of San Jerónimo				
Cañas Viejas	Maize	Tomato			
Los Molinos	Tomato	Maize	Cucumber		
San Juán	Maize	Tomato	Cucumber	Chili	Bean
Los Jocotes	Maize	Tomato	Cucumber		
Los Limones	Tomato				
El Cacao	Maize	Tomato	Cucumber		
El Coyolito	Maize	Cucumber	Tomato	Bean	
Los Pinos	Maize	Bean	Tomato	Cucumber	
Pueblo Nuevo	Bean	Maize	Tomato	Cucumber	Sweet corn

*** Crop 1 occupies largest area, and crop 5 the smallest area (sum of all areas cited).**

Table 3. Average size (hectares) of maize plots in the villages surveyed and percentage of respondents (%R) that cultivate maize in each village.					
San Miguel Chicaj	**Area**	**%R**	**San Jerónimo**	**Area**	**%R**
Bramadero	0.7	100	Cañas Viejas	0.6	100
Chilajón	1.3	100	El Cacao	0.6	66
Chixolop	1.4	100	El Coyolito	0.8	100
El Progreso	0.8	100	Los Jocotes	0.8	100
El Tempisque	1.0	100	Los Limones	0.0	0
Las Minas	1.1	100	Los Molinos	0.3	66
Quiaté	1.0	80	Los Pinos	1.0	66
San Gabriel	1.3	100	Pueblo Nuevo	1.0	66
San Francisco	0.9	100	San Juan	0.9	50
Average	**1.0**	**98**		**0.7**	**68**

Figure 1. Total Area (has) of Predominant Crops Surveyed in San Miguel Chicaj

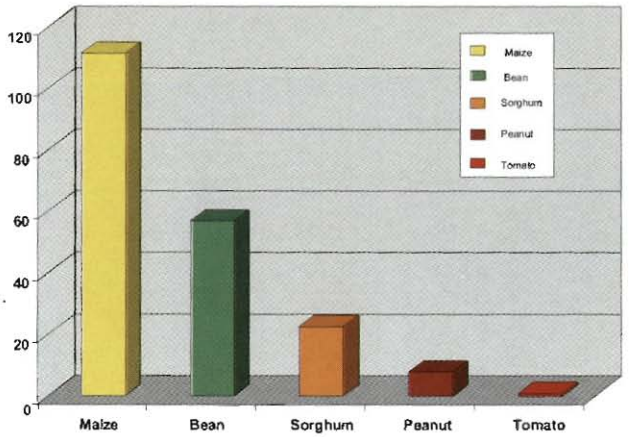


Figure 2. Total Area (has) of Predominant Crops Surveyed in San Jeronimo

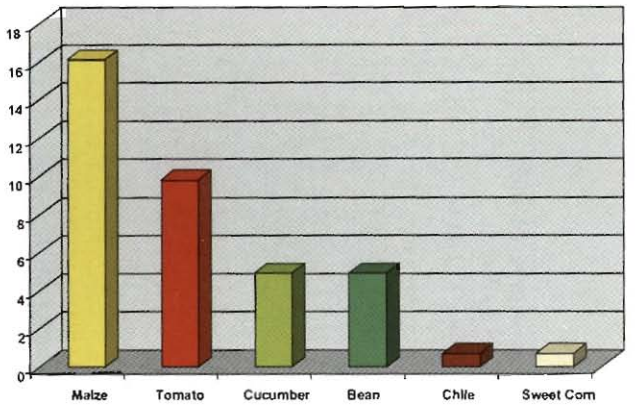


Figure 3. Crop Frequency cited by growers interviewed in San Miguel Chicaj

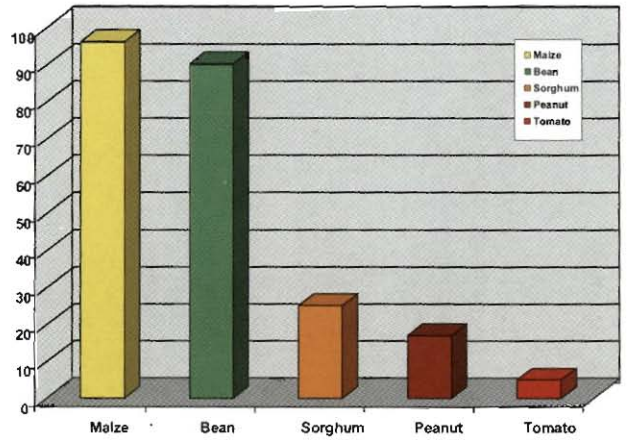


Figure 4. Crop Frequency cited by growers interviewed in San Jerónimo

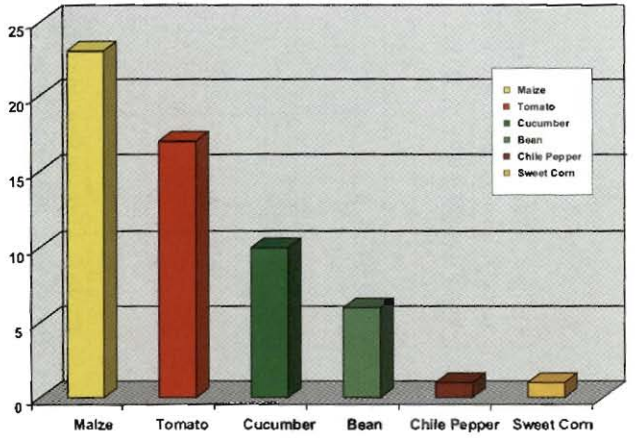


Table 4. Average size (hectares) of bean plots in the villages surveyed and percentage of respondents (%R) that cultivate beans in each village					
San Miguel Chicaj	**Area**	**%R**	**San Jerónimo**	**Area**	**%R**
Bramadero	0	0	Cañas Viejas	0	0
Chilajón	0.3	100	El Cacao	0	0
Chixolop	0.7	87	El Coyolito	0.3	25
El Progreso	0.4	75	Los Jocotes	0	0
El Tempisque	0.3	50	Los Limones	0	0
Las Minas	0.7	100	Los Molinos	0	0
Quiaté	1.0	80	Los Pinos	0.8	66
San Gabriel	0.8	100	Pueblo Nuevo	1.4	66
San Francisco	0.4	100	San Juan	0.2	50
Average	**0.6**	**77**	**Average**	**0.6**	**23**

Table 5. Average size (hectares) of sorghum plots in the villages surveyed and percentage of respondents (%R) that grow sorghum in each village					
San Miguel Chicaj	**Area**	**%R**	**San Jerónimo**	**Area**	**%R**
Bramadero	0	0	Cañas Viejas	0	0
Chilajón	0	0	El Cacao	0	0
Chixolop	0.6	73	El Coyolito	0	0
El Progreso	0.1	16	Los Jocotes	0	0
El Tempisque	0	0	Los Limones	0	0
Las Minas	0.7	63	Los Molinos	0	0
Quiaté	0	0	Los Pinos	0	0
San Gabriel	1.8	12	Pueblo Nuevo	0	0
San Francisco	0.2	10	San Juan	0	0
Average	**0.7**	**19**	**Average**	**0**	**0**

Table 6. Average size (hectares) of peanut plots in the villages surveyed and percentage of respondents (%R) that grow peanuts in each village.					
San Miguel Chicaj	**Area**	**%R**	**San Jerónimo**	**Area**	**%R**
Bramadero	0.3	50	Cañas Viejas	0	0
Chilajón	0.2	16	El Cacao	0	0
Chixolop	0.3	20	El Coyolito	0	0
El Progreso	0.4	8	Los Jocotes	0	0
El Tempisque	0.0	0	Los Limones	0	0
Las Minas	0.0	0	Los Molinos	0	0
Quiaté	0.3	40	Los Pinos	0	0
San Gabriel	1.0	28	Pueblo Nuevo	0	0
San Francisco	0.4	10	San Juan	0	0
Average	**0.4**	**19**	**Average**	**0**	**0**

Tomato was the second largest crop in the municipality of San Jerónimo (Figure 4), where 67% of the respondents of the survey cultivated this vegetable. In San Miguel Chicaj, on the contrary, only 3% of the total number of farmers interviewed grew tomato, and only in the village of San Francisco. The average area planted to tomato was relatively small (0.5 ha in San Jerónimo and 0.2 ha in San Miguel Chicaj) as compared to the areas planted to the major crops in the region (**Table 7**).

Table 7. Average size (hectares) of tomato plots in the villages surveyed and percentage of respondents (%R) that grow tomatoes in each village.

San Miguel Chicaj	Area	%R	San Jerónimo	Area	%R
Bramadero	0	0	Cañas Viejas	0.7	66
Chilajón	0	0	El Cacao	0.3	50
Chixolop	0	0	El Coyolito	0.2	50
El Progreso	0	0	Los Jocotes	0.5	66
El Tempisque	0	0	Los Limones	0.7	100
Las Minas	0	0	Los Molinos	0.5	100
Quiaté	0	0	Los Pinos	0.7	33
San Gabriel	0	0	Pueblo Nuevo	0.7	66
San Francisco	0.2	26	San Juan	0.6	75
Average	**0.2**	**3**	**Average**	**0.5**	**67**

Cucumber was the third largest crop in San Jerónimo (Figure 4) with a mean average area of 0.4 ha. This vegetable was cultivated by 32% of the respondents (**Table 8**). Chili pepper and sweet corn were grown separately by only one farmer each, in the villages of San Juan and Pueblo Nuevo, in the municipality of San Jerónimo. These crops occupied 0.7 ha (equivalent to 1 manzana, the local unit of area).

Table 8. Average size (hectares) of cucumber plots in the villages surveyed and percentage of respondents (%R) that grow cucumbers in each village

San Miguel Chicaj	Area	%R	San Jerónimo	Area	%R
Bramadero	0	0	Cañas Viejas	0	0
Chilajón	0	0	El Cacao	0.1	25
Chixolop	0	0	El Coyolito	0.4	50
El Progreso	0	0	Los Jocotes	0.4	66
El Tempisque	0	0	Los Limones	0	0
Las Minas	0	0	Los Molinos	0.2	66
Quiaté	0	0	Los Pinos	0	0
San Gabriel	0	0	Pueblo Nuevo	0.7	33
San Francisco	0	0	San Juan	0.7	50
Average	**0**	**0**	**Average**	**0.4**	**32**

Regarding the use of the various commodities described above, **Figures 5A-D** show the frequency of the three choices presented to respondents in San Miguel Chicaj: (1) home-consumption, (2) sale, and (3) both home-consumption and sale. **Figure 5A** shows that the majority of farmers in this municipality grow maize for home-consumption, and also sell part of the produce. Very few farmers grow maize strictly for sale. In the case of common bean, **Figure 5B** shows that a higher proportion of farmers in San Miguel Chicaj commercialize beans, as compared to maize. However, the majority of farmers grow beans for home-consumption and sale. Sorghum presents a different pattern, showing a greater volume of this cereal being produced for sale as animal feed (concentrates). However, the majority (65%) of the farmers grow local sorghum varieties to satisfy their own needs of animal feed and flour mixes to prepare maize tortillas (**Figure 5C**). Peanut shows yet another situation, with most of the produce destined for sale (**Figure 5D**). Peanuts are commercialized locally or sold at supermarkets in urban areas.

The destination of crops in the municipality of San Jerónimo is shown in Figures **6A-D**. Maize is grown in this municipality both for local consumption and sale. Few growers grow maize strictly for consumption, and none grows it for sale alone (**Figure 6A**). On the contrary, tomato is grown for sale only, by all farmers interviewed (**Figure 6B**). The same pattern was observed for cucumber (**Figure 6C**). Common bean is grown here mostly for local consumption, although part of the produce is sold (**Figure 6D**).

III. Economic analysis

When asked about the most profitable crop, the majority of the farmers interviewed in the municipality of San Miguel Chicaj, cited common bean (**Figure 7**). In San Jerónimo, most respondents mentioned tomato as the most profitable crop (**Figure 8**). The remaining crops were mentioned by few respondents.

Tables 9-16 (**Appendix 2**) present a descriptive economic analysis of the main crops in selected localities, including maize (**Tables 9 and 10**) and common bean (**Tables 11 and 12**) in three villages (Chixolop, Las Minas, and San Gabriel) of San Miguel Chicaj. The remaining tables include sorghum (**Table 13**) and peanut (**Table 14**) in San Miguel Chicaj; tomato (**Table 15**) in both municipalities; and cucumber in San Jerónimo (**Table 16**).

Figure 5A. End Use of Maize in San Miguel Chicaj

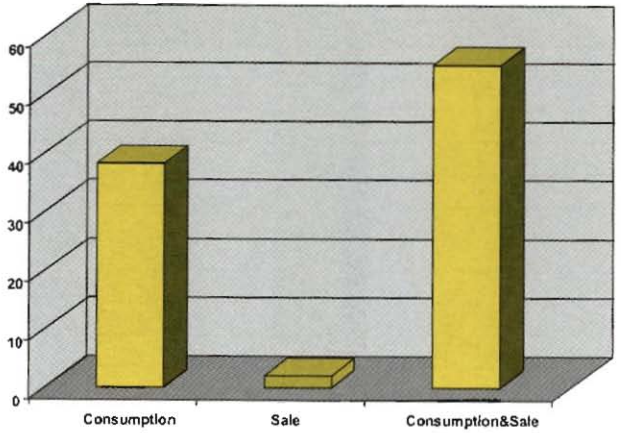


Figure 5B. End Use of Common Bean in San Miguel Chicaj

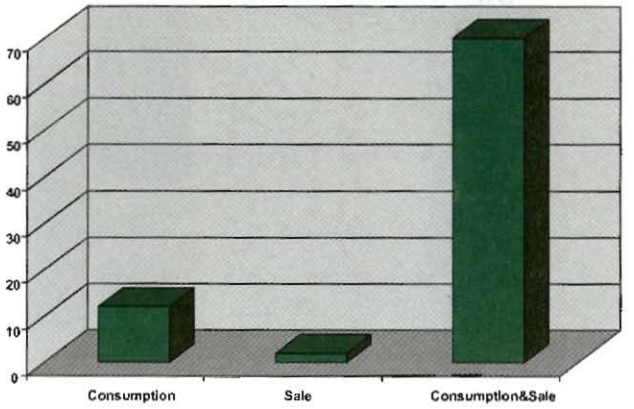


Figure 5C. End Use of Sorghum in San Miguel Chicaj

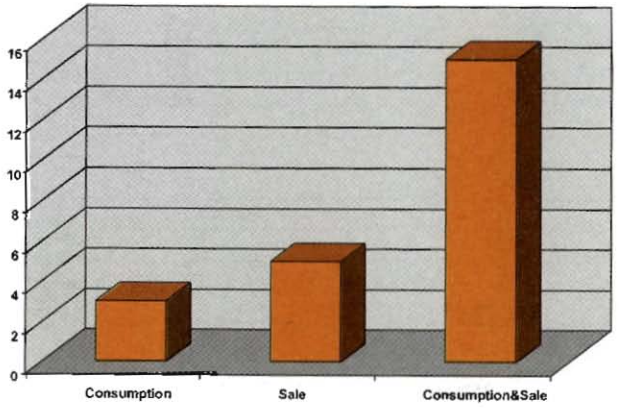


Figure 5D. End Use of Peanut in San Miguel Chicaj

Figure 6A. End Use of Maize in San Jerónimo

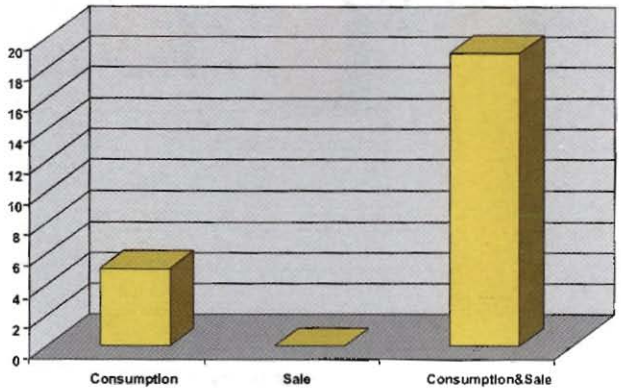


Figure 6B. End Use of Tomato in San Jerónimo

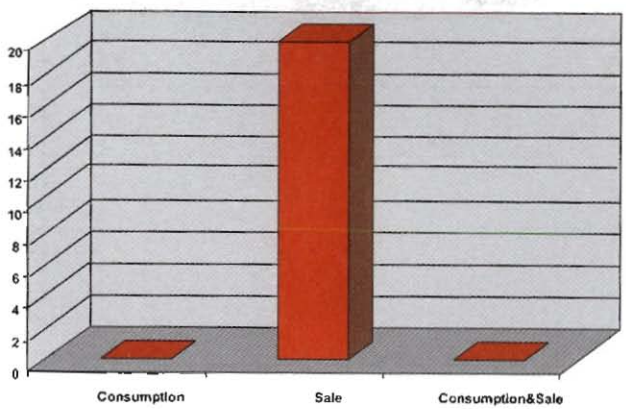


Figure 6C. End Use of Cucumber in San Jerónimo

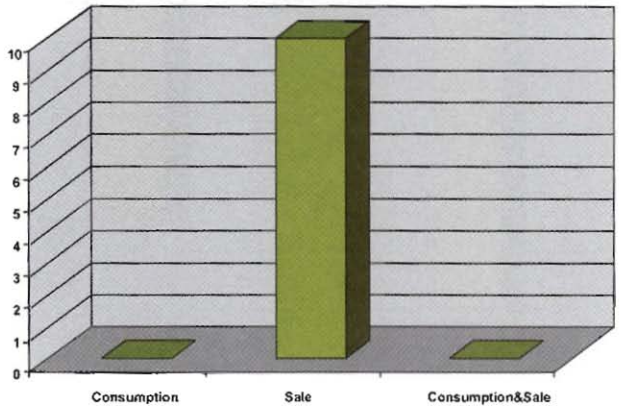
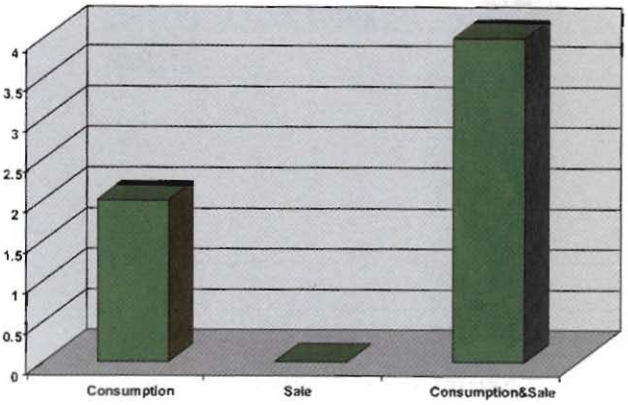


Figure 6D. End Use of Common Bean in San Jerónimo



IV. Changes in cropping systems

In the municipality of San Miguel Chicaj, less than 12% of the farmers interviewed had abandoned crops. However, most of the farmers mentioned common bean as the crop they had abandoned, with only two respondents mentioning either sorghum or peanut (**Figure 9**).

When asked about the reasons for abandoning bean production, farmers mentioned bean golden mosaic as the main reason. This is the main disease of common bean caused by a whitefly-transmitted virus: *Bean golden yellow mosaic virus*. Three farmers mentioned high production costs as either the main (two farmers) or the second most important (one farmer) reason for not cultivating beans any more. One grower cited the "lack of seed and its high cost" as a secondary factor causing the abandonment of bean production (**Figure 10**). The farmer who stopped growing peanut, did so because he ran out of land; and the grower who abandoned sorghum, cited "lack of water" as the main factor for abandoning this crop.

In the municipality of San Jerónimo, common bean was again the main crop that most farmers (60%) had abandoned. Only two other farmers had abandoned a different crop, tomato or cucumber (**Figure 11**). Among the reasons cited by the farmers who were not growing beans anymore, were the high incidence of bean golden mosaic and/or the whitefly *Bemisia tabaci* (90%). One farmer cited "low profits", and another one "too much disease pressure", as the main cause for having abandoned bean production. One respondent had abandoned both beans (due to low yields) and cucumber (because of low market prices). Two farmers in this municipality had abandoned tomato, due to high production costs (**Figure 12**). **Figure 13** shows the frequency of farmers that had abandoned bean production from 1985 (A85) until 1998 (A98).

Figure 14 shows the frequencies of farmers who produce common beans, as well as the frequencies of those who do not grow beans in the two municipalities surveyed in Baja Verapaz. When those farmers who do not grow beans, were asked about bean consumption, all of them responded that they consume common beans, mostly black-seeded grain types. Of 47 respondents, the average consumption of beans was 13 times per week, and the household consumed an average of 5.5 lb per week (range: 2-16 lb/wk), which had to be purchased in nearby markets.

Figure 7. Most Profitable Crop according to Farmers in San Miguel Chicaj

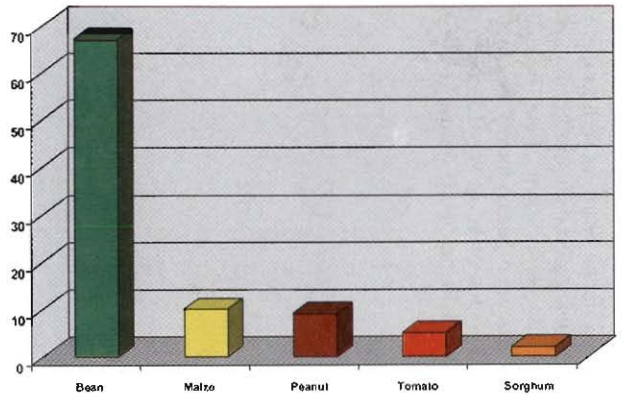


Figure 8. Most Profitable Crop according to Farmers in San Jerónimo

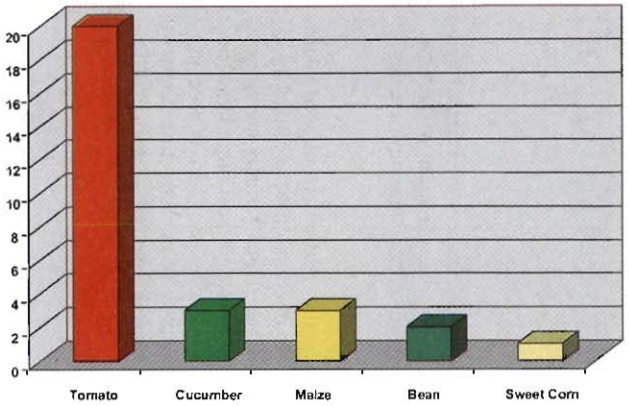


Figure 9. Crop Abandonment in San Miguel Chicaj

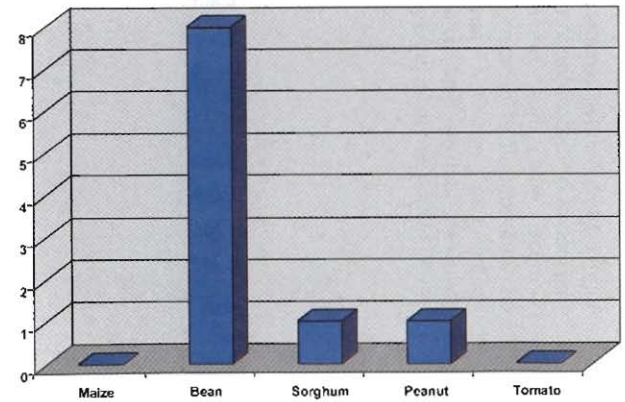


Figure 10. Factors determining Abandonment of Common Bean Production in San Miguel Chicaj

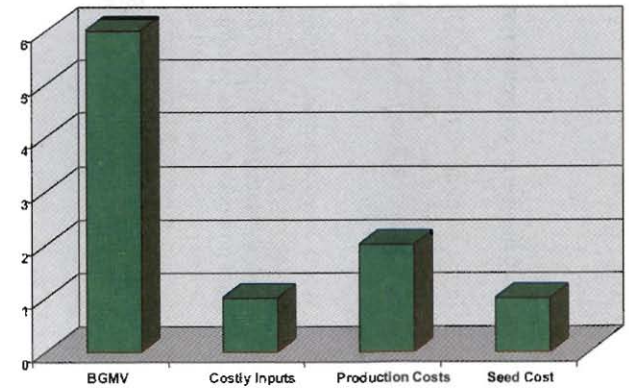


Figure 11. Crop Abandonment in San Jerónimo

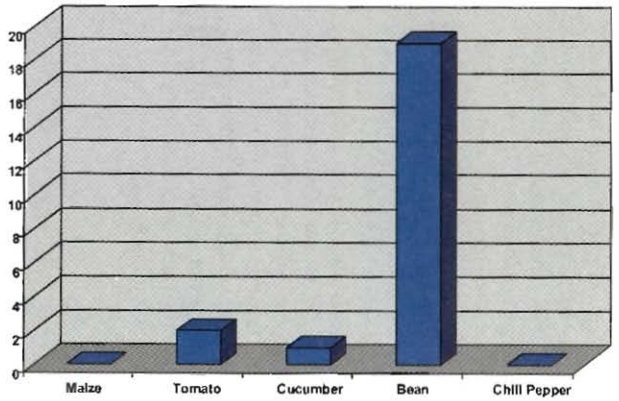


Figure 12. Factors determining Abandonment of Common Bean Production in San Jerónimo

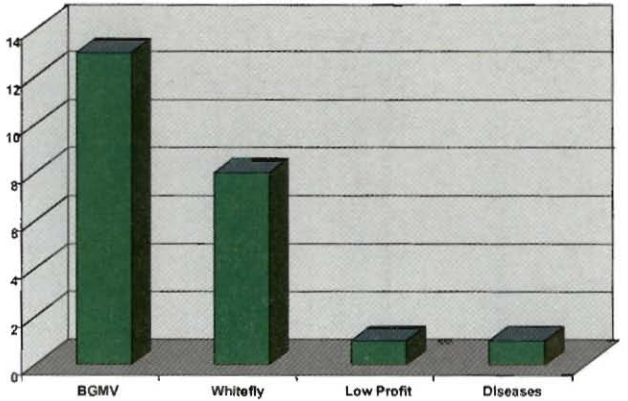


Figure 13. Frequency of Farmers that have Abandoned Bean Production in Selected Years (Y) (1985-1998)

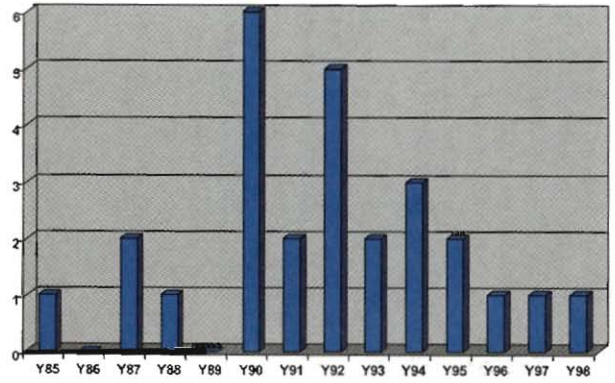


Figure 14. Frequency of Bean (BG) and Non-Bean (NBG) Growers in S. Miguel Chicaj (SM) and San Jerónimo (SJ)

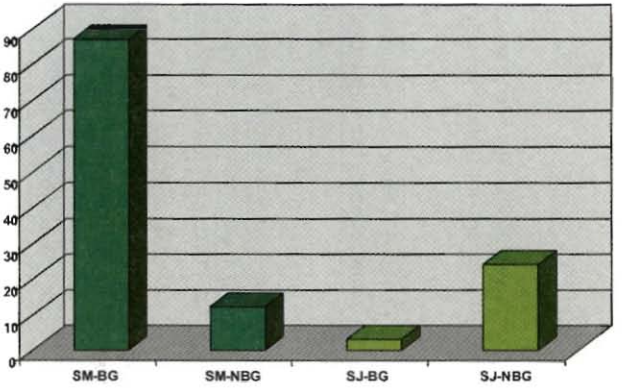


Table 17 lists the necessary conditions or factors that the above farmers considered important for them to resume bean production.

Table 17. Farmers' perception of factors required to bring common beans back into production in the municipalities of San Miguel Chicaj and San Jerónimo, B.V. GA.

Conditions or Factors	No. respondents
1. Improved common bean cultivars with BGMV resistance	17
2. Absence of BGMV and whiteflies	8
3. Better management practices for BGMV/whitefly problem	5
4. Cheaper production inputs	5
5. More effective insecticides to control whiteflies	3
6. More money to buy the necessary inputs	3
7. High yielding bean cultivars	2
8. Lower cost of renting land	1
9. More time	1
10. Higher profitability	1
11. Not willing to grow beans anymore	1
12. No response	1

Discussion

The relative distribution of crops in San Miguel Chicaj, shows the predominance and/or importance of food crops, particularly maize and common bean, in traditional agricultural systems. Maize is clearly the main food crop in both San Miguel Chicaj and San Jerónimo, probably since pre-Hispanic times. Common bean is the second most important traditional food crop in San Miguel Chicaj, but, area-wise, it has been displaced to a fourth place in San Jerónimo, where cash crops predominate. The average size of maize plots in San Jerónimo is 30% smaller than the average maize plot in San Miguel Chicaj, whereas the average size of bean plots in both municipalities is similar (0.6 ha). These observations show the gradual displacement of food crops by cash crops.

The cultivation of peanut (a South American crop introduced into Middle America in pre-Columbian times) as a cash crop in San Miguel Chicaj, is interesting. Peanut germplasm surveys conducted in San Miguel Chicaj (Azurdia et al., 1999) showed the existence of two different varieties of *Arachis hypogaea*, including peanuts of the "Virginia" type, introduced into Mesoamerica during colonial times. These findings suggest that peanuts have been cultivated in this region for many generations. The average size of the peanut fields in San Miguel Chicaj was 0.4 ha, whereas this crop was not grown by any of the respondents in San Jerónimo. Thus, peanut seems to be cultivated as a cash crop by traditional farmers, probably as a risk-aversion or crop-diversification strategy.

Sorghum is the third most important crop, area-wise, in San Miguel Chicaj. This crop was introduced into the Americas from Africa during the Spanish colonial period, but it has not become a staple food crop in this continent, except in countries with a large Afro-American population, such as Haiti. Sorghum is regarded as a rustic crop that can be used as animal feed, and as a substitute for maize in times of scarcity or crop failure. The average area of the sorghum fields in San Miguel Chicaj was 0.7 ha. This crop was not found among any of the farmers interviewed in San Jerónimo, and is probably cultivated by traditional farmers as a "buffer" crop to minimize risk.

Tomato was grown only in one of the nine villages surveyed in San Miguel Chicaj, which could be interpreted as an example of the on-going transition between traditional and non-traditional agriculture. The relatively small average area planted to tomato in this village (0.2 ha) suggests that farmers in this community are "experimenting" with this crop for the time being.

In San Jerónimo, the average area planted to tomato was 0.5 ha. Tomato was the second most extensive crop, which demonstrates the emphasis on cash crops in this municipality. Despite being a New World species, tomato did not become a staple food until considerable genetic improvement took place outside Latin America. It is not surprising, then, that tomato production in Baja Verapaz is destined mostly for sale and not for auto-consumption.

Cucumber is another non-traditional crop grown for sale in San Jerónimo, and is the third crop in area planted after tomato. It is interesting to note that only one farmer in San Jerónimo grows chili pepper, a crop that has greatly expanded together with tomato, in other Middle American countries. The average area planted to cucumber in San Jerónimo was 0.4 ha. This cucurbit is another cash crop that contributes to crop diversification in the study area.

Although maize occupies the largest area in both municipalities, it was not considered the most profitable crop. In San Miguel Chicaj, common bean was considered as the most profitable crop, by the majority of farmers interviewed. In the economic analysis conducted for the five crops grown in San Miguel Chicaj, the average profit per hectare was: USD$147 for maize, $580 for beans, $160 for sorghum, $334 for peanut and $7,428 for tomato. The profit margin for common bean is very high when compared to other bean-producing departments of Guatemala, such as Jutiapa (US$190/ha). This discrepancy could be attributed to the broad range of production costs (US$61-306/ha) reported by bean farmers in Baja Verapaz. Regarding expected bean prices, the minimum average price quoted by farmers in San Miguel Chicaj was US$683/ton, which is only slightly above international (US) bean prices. Thus, the main factor contributing to the unexpectedly high profit margin calculated for common bean in San Miguel Chicaj, could be the low production cost (the mode was US$102/ha). It would be interesting to analyze this finding in more detail.

In the municipality of San Jerónimo, tomato was by far the most profitable crop (average profit: US$6,518/ha), although it is the second crop in total area planted. The second

most profitable crop is cucumber (average: US$3,741/ha.), showing the high value and economic potential of cash crops.

Excluding the five tomato farmers interviewed in the village of San Francisco, common bean was the most profitable crop in the municipality of San Miguel Chicaj. The profitability of tomato per area cultivated, is over 12 times greater than that of common bean, but the low number of tomato growers in this municipality, made common bean the most profitable crop alternative. Furthermore, the main economic factor determining the selection of crops is probably their production cost (US$/ha): $135 for maize, $138 for common bean, $83 for sorghum, $222 for peanut, $1,400 for cucumber, and $3,400 for tomato. Chemical protection is a significant component of production costs. In this study, the cost (US$/ha) of chemical protection for the different crops analyzed were: $18 for maize, $34 for common bean, $8.50 for peanut and sorghum, $728 for cucumber, and $1,870 for tomato.

Interestingly, when these data are analyzed as the average net return on the money invested (the "accounting profit" in economic terms), the order of the crops (from the most to the least profitable crop) changes to: bean (265%), cucumber (191%), tomato (137%), sorghum (134%), peanut (107%), and maize (76%). These figures are a product of the calculations carried out using average values for the economic data collected among selected communities of farmers in Baja Verapaz. Official agricultural production figures available in Guatemala, consider high value crops, such as tomato, as the most profitable with a net return of 100%, whereas crops such as maize, beans and sorghum have profit margins that range between 5% and 42% (A. Viana, personal communication). Again, these discrepancies may be explained by the relatively low production costs registered in the small farming communities of Baja Verapaz.

Although tomato is a cash crop, it is better classified as a high value crop. The average net profit obtained from tomato per area cultivated, is over 40 times higher that of maize; and 12 times higher than the net profit from common bean production. However, production costs for tomato are 25 times higher than the cost of growing either maize or common bean. Over 55% of the total cost of producing tomatoes, corresponds to pesticide applications.

Unfortunately, when tomato production exceeds market demand, growers may lose as much as 72% of the maximum expected income. The minimum average price may not cover production costs for tomato. The difference between expected maximum and minimum average prices for maize and common bean does not exceed 38% and 32%, respectively. These data clearly show the importance of price stability for small-scale farmers.

Regarding "crop stability", **Figures 15** and **16** clearly show that there is a greater tendency to abandon crops in the municipality of San Jerónimo than in San Miguel Chicaj, where high value crops have not displaced traditional crops to a significant extent yet. The main crop that has been displaced in San Jerónimo is common bean. Interestingly, some farmers in this municipality, have stopped growing the main two cash

Figure 15. Crop Stability (No. of farmers that have maintained, abandoned or reduced crops) In San Miguel Chicaj

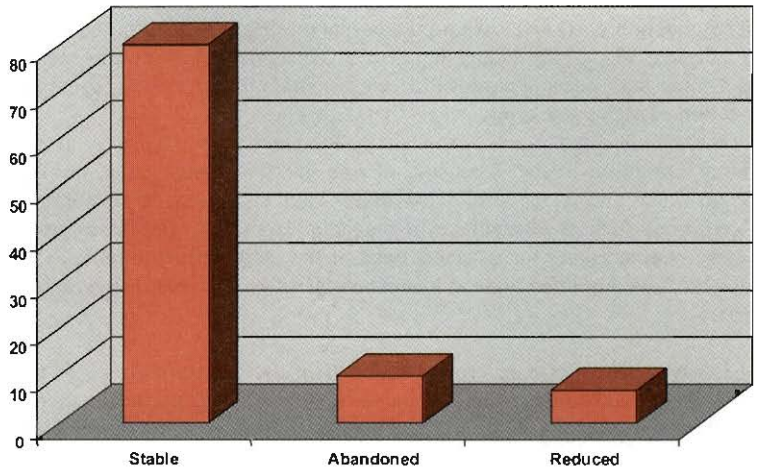
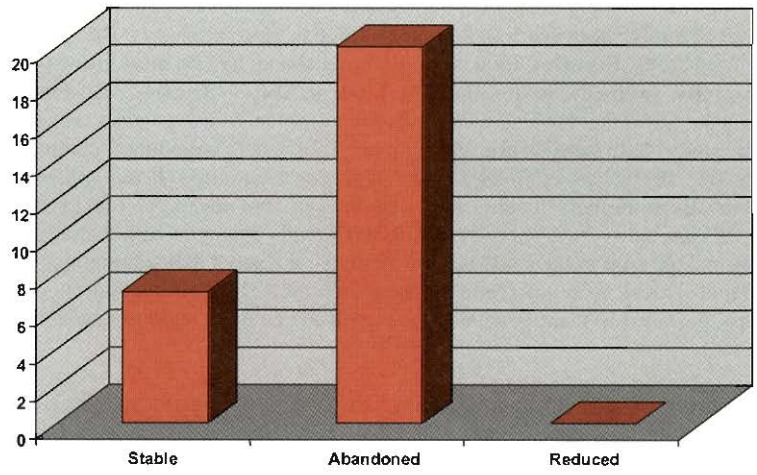


Figure 16. Crop Stability (No. of farmers that have maintained, abandoned or reduced crops) in San Jerónimo



crops: tomato and cucumber. Tomato was abandoned due to high production costs, and cucumber due to low market prices. These are limiting factors in the adoption of high value cash crops by small-scale farmers, because these crops demand a significant initial investment (production cost) and have a greater market price fluctuation than traditional food crops (**Figure 17**). Many ladino families in Guatemala send family members to work in the United States during part of the year, to obtain the necessary capital to invest in the production of high value crops.

Another major limitation to the expansion of non-traditional high value crops, is the availability of water during the prolonged dry season characteristic of some Central American countries, such as Guatemala, El Salvador, Honduras, and Nicaragua. In the case study area selected here, for instance, most of the crops grown the municipality of San Miguel Chicaj were rainfed and are located on hillsides, whereas San Jerónimo is an irrigated valley.

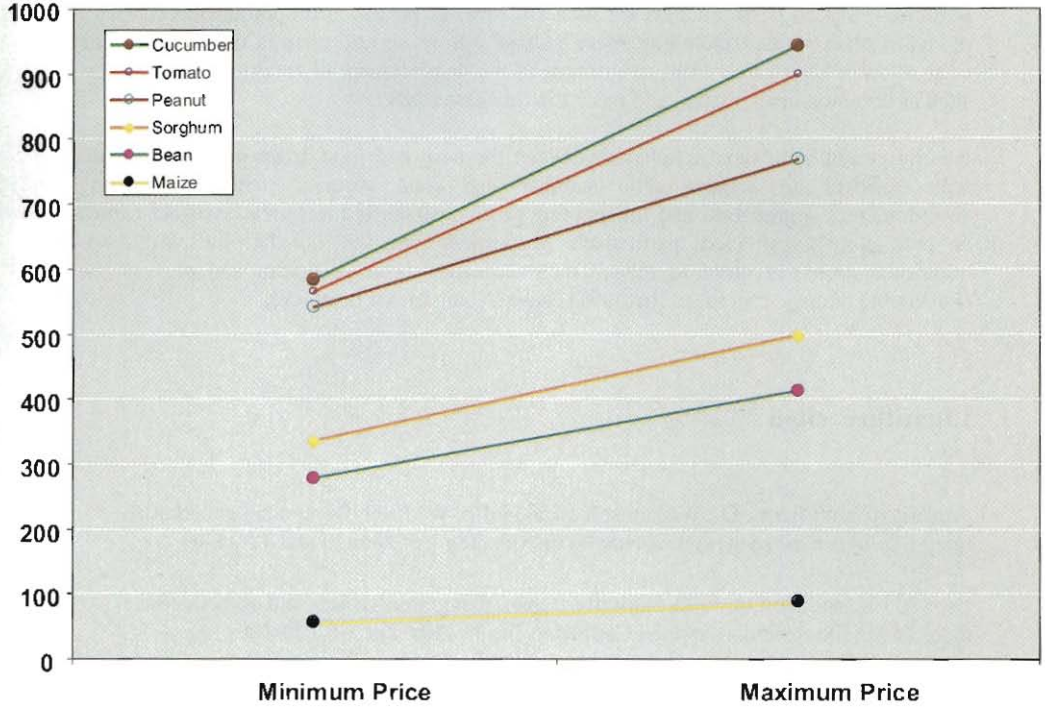
Common bean was also the main crop abandoned in the municipality of San Miguel Chicaj, although it was only recorded for a very low percentage of the farmers interviewed. The main factor responsible for this observation, was the high incidence of *Bean golden yellow mosaic virus* and its whitefly vector, *Bemisia tabaci*. Interestingly, tomato is also highly susceptible to whitefly-transmitted viruses, but none of the respondents has abandoned tomato due to this pest-disease problem. The reason might be the large amount of pesticides applied to tomato, sometimes on a daily basis.

Conclusions

The region selected for this case study included small-scale (<1 ha/crop) farming communities, characterized by contrasting cropping systems and socio-economic ethnic groups. The choice of cropping system was determined to a large extent by either the availability or lack of irrigation and capital. Farmers with access to irrigation systems and capital, were largely associated with non-traditional cash crops, at the expense of traditional food crops. However, food crops were not abandoned by most growers of non-traditional crops, probably in response to food security concerns. The food crops abandoned were those that have serious production problems, such as pests and diseases. In this case study, both subsistence and commercial farmers abandoned common bean production, due to its susceptibility to the whitefly-transmitted *Bean golden yellow mosaic virus*. Bean farmers in the study region were not aware of the existence of BGYMV-resistant cultivars. Maize is not affected by this pathogen and, consequently, it was the most stable crop in the study region. Peanut, considered as a traditional cash crop in San Miguel Chicaj, was not found in San Jerónimo. This observation suggests the possible loss of valuable plant genetic resources in agricultural regions devoted to non-traditional cash crops.

Commercial practices are evident both among subsistence and high value crop growers in Baja Verapaz. In San Miguel Chicaj, low-input, rain-fed crops, such as sorghum and peanut, are grown as cash crops; whereas in San Jerónimo, high input cash crops, such as

Figure 17. Market Price Fluctuation for Traditional and Non-Traditional Crops in Baja Verapaz



tomato and cucumber, predominated. The production of high value crops requires considerable capital investment from non-agricultural sources (e.g. migratory farm labor, bank loans, and other commercial activities). The need to protect this capital investment, forces growers to overprotect high value crops with a wide array of chemical pesticides applied on a regular basis. Not surprisingly, non-traditional cropping systems are invariably associated with pesticide abuse, environmental degradation, and covert health problems in rural communities. Urban consumers are also affected by the high levels of pesticide residues found in most horticultural products sold in Latin America. The lack of technical assistance to growers of non-traditional cash crops, further aggravates the problem of pesticide abuse.

The excessive application of agrochemicals is also responsible for the emergence of pesticide-resistant pests, such as the whitefly *Bemisia tabaci*, an important insect vector of many plant viruses including *Bean golden yellow mosaic virus*. Consequently, the cultivation of high value crops contributes to the displacement of traditional food crops, such as common bean, maize, and peanut in this case study.

It is important to achieve a balance between the cash and food crops grown by small-scale farmers, to achieve crop stability and food security, while minimizing environmental degradation and maximizing profits. Qualified technical assistance must be continuously provided, particularly to farmers who are not familiar with non-traditional crops, in order to reduce their dependence on pesticides and prevent the irreversible damage that these chemicals cause to our natural resources.

Literature cited

Azurdia, C.; Williams, D.; Williams, K.; and Nufio, W. 1999. Diversidad genética de maní (*Arachis hypogaea*) en Guatemala: distribución y erosión. ikatia 17:25-40.

Brown, J.K. and Bird, J. 1992. Whitefly-transmitted geminiviruses and associated disorders in the Americas and the Caribbean Basin. Plant Dis. 76:220-225.

Casley, D.J. and Lury, D.A. 1989. Data collection in developing countries. Second edition. Clarendon Press, Oxford, U.K. 225 p.

FAO. 1998. 1997 Statistics series no. 142. Roma. 239 p.

Thrupp, L.A.; Bergeron, G.; and Waters, W.F. 1995. Bittersweet harvests for global supermarkets: challenges in Latin America's agricultural export boom. World Res. Inst. Washington D.C. 202 p.

Vlahos, O. 1970. New World beginnings: Indian cultures in the Americas. Fawcett Publ. Inc., Greenwich, Conn. 266 p.

Appendix 1

Estudio Dinámica del frijol en el Departamento de Baja Verapaz

I- DATOS ENCUESTA

1- Encuesta Número: [ ] 2- Fecha: [ ]

3- Encuestador: [ ]

4- Nombre del encuestado: [ ]

5- Propietario ☐ Arrendante ☐ Medianero ☐ Jornalero ☐

6- Cuantos años lleva trabajando esta finca ? [ ] años

7- Hace cuanto vive en esta aldea ? [ ] Toda la vida ? Si ☐ No ☐

8- Aldea [ ] 9- Municipio [ ]

10- Departamento [ ]

III- SISTEMAS DE CULTIVO

11- Qué cultivos siembra en esta finca, que área (de mayor a menor), con que destino ?

C1 [ ] Área [ ] Mz Consumo ☐ Venta ☐ Ambos ☐

C2 [ ] Área [ ] Mz Consumo ☐ Venta ☐ Ambos ☐

C3 [ ] Área [ ] Mz Consumo ☐ Venta ☐ Ambos ☐

C4 [ ] Área [ ] Mz Consumo ☐ Venta ☐ Ambos ☐

12- Cuando se siembran estos cultivos ?. Marque si es con lluvia (ll) o riego (r).

C1 [ ] Siembra 1 [ ] ☐ Lluvia ☐ Riego Siembra 2 [ ] ☐ Lluvia ☐ Riego

C1 [ ] Siembra 1 [ ] ☐ Lluvia ☐ Riego Siembra 2 [ ] ☐ Lluvia ☐ Riego

C1 [ ] Siembra 1 [ ] ☐ Lluvia ☐ Riego Siembra 2 [ ] ☐ Lluvia ☐ Riego

C1 [ ] Siembra 1 [ ] ☐ Lluvia ☐ Riego Siembra 2 [ ] ☐ Lluvia ☐ Riego

III- FACTORES ECONÓMICOS Y FITOSANITARIOS

13- Cuales cultivos de los que vende le dejan más dinero ?

1- [ ] 2- [ ] 3- [ ]

14- Cuando desembolsa en efectivo por una manzana de los cultivos que usted siembra, si es en invierno o bajo riego? (anotar ll ó r).

C1- [ ] Q [ ] ☐ Lluvia ☐ Riego C2- [ ] Q [ ] ☐ Lluvia ☐ Riego

C3- [ ] Q [ ] ☐ Lluvia ☐ Riego C4- [ ] Q [ ] ☐ Lluvia ☐ Riego

15- Qué producción (qq/mz) y qué precio máximo y mínimo (Q) espera para estos cultivos ?

C1 [ ] Prod [ ] Precio Máximo [ ] Mínimo [ ]

C2 [ ] Prod [ ] Precio Máximo [ ] Mínimo [ ]

C3 [ ] Prod [ ] Precio Máximo [ ] Mínimo [ ]

C4 [ ] Prod [ ] Precio Máximo [ ] Mínimo [ ]

16- Cuales son las principales plagas y enfermedades en cada uno de los cultivos (máximo 3 por cultivo en orden de importancia) ? marque si es plaga (p) o enfermedad (e).

C1 [ ] [ ] p ☐ e ☐ [ ] p ☐ e ☐

[ ] p ☐ e ☐

C2 [ ] [ ] p ☐ e ☐ [ ] p ☐ e ☐

[ ] p ☐ e ☐

C3 [ ] [ ] p ☐ e ☐ [ ] p ☐ e ☐

[ ] p ☐ e ☐

C4 [ ] [ ] p ☐ e ☐ [ ] p ☐ e ☐

[ ] p ☐ e ☐

Antes de Cancelar, presione Escape [Cancelar] [Continuar]

Encuesta Número:

17- Cuanto le cuesta en dinero controlar estas plagas y enfermedades en cada cultivo en invierno o bajo riego (anotar ll ó r)

C1 Q l r C2 Q l r

C3 Q l r C4 Q l r

18- Qué otros problemas (p) diferentes a las plagas y enfermedades mencionadas tienen los cultivos que usted siembra ?

C1 P1 P2 P3

C2 P1 P2 P3

C3 P1 P2 P3

C4 P1 P2 P3

IV- CAMBIOS EN LOS SISTEMAS DE PRODUCCIÓN

19- Ha habido abandono o reducción de cultivos en esta finca ? No Si

20- Cuáles abandonó el (los) cultivos ?

Cultivo 1 Por qué ?

Cultivo 1 Por qué ?

Cultivo 1 Por qué ?

21- Cuáles redujo ?

Cultivo 1 Por qué ?

Cultivo 1 Por qué ?

Cultivo 1 Por qué ?

22- Ha vuelto a sembrar cultivos que abandonó antes ? No Si

V- EL CULTIVO DE FRIJOL

23- Cultiva usted Frijol ? No ☑ Si ☐

24- Porqué no cultiva frijol ?

25- Lo cultivava usted antes ? No Si

26- Cuando lo dejó de cultivar ? 19

27- Si no lo cultiva, consume usted frijol ? No Si

28- Cuantas veces diarias o por semana consume usted frijol ?

29- Cuanto frijol compra por semana ? Kg

30- Donde lo compra ?

31- Sabe usted de donde viene el frijol que compra ? No Si

de donde ?

32- Qué clase de frijol consume ? Negro ☑ Otro ☐ Negro y Otro ☐

33- Que necesitaría para que usted volviera a cultivar frijol ?

34- Si cultiva frijol, qué área siembra en primera ? Mz en segunda ? Mz

35- Cuanto vende ? qq No vende

36- A quien vende ? Mercado Intermediario Ambos

37- A que precio vende ? Máximo Q/pp) Mínimo (Q/pp)

38- Escolaridad del productor ?

39- Tamaño de familia ?

40- Edad del productor ? años

OBSERVACIONES

Antes de Cancelar presione Escape

Cancelar Continuar Terminar

Appendix 2

Table 9. Descriptive economic analysis of maize production in San Miguel Chicaj.

Chixolop	P.Cost/mz	Yield/qq/mz	Max.Price	Min.Price	Avg.Price	Prot.Cost	Max.Profit	Min.Profit	Avg.Profit	Av.Pro.US	Pr/Av/Area	Mx.Pro.US	Pr/Mx/Area
1	600	18	90	50	70	75	1025	300	660	94	188	146	292
2	400	22	65	60	62	110	1030	920	964	137	274	147	294
3	1000	15	75	60	67	60	125	-100	5	0	0	18	36
4	2000	50	90	50	70	75	2500	500	1500	214	428	357	714
5	500	25	80	60	70	100	1500	1000	1250	178	356	214	428
6	700	15	60	50	55	25	200	50	125	17	34	28	56
7	1000	25	75	50	62	100	885	250	550	78	156	126	252
8	500	40	80	50	65	200	2700	1500	2100	300	600	385	770
9	250	20	85	60	72	60	1450	950	1190	170	340	207	414
10	450	20	100	55	78	90	1550	650	1110	158	316	221	442
11	1000	14	100	50	75	120	400	-300	50	7	14	57	114
12	1000	50	100	50	75	150	4000	1500	2750	392	784	571	1142
13	600	10	90	60	75	150	300	0	150	21	42	43	86
14	450	10	80	50	65	30	350	50	200	28	56	50	100
15	500	34	70	50	60	64	1880	1200	1550	221	442	268	536
Average	**730**	**25**	**83**	**54**	**68**	**94**	**1326**	**564**	**944**	**134**	**268**	**189**	**378**
Las Minas													
1	500	40	80	50	65	180	2700	1500	2100	300	480	386	618
2	650	21	75	45	60	30	925	295	610	87	139	132	211
3	500	50	80	50	65	35	3495	2000	2750	392	672	499	798
4	1000	25	75	55	65	0	3000	440	625	89	142	428	685
5	500	10	90	50	70	0	400	-400	200	28	45	57	91
6	1500	16	100	60	80	0	100	-640	-220	0	0	14	22
7	400	18	90	75	82	50	1220	950	1076	153	245	174	278
8	2000	20	90	60	75	200	-200	-800	-500	0	0	0	0
9	500	20	110	45	77	300	1700	-50	1040	148	237	242	387
10	600	10	90	45	67	0	300	-150	70	10	16	42	67
11	600	16	110	45	77	300	560	120	632	90	144	80	128
Average	**795**	**22**	**90**	**53**	**71**	**100**	**1291**	**297**	**762**	**118**	**193**	**187**	**298**

Table 10. Descriptive economic analysis of maize production in San Gabriel, San Miguel Chicaj.

S.Gabriel	P.Cost/mz	Yle/qq/mz	Mx.Price	Mln.Price	Av.Price	Prot.Cost	Mx.Profit	Min.Profit	Av.Profit	Av.Pro.US	Av.Pro.Ar	Mx.Pro.US	Mx.Pro/Ar
1	600	25	100	70	85	40	1900	1150	1525	217	435	271	542
2	450	30	80	50	65	30	1950	1050	1500	214	428	278	557
3	500	20	70	50	60	15	900	500	700	100	200	128	257
4	600	20	60	50	55	200	600	400	500	71	142	86	171
5	450	35	60	45	52	18	1650	1125	1370	196	391	235	471
6	400	20	75	50	62	45	1100	600	840	120	240	157	314
7	400	20	100	50	75	50	1600	600	1100	157	314	228	457
8	175	30	100	50	75	25	2825	1325	2075	296	593	403	807
9	350	8	90	50	70	60	370	50	210	30	60	53	105
10	500	75	90	75	82	60	6250	5125	5650	807	1614	893	1785
11	450	30	100	50	75	25	2550	1050	1800	257	514	364	728
12	300	20	100	60	80	100	1700	900	1300	186	371	243	485
13	550	40	80	60	70	40	2650	1850	2250	321	642	378	757
14	300	40	60	35	47	100	2100	1100	1580	226	451	300	600
15	400	20	80	60	70	50	1200	800	1000	143	286	171	342
16	450	35	80	60	70	0	2350	1650	2000	286	571	335	671
17	350	25	80	60	70	25	1650	1150	1400	200	400	235	471
18	500	15	85	60	72	200	775	400	580	83	166	110	220
19	300	35	90	60	75	400	2850	1800	2325	332	664	407	814
20	500	15	140	50	85	80	1600	250	775	110	220	228	457
21	850	20	100	75	87	50	1150	650	890	127	254	164	328
22	800	15	80	40	60	75	400	-200	100	14	28	57	114
23	500	10	140	80	110	400	900	300	600	86	172	128	256
24	600	8	90	45	67	50	120	-240	-64	0	0	17	34
Average	**470**	**25**	**89**	**56**	**72**	**89**	**1714**	**974**	**1333**	**191**	**381**	**244**	**489**

Table 11. Descriptive economic analysis of bean production in selected villages in San Miguel Chicaj, Baja Verapaz, Guatemala.

Chixolop	P.Cost/mz	ield/qq/mz	Max.Price	Min.Price	Avg.Price	Prot.Cost	Max.Profit	Min.Profit	Avg.Profit	Av.Pro.US	Pr/Av/Area	Mx.Pro.US	Pr/Mx/Area
1	350	15	300	200	250	200	4150	2650	3400	485	970	593	1186
2	900	15	350	250	250	180	4350	2850	2850	407	814	621	1243
3	1200	18	300	275	287	120	4200	3750	3966	566	1133	600	1200
4	350	18	300	250	275	90	5050	4150	4600	657	1314	721	1443
5	600	20	350	250	300	200	6400	4400	5400	771	1542	914	1828
6	1000	15	350	200	275	100	4250	2000	3125	446	892	607	1214
7	1000	20	325	200	262	300	5500	3000	4240	605	1211	785	1571
8	600	30	250	125	187	150	6900	3150	5010	715	1431	985	1971
9	600	30	450	325	387	500	12900	9150	11010	1572	3145	1842	3685
10	600	10	250	180	215	150	1900	1200	1550	221	442	271	542
11	800	10	300	250	275	150	2200	1700	1950	278	557	314	628
12	1200	20	450	250	350	150	7800	3800	5800	828	1657	1114	2228
13	550	19	350	200	275	50	6100	3250	4675	667	1335	871	1742
14	700	16	350	150	250	75	4900	1700	3300	471	942	700	1400
Average	746	18	334	222	274	172	5471	3339	4348	620	1242	781	1563
Las Minas													
1	700	25	400	300	350	80	9300	6800	8050	1150	1840	1328	2125
2	600	14	225	190	207	110	2550	2060	2298	328	525	364	582
3	600	20	350	250	300	40	6400	4400	5400	771	1233	914	1462
4	1500	20	300	250	275	60	4500	3500	4000	571	914	643	1028
5	500	10	300	200	250	300	2500	1500	2000	285	456	357	571
6	1000	10	250	200	225	200	1500	1000	1250	178	285	214	342
7	300	18	250	200	225	250	4200	3300	3750	535	856	600	960
8	800	15	350	100	225	300	4450	700	2575	367	587	635	1016
9	800	10	350	200	275	200	2700	1200	1950	278	445	385	617
10	700	14	350	325	337	150	4200	3850	4018	574	918	600	960
11	750	17	350	200	275	300	5200	2650	4350	621	994	742	1485
Average	750	16	316	220	268	181	4318	2815	3603	514	823	616	1013

Table 12. Descriptive economic analysis of bean production in San Gabriel, San Miguel Chicaj, Baja Verapaz, Guatemala.

S.Gabriel	P.Cost/mz	Yie/qq/mz	Mx.Price	Min.Price	Av.Price	Prot.Cost	Mx.Profit	Min.Profit	Av.Profit	Av.Pro.US	Av.Pro.Ar	Mx.Pro.US	Mx.Pro/Ar
1	700	12	350	300	325	100	3500	2900	3200	457	914	500	1000
2	600	15	350	175	262	75	4650	2025	3337	476	953	664	1328
3	700	16	300	200	250	150	4100	2500	3300	471	943	586	1171
4	700	10	325	250	300	300	2550	1800	2175	310	621	364	728
5	525	7	300	175	237	86	1575	665	1120	160	320	225	450
6	500	15	400	170	285	65	5500	2050	3775	539	1078	785	1571
7	450	20	400	250	325	100	7550	4550	6050	864	1728	1078	2157
8	400	25	450	250	350	100	10850	5850	8350	1193	2385	1550	3100
9	700	30	300	250	275	150	8300	6800	7550	1078	2157	1185	2371
10	500	18	325	275	300	140	5350	4450	4900	700	1400	764	1528
11	500	25	350	150	250	60	8250	3250	5750	821	164	1178	2357
12	400	20	300	250	275	150	5600	4600	5100	728	1457	800	1600
13	650	30	300	250	275	150	5600	6850	6225	889	1778	800	1600
14	400	25	200	150	175	200	4600	3350	3975	568	1136	657	1314
15	525	20	300	225	262	150	5475	3975	4725	675	1350	782	1564
16	560	25	350	200	275	0	8190	4440	6315	902	1804	1170	2340
17	400	15	275	250	262	140	3725	3350	3537	505	1010	532	1064
18	300	14	300	250	275	200	3900	3200	3550	507	1014	557	1114
19	800	14	300	250	275	500	3400	2700	3050	436	871	486	971
20	500	9	320	200	260	80	2380	1300	1840	263	526	340	680
21	850	20	320	225	272	400	5550	3650	4600	657	1314	793	1585
22	500	6	275	200	237	100	1150	700	925	132	264	164	328
23	300	14	350	250	300	400	4600	3200	3900	557	1114	657	1314
Average	**541**	**17**	**323**	**224**	**274**	**165**	**5058**	**3398**	**4228**	**604**	**1143**	**722**	**1445**

Table 13. Descriptive economic analysis of sorghum production in San Miguel Chicaj.

S.Miguel	P.Cost/mz	Yield/qq/mz	Max.Price	Min.Price	Avg.Price	Prot.Cost	Max.Profit	Min.Profit	Avg.Profit	Av.Pro.US	Pr/Av/Area	Mx.Pro.US	Pr/Mx/Area
1	300	16	50	30	40	50	500	180	340	48	48	71	71
2	800	25	70	50	60	60	950	450	700	100	100	135	135
3	400	30	80	60	70	0	2000	1400	1700	243	243	286	286
4	400	20	80	50	65	0	1200	600	900	128	128	171	171
5	300	15	70	50	60	0	750	450	600	86	86	107	107
6	500	40	80	60	70	200	2700	1900	2300	329	329	385	385
7	250	20	90	70	80	60	1550	1150	1350	193	193	221	221
8	225	10	100	55	77	90	775	325	545	78	78	110	110
9	150	8	60	50	55	0	330	250	290	41	41	47	47
10	300	15	60	50	55	40	600	450	525	75	75	85	85
11	1000	25	75	55	65	0	875	375	625	89	89	125	125
12	400	15	75	40	57	100	725	200	455	65	65	103	103
13	200	30	50	45	47	0	1300	1150	1210	173	173	185	185
14	500	13	75	40	52	150	475	20	176	25	25	68	68
15	300	25	150	60	105	0	3450	1200	2325	332	332	493	493
16	500	25	150	120	135	0	3250	2500	2875	410	410	464	464
17	400	20	150	100	125	0	2600	1600	2100	300	300	371	371
Average	**407**	**20**	**86**	**58**	**71**	**44**	**1413**	**835**	**1118**	**160**	**160**	**202**	**202**

Table 14. Descriptive analysis of peanut production in San Miguel Chicaj.

S.Miguel	P.Cost/mz	Ield/qq/mz	Max.Price	Mln.Price	Avg.Price	Prot.Cost	Max.Profit	Mln.Profit	Avg.Profit	Av.Pro.US	Pr/Av/Area	Mx.Pro.US	Pr/Mx/Area
1	800	18	300	250	275	0	4600	3700	4150	593	355	657	394
2	1000	10	275	200	237	50	1750	1000	1375	196	118	250	150
3	70	18	250	175	212	60	4430	3080	3755	536	322	633	380
4	800	6	300	200	250	0	1000	400	700	100	60	142	85
5	300	3	250	160	205	0	450	180	315	45	27	64	38
6	800	18	325	255	290	50	5050	3790	4420	631	378	721	433
7	500	12	200	175	187	200	1900	1600	1750	250	150	271	163
8	2000	18	275	200	237	0	2950	1600	2266	323	194	421	253
9	2000	18	275	250	262	0	2950	2500	2716	388	233	421	253
10	2100	15	275	200	237	0	2025	900	1455	208	125	289	173
11	2200	15	250	200	225	0	1550	800	1175	168	100	221	133
12	2000	12	270	200	235	0	1240	400	820	117	70	177	106
13	300	30	250	175	212	0	7200	4950	6075	868	520	1028	617
14	400	8	290	250	270	200	1920	1600	1760	251	151	274	164
Average	**1090**	**14**	**270**	**206**	**238**	**40**	**2786**	**1893**	**2338**	**334**	**200**	**398**	**238**

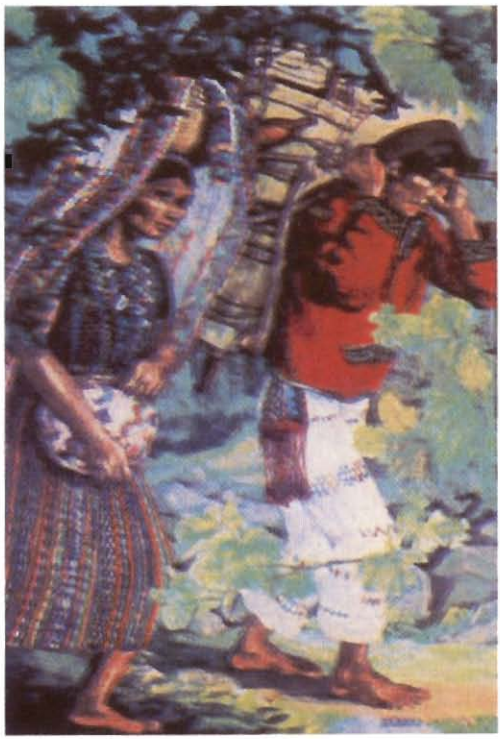
Table 15. Descriptive economic analysis of tomato production in San Miguel Chicaj (S.Fco) and San Jerónimo.

S.Fco	P.Cost/mz	Yield/qq/mz	Max.Price	Min.Price	Avg.Price	Prot.Cost	Max.Profit	Min.Profit	Avg.Profit	Av.Pro.US	Pr/Av/Area	Mx.Pro.US	Pr/Mx/Area
1	15000	1000	110	25	67	2000	95000	10000	52500	7500	2250	13571	4071
2	12000	600	130	30	80	3000	66000	6000	36000	5142	1543	9428	2828
3	25000	1200	160	30	95	10000	167000	11000	89000	12714	3815	23857	7157
4	20000	1000	100	50	75	6000	80000	30000	55000	7857	2357	11428	3428
5	8000	800	100	40	70	6000	72000	24000	48000	6857	2057	10286	3085
6	6000	500	100	50	75	5000	44000	19000	31500	4500	1350	6285	1885
Average	**14333**	**850**	**117**	**37**	77	**5333**	**87333**	**16667**	**52000**	**7428**	**2228**	**12476**	**3742**

S. Jerón.	P.Cost/mz	Yield/qq/mz	Max.Price	Min.Price	Avg.Price	Prot.Cost	Max.Profit	Min.Profit	Avg.Profit	Av.Pro.US	Pr/Av/Area	Mx.Pro.US	Pr/Mx/Area
1	16000	1000	150	5	77	3000	134000	-11000	61500	8785	6150	19142	13399
2	16000	900	80	30	55	9000	56000	11000	33500	4785	3350	8000	5600
3	25000	900	90	40	65	10000	56000	11000	33500	4785	3350	8000	5600
4	23000	1000	120	60	90	8000	97000	37000	67000	9571	6700	13857	9700
5	15000	1300	130	15	72	11000	154000	4500	79250	11321	7925	22000	15400
6	12000	1000	80	30	55	10000	68000	18000	43000	6143	4300	9714	6800
7	18000	1200	145	7	76	10000	156000	-9600	73200	10457	7320	22285	15600
8	23000	800	90	30	60	10000	49000	1000	25000	3571	2500	7000	4900
9	24000	800	170	5	87	9000	112000	-20000	46000	6571	4600	16000	11200
10	15000	1200	70	20	45	8000	69000	9000	39000	5571	3900	9857	6900
11	20000	1200	60	30	45	10000	52000	16000	34000	4857	3400	7428	5200
12	20000	1000	60	30	40	8000	40000	10000	25000	3571	2500	5714	4000
13	20000	1000	90	20	55	12000	70000	0	35000	5000	3500	10000	7000
14	20000	800	90	20	55	10000	52000	-4000	24000	3428	2400	7428	5200
15	16000	1200	140	10	75	10000	152000	-4000	74000	10571	7400	21714	15200
16	18000	1000	100	25	62	10000	82000	7000	44500	6357	4450	11714	8200
17	20000	1000	70	30	50	8000	50000	10000	30000	4285	3000	7143	5000
18	20000	1000	120	25	72	10000	100000	5000	52500	7500	5250	70000	49000
19	18000	1000	100	30	65	8000	82000	12000	47000	6714	4700	11714	8200
Average	**18894**	**1015**	**103**	**24**	**63**	**9158**	**85842**	**5415**	**45629**	**6518**	**4563**	**15195**	**10637**

Table 16. Descriptive analysis of cucumber production in San Jerónimo.

S.Jeron.	P.Cost/mz	Yie/Caj/mz	Max.Price	Min.Price	Avg.Price	Prot.Cost	Max.Profit	Min.Profit	Avg.Profit	Av.Pro.US	Pr/Av/Area	Mx.Pro.US	Pr/Mx/Area
1	9000	1100	50	30	40	7000	46000	24000	35000	5000	3500	6571	4600
2	11000	900	50	30	40	7000	34000	16000	25000	3571	2500	4857	3400
3	5000	1000	60	20	40	2000	55000	15000	70000	10000	7000	7857	5500
4	5000	1000	30	10	20	2500	25000	5000	15000	2143	1500	3571	2500
5	2700	300	40	15	27	900	9300	1800	5550	793	555	1328	930
6	12000	1200	60	25	42	6000	60000	18000	39000	5571	3900	8571	6000
7	1700	1800	50	15	32	350	88300	25300	3614	516	361	12614	8830
8	8000	1800	40	10	25	4000	64000	10000	37000	5285	3700	9143	6400
9	6000	1000	35	15	25	1000	29000	9000	5950	850	595	4143	2900
10	8000	1500	35	10	22	5000	44500	7000	25750	3678	2575	6357	4450
Average	**6840**	**1160**	**45**	**18**	**31.3**	**3575**	**45510**	**13110**	**26186**	**3741**	**2619**	**6501**	**4551**



Inhabitants of the community of San Miguel Chicaj wearing their typical costumes