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COMPARISON OF SELECTED AGRICULTURAL PRACTICES OF MENNONITES  
AND NON-MENNONITES IN CHIHUAHUA, MEXICO

*The University of Arizona*

M.S. 1986

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COMPARISON OF SELECTED AGRICULTURAL PRACTICES  
OF MENNONITES AND NON-MENNONITES  
IN CHIHUAHUA, MEXICO

by

Marianne Bensing

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A Thesis Submitted to the Faculty of the  
DEPARTMENT OF AGRICULTURAL EDUCATION  
In Partial Fulfillment of the Requirements  
For the Degree of  
MASTER OF SCIENCE  
In the Graduate College  
THE UNIVERSITY OF ARIZONA

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Date

Dedicated to my wonderful mother  
in infinite gratitude.

## ACKNOWLEDGEMENTS

The author wishes to express her heartfelt appreciation to her major professor, Dr. Christopher Kalangi, for competent advice, patience and personal interest.

The author also wishes to thank Dr. Phillip R. Zurbrick for his extended assistance in preparation of this thesis, as well as Dr. Melvin Schonhorst for his suggestions and support. Thanks are due to Dr. Floyd G. McCormick for serving on the committee and to Dr. Leslie S. Forster for assistance.

Appreciation is extended to Mr. Francisco Delgado for suggesting the topic and for personal help and to Thomas Laase for advice about statistics.

The author is indebted to Mr. Jaime Delgado, Mr. Peter Reimer and family, and especially to Dr. Philip Dyck and family for facilitating the study and for lodging the author. Special thanks are due to Mrs. Lore Dyck and Miss Tina Rempel for interpreting and transportation.

Finally, thanks are due to all Mennonite and non-Mennonite farmers who participated in this study.

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## ABSTRACT

This study compared some agricultural practices used by the Mennonite and non-Mennonite farmers in Chihuahua, Mexico, relative to the production of corn, beans and dairy milk.

Data were obtained by means of an interview schedule that was administered personally by the investigator. Data were analysed statistically using Chi-square and T-tests in order to determine significant differences.

The Mennonites had higher corn and bean yields than the non-Mennonites, while dairy milk yields were similar. Mennonites worked more hours per day and also used more family labor than non-Mennonites.

Both groups had similar family and farm sizes, with cultivation almost entirely rainfed.

Soil improvement and preparation practices as well as plant protection practices were applied by both groups, whereas there were differences in seed usage, weed control and harvesting.

## CHAPTER 1

### INTRODUCTION

The Mennnonites are one of the oldest Protestant sects. They were named after Menno Simons in the sixteenth century. Their creed is "based on the authority of the scripture as interpreted by their own consensus" (Sawatzky 1971, p. vii). Their strong beliefs are 1) not to bear arms or to defend themselves, 2) not to swear an oath, 3) to teach their children the Bible and the simple rural life style in their own religious schools.

Whenever these orthodox strongholds were threatened, the Mennonites migrated and founded new settlements. Land scarcity in their expanding colonies also came into play because of steadily rising population growth (Eighmy 1978).

The Mennonites migrated from the Netherlands and Germany to Russia, from there to Canada, and from Canada nearly 6000, mostly of the sub-group "Altkolonier" (Old Colony) moved on to Chihuahua, Mexico, in 1922. The Mexican Government granted them a "Privilegium" that exempts them from military service and allows them to have their own schools. Their "way of life" is the simple,

self-sustaining agrarian one. They live in isolated colonies in small villages and have preserved their culture, traditions, and German language over four centuries by separation from "the world" around them.

The Altkolonier-Mennonites in Chihuahua founded the "Manitoba" and "Swift Current" colonies in the Bustillo Valley. They are "the most agrarian and conservative of the Mennonites" (Hostetler 1974, p. 8).

This study deals with some agricultural practices of the Mennonite farmers as compared to those of the non-Mennonite Mexican farmers in the same region.

#### Need for the Study

The literature about the Mennonites is mostly limited to sociological and anthropological issues. Although all authors recognize that agriculture is the foundation of the Mennonites' way of life, no investigations have been made about their agricultural system, with the exception of a dissertation about the Mennonite colony in Belize, a tropical country (Hall 1974). Geographers showed little interest in the adapted Mennonite agricultural system, and "the scope of previous studies has not allowed for a detailed analysis of the Mennonite agricultural system in terms of the factors associated with productivity and the efficiency of resource allocation" (Hall 1974, p. iii).

Hints about the high agricultural productivity of the Mennonites in Mexico have been given by Sawatzky, Redekop, and other authors. But the reasons for this alluded higher proficiency, compared to the Mexican agriculture surrounding them, have not been studied.

The literature does not document the proverbial higher productivity of the Mennonite farmers in comparison to the productivity of the native Mexican farmers. In an exhaustive literature review, production data for corn and beans for the Mennonites could only be found for the year 1925: Yields for corn were 500 to 1250 kg/ha and yields for beans were 600 to 1000 kg/ha, according to Schmiedehaus (1982). On the other hand, calculated average yields were 1686 kg/ha for corn and 616 kg/ha for dry beans for all of Mexico in 1974 to 1982 (FAO Production Yearbook 1982). This suggests that even in the year 1925, the Mennonites' corn and bean yields were quite high, compared to those of the Mexicans in the 1970's, despite the use of high yielding varieties and other modern agricultural practices by the Mexicans in recent times.

Reason for selecting corn and beans:

Corn and beans are staple foods in Mexico. The Mennonites adopted them soon after they arrived in Chihuahua in 1922, as Sawatzky showed in his dissertation: "Beans, being unfamiliar to the Mennonites as a crop, did not at once find a vogue. However, since beans and corn were the only field crops for which there was any active demand on the Mexican market, these, along with oats, were, by 1926, dominating the cropping practices of the more forward-looking of the Mennonite farmers." (Sawatzky 1967, p. 169). These crops are so important in Mexico that "the Mexican government has taken some action toward stabilizing prices and assuring consistent markets. This influence, however, insofar as the Mennonite colonies have been concerned, has applied mainly to the staples of the Mexican food economy, beans and corn." (Sawatzky 1971, p. 211)

Reason for selecting dairy milk production:

Milk production is a very important segment of Mexican agriculture. According to FAO estimates, the number of milk cows in Mexico in the year 1982 was 9,000,000 which is quite high when compared with the 11,000,000 found in the United States. Although the milk yield per animal in Mexico is low, it increased 25 percent from 1974 to 1982 (620 to 770 kg/cow). This indicates that

the Mexican dairy industry has begun to pay some attention to production efficiency in recent times.

Dairying is an important part of the Mennonite economy. Sawatzky, a scholar on Mennonites in Mexico, notes that the first cheese factory was founded in 1931, and by the year 1937 "... the cheese industry was convincingly proving its importance to the economic viability of Mennonite agriculture" (Sawatzky 1971, p. 252). About dairy milk production, the same author states: "The supplying of milk to cheese factories was to become, and in general continues to be, the most reliable single producer of revenue to the vast majority of the Mennonite farmers in Mexico. It frequently becomes the sole avenue of earning when field crops fail." (Sawatzky 1971, p. 141)

#### Statement of the Problem

The purpose of this study was to compare the agricultural practices used by the Mennonite and non-Mennonite farmers in Chihuahua, Mexico, relative to the production of corn (*Zea mays* L.), beans (*Phaseolus* spp.), and dairy milk.

#### Research Questions

Answers to the following questions were sought:

1. Do the Mennonites and non-Mennonites differ significantly in their family and total farm sizes and in hectarages of corn, beans, and pasture grown?

2. Do the Mennonites and non-Mennonites differ significantly in the extent of mechanization on their farms?

3. Do the Mennonites and non-Mennonites differ significantly in the application of soil-related practices on their farms?

4. Do the Mennonites and non-Mennonites differ significantly in the application of agricultural practices concerning corn and bean production on their farms?

5. Do the Mennonites and non-Mennonites differ significantly in their plant protection practices.

6. Do the Mennonites and non-Mennonites differ significantly in seeking advice for crop problems?

7. Do the Mennonites and non-Mennonites differ significantly in the amount of human labor input on their farms?

8. Do the Mennonites and non-Mennonites differ significantly in the corn and bean yields of their farms?

9. Do the Mennonites and non-Mennonites differ significantly in their agricultural practices and yields concerning dairy milk production?

10. Do the Mennonites and non-Mennonites differ significantly in feeding and treatments of dairy cows?

### Limitations

The following factors are potential threats to the internal and external validity of the study and as such, they might affect the validity and the generalizability of the reported results.

1. The cultural and educational background of the surveyed farmers might have influenced their answers.

2. The selected farmers might not have been representative for the population, because simple random sampling technique was not used.

3. The farmers might have tried to "help" the investigator by providing answers they thought were anticipated. To minimize this threat, the investigator explained the purpose of the study and asked for factual information.

4. Most non-Mennonite respondents were "ejido" farmers who do not own their land. This might have limited the comparability to land-owning Mennonite farmers.

5. Non-response was anticipated to be a factor limiting generalizability of the findings. The investigator administered the questionnaire personally, and assured anonymous treatment of the data.

6. This study was delimited to the responses received from the sample in the summer of 1985 in the Bustillo Valley and its surroundings in the state of Chihuahua, Mexico. The study was delimited by the type of response received when using an interview schedule.

### Definitions

1. Mennonite farmer:

A full-time farmer belonging to the Mennonite Church, and living in the study area.

2. Non-Mennonite farmer:

A full-time farmer not belonging to nor affiliated with the Mennonite Church, and living in the study area.

3. Agricultural practices:

Actions carried out by the farmer relative to growing corn and beans and to dairy milk production.

3. Dairy cow:

A cow that is kept for the purpose of milk production.

### Assumptions

The investigator conducted this study based on the following assumptions:

1. The investigator assumed that the Mennonite and non-Mennonite farmers provided true and unbiased answers.

2. The investigator assumed that the method of using an interview schedule to research agricultural practices was appropriate and served the purpose sought.

### Procedure

The procedure was subdivided into the following sections: design, population and sample, collection of data, and data analysis.

#### Design

This was a descriptive survey study utilizing a personal interview technique.

#### Population and sample

The target population consisted of all Mennonite and non-Mennonite farmers in the Bustillo Valley and its surroundings in the state of Chihuahua, Mexico, in 1985.

The nonprobability sample consisted of forty farmers, twenty from the Mennonite community and twenty from the non-Mennonites. The sampling unit was one farmer.

Mr. Philip Dyck, an agronomist working for the experiment farm in Cuauhtemoc, and Mr. Jaime Delgado, an agronomist working for the National Bank of Mexico, assisted in selecting the purposive sample. These persons knew many farmers in the area and suggested representative individuals who would be willing to cooperate.

#### Collection of data

An interview schedule was used to survey the above farmers. It had been developed specifically for this

purpose. It was field tested prior to interviewing. It was administered personally by the investigator. The anonymity of the farmers and confidential treatment of the results was assured.

#### Data analysis

The data accumulated from the research questions were quantified and analysed statistically using a computer in order to determine if significant differences existed between the Mennonites and non-Mennonites according to the research questions. Chi-square tests and T-tests were applied. The yields for corn and beans were recorded in kg/ha and for milk production in kg per cow per day.

## CHAPTER 2

### LITERATURE REVIEW

This chapter traces the history of the Mexican Mennonites with special attention to their agriculture.

The literature about Mennonites mostly deals with their religion, history, and migrations. In all of these sources, however, it is emphasized that from the early beginnings, the Mennonites' way of life has been farming, and the development of their reputation for being extraordinarily good farmers is described by most authors. Despite this recognition of the importance of agriculture to the Mennonites and their specific success with it, their agricultural system has not been studied, except by Hall (1974), who wrote a dissertation about the Mennonite colony in Belize.

The literature about the Mennonites in Mexico is also scarce. Only three books, one dissertation, and one thesis could be found dealing exclusively with them.

#### Brief History of the Mennonites

The Mennonites emerged from the Anabaptist movement, the most radical wing of the Protestant

Reformation in the beginning of the sixteenth century. The Anabaptists' early fundamentals were believer's baptism instead of infant baptism, life of discipleship, and nonresistance.

From the very beginning, the Anabaptists were persecuted, because they disrupted the church - state unity, believing in a voluntary church membership.

The Anabaptist movement consisted of a multitude of small groups, many of which the Dutchman Menno Simons, a converted Roman Catholic priest, united under the motto of passiveness and civil obedience, except in the case of swearing an oath (Epp 1974). These groups came to be called Mennonites. Other groups followed Jakob Ammann, who believed in strict avoidance ("shunning") of expelled church members (Gingerich 1939); they were to be called Amish or Amish-Mennonites.

These two groups can probably be regarded here as one category, which explains the same claims of innovations in agriculture by different authors. They have in common "a love for land and for large families" (Epp 1974, p. 81). Maintaining the self-sufficient, agrarian lifestyle under ongoing persecution, they educated their children accordingly. "The sons all became farmers like the fathers. The daughters all learned to milk cows, to plant vegetable gardens, to weave wool, to spin flax, and sew their own clothes" (Epp 1974, p. 81).

The peculiar Amish dress code and beard fashion developed after their immigration (1714 to 1840) to America. The Amish separated themselves from the world around them even more than the Mennonites in outward appearance and by continuing to farm with horses instead of adopting tractors.

Many Anabaptists fled to eastern territories (Prussia), where they earned respect as good laborers and were granted full land rights (Epp 1974). The Amish were banished from land ownership, they only secured marginal or mountainous land and saw themselves forced to improve the poor soil's fertility. "They became the first in central Europe to try new methods of fertilization, cattle feeding, and fodder cultivation", as well as crop rotation (Schwieder and Schwieder 1975, p. 14).

The Swiss and Swiss-Palatine Mennonites are said to have been "the first to introduce such practices as crop rotation, use of animal manure and lime for fertilizers, and legumes to enrich the soil" (Epp 1974, p. 76).

Under the constant pressure of religious intolerance and land hunger, Swiss-German Mennonites migrated to America and founded Germantown in Pennsylvania in 1683. From there they spread to Ohio, Virginia, Maryland, Indiana, Illinois, and Iowa.

Refraining from proselytizing, and being conservative in religious and personal matters, the Mennonites have been progressive adopters of new farm machines and methods. They prospered under extremely difficult circumstances by using superior farming methods. According to Gingerich, they were also known for raising the best dairy herds in Iowa. By 1938, they had been testing their cattle for tuberculosis for over twenty years. In 1893, one of the first Mennonite cheese and butter factories established high standards by accepting only perfectly sweet, fresh milk, that had not been kept overnight in the cow stable, exposed to flies, or frozen (Gingerich 1939).

Mennonite farmsteads, buildings, fields, gardens, and fences were always neat and clean and proved the owner's prosperity and pride. Honesty, industry, and thrift distinguished the Mennonite's character. Wherever they settled, they contributed to moral, ethical, and spiritual values, as well as to the economy of the region.

#### The Origin of the Mennonites in Mexico

Dutch and North-German Mennonites migrated from Prussia to Russia at the invitation of the Tsarina Catherine the Great. About 10,000 Mennonites left Prussia because Frederick the Great mobilized for war (Seven Years War 1756 to 1763); they settled around the Dnieper River

north of the Black Sea, and in the Middle Volga area (Epp 1974). "In Russia the Mennonites developed the most advanced system practiced by the farmers of that nation. During the latter part of the 19th century their model farms, with the latest equipment and advanced techniques of cattle and crop production, brought them a world-wide reputation of being progressive farmers." (Minnich 1970, p. 6/15)

In 1870, Tsar Alexander II announced compulsory military training, implying that nonconformists could emigrate within ten years. Epp (1974) concludes that loss of cultural autonomy, introduction of Russian as official language in the schools and the prospect of future land redistribution marked the end of a century of peaceful, privileged Mennonite settlement in Russia.

At this time, many Mennonites prepared for emigration to Turkestan, Palestine, Australia, and the Americas. Epp (1974) relates that one third of the 50,000 Mennonites in Russia left for North America. Canadian and American agents and Mennonite leaders competed for good agricultural immigrants. Consul Zohrab of Canada saw the Mennonites and other Germans as a "valuable acquisition". He added, "...they are not only much greater proficients in agriculture than the native population, and consequently produce heavier crops and finer qualities but they are very hard working and, therefore, ... they bring a much

larger quantity of land under cultivation and thus increase the production of the country." (Epp 1974, p. 186)

The Canadian government offered free 160-acre homesteads in compact blocks in Manitoba, complete exemption from military service, full exercise of religious principles and education, and the right to affirm instead of swearing (Epp 1974).

Although the United States' offer was not as liberal, the majority of Russian Mennonites preferred to settle there for the more fertile land. The ones who stressed religious liberty settled in Canada.

Western Canada was opened to settlement by these Mennonites who first demonstrated the practicality of farming the open prairie. The early years (1874/5) were characterized by crude agricultural methods and crop failures because of grasshoppers and early frosts. But in 1877, government officials already described Mennonite settlements as "show places for what could and should be done with the untamed west" (Epp 1974, p. 217).

Grain surplus was first produced in 1883. Dairy and poultry products provided cash income for women and children. The poultry was protected from hawks, wolves, and foxes in the villages, and they produced well in the heat of the stables.

The villages were planted with rows of trees, and dahlias and roses beautified them, ever-blooming potted roses were also sold for additional income. Cheese factories, mills, tanneries, machine shops, lumber yards, and general stores were founded in trading centers along the railroads and modified the self-contained village life.

The Mennonites set up their own schools, but the government tried to assimilate the immigrants through public schools. World War I brought about a general anti-German attitude, which was manifested in the struggle for independent German speaking Mennonite schools. The government insisted that all Mennonite children attend public schools where German was not to be taught. But the most conservative Mennonites "regarded the German language as an integral part of their religious faith" (Smith 1957, p. 708). "The public school pointed to Anglo-Canadianism rather than German Mennonitism, to urbanization rather than the rural life, to militarism rather than pacifism, to ostentation rather than the simple lifestyle they and their ancestors in faith had always advocated." (Epp 1982, p. 100)

In 1919, the very conservative Altkolonier (Old Colony) Mennonites decided to emigrate from Canada in order to preserve their culture. Delegates were sent to

South America and Mexico. The difficult decision, to leave their prosperous farms and secure existence in Canada, was not made easier by the delegation's descriptions of the poverty and social conditions in Mexico. On the other hand, Mexico was the only country that granted the "Privilegium", exemption from military service and school freedom. The constitution of 1917 "provided all the guarantees they desired without special legislation" (Smith 1957, p. 709). The constitution provided for voluntary military service, school laws were liberal, there was no restriction against any foreign language in schools or churches, and court procedure did not demand an oath (Smith 1957).

Furthermore, land was available at reasonable prices and in large blocks, accomodating all prospective immigrants together in one area.

The Mexican government was anxious to settle the uncultivated lands with Mennonites who could "serve...as model farmers to the less thrifty and efficient native peons" (Smith 1957, p. 710).

In 1921, Mennonites purchased 230,000 acres for \$ 8.25/acre in the state of Chihuahua (Epp 1982). From 1922 to 1926, nearly 6,000 Mennonites migrated from Canada to Mexico.

## Geography and Climate of Mennonite Colonies in Chihuahua

The Mennonite colonies are situated in the Bustillo Valley, at an elevation of 6500 to 7500 feet, in the upland and basin country of the eastern flank of the Sierra Madre Occidental. It is a typical enclosed drainage basin, with the saline lake Bustillos occupying the lowest portion.

The soil consists of alluvial materials with varying textures, sandy loams low in humus.

The climate is continental, semiarid with a summer precipitation maximum, low humidity, high evaporation, intense sun, and large seasonal and daily temperature variations. Sporadically, in winter, cyclonic storms bring widespread precipitation, usually as rain. Snow occurs only for a few days each year. But the rainy season from July to September brings the most rain in the form of localized, patchy, convectional showers of erratic distribution, associated with extreme levels of electrical phenomena and often hail.

The annual areal and time distribution of precipitation is highly unpredictable, and precipitation amounts fluctuate by as much as 50 percent above or below the mean. Thirteen inches of rain was the mean from 1953 to 1964, according to Mennonite records.

The mean annual temperature of Cuauhtemoc, the town just south of the Mennonite colony, is 60.5 F. The reliable frost-free period that can be used under dry-farming practices is little more than 100 days.

The environmental conditions in Mexico were very different from those of the steppes and prairies where the Mennonites' agricultural system had evolved. But they quickly adapted their farming practices to the new conditions. Nowadays, the field work is made easier by mechanization. The Mexican Mennonite Colony farmer usually has a three-crop rotation: corn, oats, beans. These are also the main crops. Traditionally, the Mennonite farm produces milk, eggs, and meat for family consumption, too. Despite the harsh environment, in a few years, the barren desert had been transformed into prosperous villages and fields and pastures with fine livestock (Smith 1957).

Under the protection of the Mexican government's "Privilegium", the Mennonites in Chihuahua have been able to preserve their religious and cultural values and their agrarian way of life.

## CHAPTER 3

### PROCEDURE

The procedure of the study was subdivided into the following sections: design, population and sample, collection of data, and data analysis.

#### Design

This was a descriptive survey study utilizing a personal interview technique. The investigator used an interview schedule for collection of the data.

#### Population and Sample

The target populations consisted of all Mennonite and non-Mennonite farmers in the Bustillo Valley and its surroundings in the state of Chihuahua, Mexico, during 1985. The accessible populations were the Mennonite farmers in the southern part of the Mennonite colony, and the non-Mennonite farmers south of the Mennonite colony as well as the non-Mennonite farmers in the village of Pena Blanca north of the Mennonite colony.

The sample consisted of forty farmers, twenty from the Mennonite community and twenty from the non-Mennonites. The sampling unit was one farmer.

### Collection of Data

In order to gather the data for this study, the investigator traveled to Mexico in June/July 1985. Mr. Jaime Delgado, an agronomist working for the National Bank of Mexico in the village of Pena Blanca, north of the Mennonite colony, facilitated arrival and introduction to the Mennonite community through Mr. Peter Reimer, a Mennonite who owns a small factory for manufacturing agricultural implements. Mr. Delgado also assisted in selecting the sample of non-Mennonite farmers in the village of Pena Blanca, and in translation.

Mr. Philip Dyck, a Canadian-born Mennonite, is the grain specialist for the INIA (National Agricultural Research Institute) experiment farm in Cuauhtemoc, just south of the Mennonite colony. He facilitated the interviews with the Mennonite farmers.

The selection of the sample was not done by simple random sampling techniques, as originally planned. Random sampling could not be carried out due to time constraints and lack of information on which to base it. Upon arrival in the Mennonite colony, the investigator could not gain access to lists of farmers' names, as these were only kept by the church in confidentiality. Telephone book listings could not be considered because very few Mennonites had a telephone. Instead, a purposive sample was created with

the assistance of Mr. Dyck, who introduced to the investigator farmers representative of the area and thought to be willing to cooperate. It was decided to interview one or two farmers in each of the villages that were easily accessible in the south of the Mennonite colony. The selection of the first half of the sample of non-Mennonite farmers was done in this manner, too, selecting representative farmers in the small villages that were accessible south of the Mennonite colony. The selection of the second half of the sample of non-Mennonite farmers in the village of Pena Blanca, north of the Mennonite colony, was based on the availability of the farmers for interviewing, after Mr. Delgado had notified a number of representative farmers of the study.

The interview schedule (Appendix 1) that was used in this study was developed specifically for this purpose and administered personally by the investigator, using a German translation for interviewing the Mennonites and a Spanish one for interviewing the non-Mennonite Mexican farmers. The farmers' anonymity and confidential treatment of the results was assured.

### Data Analysis

The data were collected by means of an interview schedule through personal interviews of the Mennonite and non-Mennonite respondents. The data were tabulated on separate master sheets for each group of respondents. The frequency and percentage of responses to each question were then calculated.

Statistical calculations using chi-square and t-tests were run for selected items in an attempt to determine similarities, relationships and/or differences between the two samples.

## CHAPTER 4

### FINDINGS

This chapter presents the answers to the research questions, comparing agricultural methods concerning corn, beans, and milk production of Mennonite and non-Mennonite farmers in Chihuahua, Mexico. These data were obtained by means of personal interviews in July 1985. From the original sample of twenty in each group, nineteen Mennonites and seventeen non-Mennonites were interviewed. One Mennonite was not available for interviewing. Three non-Mennonites could not be interviewed due to other circumstances.

Each research question as stated in Chapter one is repeated here, followed by its respective answer.

1. Do the Mennonites and non-Mennonites differ significantly in their family and total farm sizes and in hectarages of corn, beans, and pasture grown?

To compare the background of the two groups, their family and total farm sizes and hectarages of corn, beans, and pasture grown were investigated.

The mean numbers of family members living at home was 7.4 for the Mennonites and 6.3 for the non-Mennonites. While family size was not greatly different, it appeared that more of the Mennonites' family members were engaged in farm work (see Table 11, page 40).

As Table 1 shows, the mean total farm sizes of 97 hectares for Mennonites and 116 hectares for non-Mennonites were not significantly different, nor were the mean sizes of cultivated land of 93 hectares for Mennonites and 71 hectares for non-Mennonites. It should be noted that 95 percent (93 out of 97 ha) of the Mennonites' total farm size was cultivated as compared to 62 percent (71 out of 116 ha) of the non-Mennonites' total farm size. The Mennonites cultivated all their land with the exception of the space occupied by farm buildings and yard or washes (seasonal streams). The Mennonites included pasture as cultivated land, whereas the non-Mennonites did not include their pasture as cultivated land.

The hectarages of rainfed and irrigated corn and beans were very similar for the two groups. Corn and bean hectarages in the research area were almost entirely rainfed. As calculated from data shown in Table 1, as little as 4 percent of the Mennonites' and 1.6 percent of the non-Mennonites' corn fields were irrigated. Less than 2 percent of the Mennonites' and none of the non-Mennonites' bean fields were irrigated.

Table 1. Mean hectares of land devoted to farm use by Mennonite and non-Mennonite respondents in Chihuahua, Mexico, in 1985.

|                                | Hectares            |                          |
|--------------------------------|---------------------|--------------------------|
|                                | Mennonites*<br>N=19 | non-Mennonites**<br>N=17 |
| Total farm size                | 97                  | 116                      |
| Cultivated land                | 93                  | 71                       |
| Corn total                     | 25                  | 25                       |
| - rainfed                      | 24                  | 24.6                     |
| - irrigated                    | 1                   | 0.4                      |
| Beans total                    | 10.6                | 9                        |
| - rainfed                      | 10.4                | 9                        |
| - irrigated                    | 0.2                 | 0                        |
| Pasture total<br>(all rainfed) | 10.4                | 50.2                     |

t-value for total farm size = 0.35

t-value for cultivated land = 0.83

t-value at 0.05 significance level and 34 df = 2.03

df = degrees of freedom

\* = family size = 7.4

\*\* = family size = 6.3

2. Do the Mennonites and non-Mennonites differ significantly in the extent of mechanization on their farms?

The extent of mechanization is shown in Table 2. It appears that the Mennonites owned more mechanical implements than the non-Mennonites. Their obviously higher rates of ownership of manure spreaders, hammer mills, seed drills, combine harvesters, and threshers might be explained by the fact that some non-Mennonites did not own these implements because they had access to state-owned equipment or that the non-Mennonites used other implements instead, e.g. pitchfork instead of manure spreader.

3. Do the Mennonites and non-Mennonites differ significantly in the application of soil-related practices on their farms?

Data pertaining to soil-related practices which included the categories of soil improvement and soil preparation are shown in Tables 3 and 4.

Soil improvement practices quantified included manure use, ploughing under of residues, and yearly crop rotation (Table 3). Although more Mennonites than non-Mennonites used each of these practices, there was no significant difference in the application of these soil improvement practices.

Table 2. Percentages of Mennonites and non-Mennonites owning mechanical farm implements.

| Implement            | Mennonites       | non-Mennonites   |
|----------------------|------------------|------------------|
|                      | <u>N=19</u><br>% | <u>N=17</u><br>% |
| Tractor              | 100              | 100              |
| Cultivator           | 95               | 94               |
| Rotary hoe           | 11               | 47               |
| Blade hoe            | 16               | 67               |
| Manure spreader      | 89               | 6                |
| Bailer/bundle binder | 47               | 35               |
| Sprayer              | 44               | 47               |
| Hammer mill          | 100              | 53               |
| Hay bailer/press     | 47               | 59               |
| Plow                 | 95               | 82               |
| Harrow               | 74               | 82               |
| Seed drill           | 95               | 41               |
| Planter              | 79               | 88               |
| Grinder              | 5                | 24               |
| Sheller              | 11               | 38               |
| Combine harvester    | 37               | 12               |
| Thresher             | 32               | 0                |
| Irrigation equipment | 21               | 12               |

Table 3. Numbers and percentages of Mennonites and non-Mennonites applying selected soil improvement practices.

| Questions                       | Mennonites<br>N=19 |     | non-Mennonites<br>N=17 |    |
|---------------------------------|--------------------|-----|------------------------|----|
|                                 | No.                | %   | No.                    | %  |
| Do you use manure?              | 19                 | 100 | 13                     | 76 |
| Do you plough under residues?   | 19                 | 100 | 15                     | 88 |
| Do you rotate crops every year? | 17                 | 89  | 9                      | 53 |

chi-square for soil improvement practices = 1.970  
 chi-square at 0.05 significance level and 2 df = 5.991

df = degrees of freedom

Table 4. Numbers and percentages of Mennonites and non-Mennonites applying selected soil preparation practices.

| Questions                     | Mennonites<br>N=19 |     | non-Mennonites<br>N=17 |     |
|-------------------------------|--------------------|-----|------------------------|-----|
|                               | No.                | %   | No.                    | %   |
| Do you plough?                | 19                 | 100 | 17                     | 100 |
| Do you disk?                  | 18                 | 89  | 17                     | 100 |
| Do you fertilize at planting? | 19                 | 100 | 15                     | 88  |

chi-square for soil preparation practices = 0.156  
 chi-square at 0.05 significance level and 2 df = 5.991

df = degrees of freedom

Other soil improvement practices investigated, but not presented in Table 3, included cultivating, fertilizing, removing stones, ploughing under straw, incorporating nematocidé, and testing fertilizer. Taken together, 37 percent of the Mennonites and 35 percent of the non-Mennonites applied these practices. Subsoil ploughing was not always appropriate. Legumes were not planted by any of the interviewees for soil improvement, and although some had conducted soil analysis, no soil amendments were applied.

Soil preparation practices quantified included ploughing, disking, and fertilizing at planting. These were done by nearly all interviewees and there was no significant difference between the Mennonites and non-Mennonites in the application of soil preparation practices (Table 4).

4. Do the Mennonites and non-Mennonites differ significantly in the application of agricultural practices concerning corn and bean production on their farms?

Data pertaining to agricultural practices concerning corn and beans are shown in Tables 5,6 and 7. The practices selected for study were planting time and method, seed usage, weed control, harvesting time and method.

Table 5. Planting and harvesting times reported by Mennonites and non-Mennonites.

| Activities       | Mennonites<br>N=18 | non-Mennonites<br>N=17 |
|------------------|--------------------|------------------------|
| Planting Corn    | May/June           | April/May              |
| Harvesting Corn  | Oct/Nov/Dec        | Oct/Nov/Dec            |
| Planting Beans   | June/July          | June/July              |
| Harvesting Beans | Oct/Nov            | Oct/Nov                |

Table 6. Numbers and percentages of Mennonites and non-Mennonites reported seed usage.

| Crop  | usage                         | Mennonites<br>N=18 |    | non-Mennonites<br>N=17 |    |
|-------|-------------------------------|--------------------|----|------------------------|----|
|       |                               | No.                | %  | No.                    | %  |
| Corn  | Seed from last year's harvest | 4                  | 22 | 5                      | 29 |
|       | Selected seed                 | 6                  | 33 | 13                     | 76 |
|       | Hybrid seed                   | 12                 | 67 | 2                      | 12 |
| Beans | Seed from last year's harvest | 15                 | 83 | 5*                     | 38 |
|       | Selected seed                 | 5                  | 28 | 9*                     | 69 |
|       | Hybrid seed                   | 0                  | 0  | 0*                     | 0  |

chi-square for corn seed usage = 9.919

chi-square for bean seed usage = 5.132

chi-square at 2 df and 0.05 significance level = 5.991

df = degrees of freedom

\* = number of respondents = 13

Table 7. Numbers and percentages of Mennonites and non-Mennonites reporting weed control practices.

| Crop  | practice   | Mennonites<br>N=19 |     | non-Mennonites<br>N=17 |     |
|-------|------------|--------------------|-----|------------------------|-----|
|       |            | No.                | %   | No.                    | %   |
| Corn  | by hand    | 6                  | 33  | 13                     | 76  |
|       | mechanical | 18                 | 100 | 17                     | 100 |
|       | chemical   | 13                 | 72  | 3                      | 18  |
| Beans | by hand    | 17                 | 94  | 13*                    | 100 |
|       | mechanical | 18                 | 100 | 11*                    | 85  |
|       | chemical   | 1                  | 6   | 0*                     | 0   |

chi-square for corn weed control practices = 8.489  
 chi-square for bean weed control practices = 0.858  
 chi-square at 0.05 significance level and 2 df = 5.991

df = degrees of freedom

\* = number of respondents = 13

Planting time: The planting months for corn were May/June (Mennonites) and April/May (non-Mennonites). The planting months for beans were June/July for both groups (see table 5). The planting times showed no major differences.

Planting method: The planting method for corn and beans was 100 percent by mechanical planter for both groups (not shown in a table).

Seed usage: The findings about the kinds of seeds that were used show that there was a significant difference in the type of corn seed usage (Table 6): 67 percent of the Mennonites used hybrid corn seed, as against 12 percent of the non-Mennonites. Seventy-six percent of the non-Mennonites used selected seed, as against 33 percent of the Mennonites.

There was no significant difference in the type of bean seed usage (Table 6).

Weed control: The findings on weed control (Table 7) reveal a significant difference in the weed control for corn: It was found that 72 percent of the Mennonites controlled weeds chemically, as against 18 percent of the non-Mennonites. Seventy-six percent of the non-Mennonites controlled weeds by hand, as against 33 percent of the Mennonites.

There was no significant difference in the weed control for beans (Table 7).

Harvesting: The harvest months for corn were October, November, December for both groups, with November quoted most often. The harvest months for beans were September, October, November for Mennonites, with October quoted most often, and October, November, quoted equally often, for non-Mennonites (see Table 5).

The harvesting methods for corn were significantly different between the two groups. It was found that 83 percent of the Mennonites used machines, as against 35 percent of the non-Mennonites. Eighty-eight percent of the non-Mennonites used manual labor, as against 44 percent of the Mennonites (see Table 8).

The harvesting methods for beans, by hand and by machine, were not significantly different for either group.

5. Do the Mennonites and non-Mennonites differ significantly in their plant protection practices?

Plant protection practices selected for study were use of insecticides and rodenticides, other rodent control, and bird control (see Table 9). No significant difference was found in their application between the Mennonites and non-Mennonites.

Table 8. Numbers and percentages of Mennonites and non-Mennonites reporting harvesting methods.

| Crop  | Harvesting method | Mennonites<br>N=19 |    | non-Mennonites<br>N=17 |    |
|-------|-------------------|--------------------|----|------------------------|----|
|       |                   | No.                | %  | No.                    | %  |
| Corn  | hand              | 8                  | 44 | 15                     | 88 |
|       | machine           | 15                 | 83 | 6                      | 35 |
|       | animals           | 2                  | 11 | 6                      | 35 |
| Beans | hand              | 14                 | 78 | 11*                    | 85 |
|       | machine           | 16                 | 89 | 12*                    | 92 |
|       | animals           | 0                  | 0  | 0*                     | 0  |

chi-square for corn harvest methods = 7.878

chi-square for bean harvest methods = 0.013

chi-square at 0.05 significance level and 2 df = 5.991

df = degrees of freedom

\* = number of respondents = 13

Table 9. Numbers and percentages of Mennonites and non-Mennonites using selected plant protection practices.

| Questions                        | Mennonites |     |    | non-Mennonites |     |    |
|----------------------------------|------------|-----|----|----------------|-----|----|
|                                  | N          | No. | %  | N              | No. | %  |
| Do you use insecticides?         | 19         | 18  | 95 | 16             | 14  | 88 |
| Do you use rodenticides?         | 19         | 0   | 0  | 15             | 4   | 27 |
| Other method to control rodents? | 19         | 3   | 16 | 15             | 5   | 33 |
| Do you try to control birds?     | 19         | 1   | 5  | 15             | 2   | 13 |

chi-square for plant protection practices = 5.208  
 chi-square at 0.05 significance level and 3 df = 7.815

df = degrees of freedom

6. Do the Mennonites and non-Mennonites differ significantly in seeking advice for crop problems?

As data in Table 10 indicate, a significant difference was found between the Mennonites and non-Mennonites in the sources they used in seeking information about crop problems. The sources were: respected farmer, chemical company, bank agronomist, extension service, experimental farm, private agricultural consultant. Most Mennonites consulted a chemical company (89%), a respected farmer (78%), and the experimental farm (67%), whereas the non-Mennonites consulted the bank agronomist (75%) and a chemical company (75%). The choice of sources of advice seemed to have been influenced by their availability.

7. Do the Mennonites and non-Mennonites differ significantly in the amount of human labor input on their farms?

As shown in Table 11, the yearly averages of working days per week were not significantly different with 5.9 days for Mennonites and 5.3 days for non-Mennonites. The yearly averages of working hours per day, though, were found to be significantly different with 10.4 hours for Mennonites and 8.2 hours for non-Mennonites.

In contrast to the non-Mennonites, Mennonites used more unpaid labor (family), and in addition, they hired more paid laborers who worked all year.

Table 10. Numbers and percentages of Mennonites and non-Mennonites reporting sources of advice for crop problems.

| Source                          | Mennonites<br>N=19 |    | non-Mennonites<br>N=17 |    |
|---------------------------------|--------------------|----|------------------------|----|
|                                 | No.                | %  | No.                    | %  |
| Respected farmer                | 14                 | 78 | 5                      | 31 |
| Chemical company                | 16                 | 89 | 12                     | 75 |
| Bank agronomist                 | 6                  | 33 | 12                     | 75 |
| Extension service               | 7                  | 39 | 5                      | 31 |
| Experimental farm               | 12                 | 67 | 2                      | 13 |
| Private agricultural consultant | 3                  | 17 | 0                      | 0  |

chi-square for sources of advice for crop problems = 12.825  
 chi-square at 0.05 significance level and 5 df = 11.070

df = degrees of freedom

Table 11. Human labor input on Mennonites' and non-Mennonites' farms.

| Labor<br>Yearly means                | Mennonites<br>N=19 | non-Mennonites<br>N=17 |
|--------------------------------------|--------------------|------------------------|
| Days worked/week                     | 5.9                | 5.3                    |
| Hours worked/day                     | 10.4               | 8.2                    |
| Unpaid laborers<br>(except self)     | 1.4                | 0.9                    |
| Paid laborers<br>(employed all year) | 0.7                | 0.5                    |

t-value for hours worked/day, yearly mean = 3.76  
t-value at 0.05 significance level and 33 df = 2.03

df = degrees of freedom

Table 12. Mean yields in kilogram per hectare on Mennonites' and non-Mennonites' farms.

| Yield | <u>Mennonites</u> |      | <u>non-Mennonites</u> |      |
|-------|-------------------|------|-----------------------|------|
|       | N                 | kg   | N                     | kg   |
| Corn  | 13                | 1815 | 15                    | 1367 |
| Bean  | 17                | 1024 | 12                    | 717  |

t-value for corn yield = 2.430  
t-value at 0.05 significance level and 26 df = 2.056

t-value for bean yield = 2.776  
t-value at 0.05 significance level and 27 df = 2.052

df = degrees of freedom

8. Do the Mennonites and non-Mennonites differ significantly in the corn and bean yields of their farms?

Significant differences were found between Mennonites and non-Mennonites in both the corn and bean yields of their farms (Table 12).

The average corn yield of the Mennonite farm was 1815 kg/ha. This was significantly higher than that of the non-Mennonite farm which was 1367 kg/ha. The average bean yield of the Mennonite farm was 1024 kg/ha. This was significantly higher than that of the non-Mennonite farm which was 717 kg/ha.

9. Do the Mennonites and non-Mennonites differ significantly in their agricultural practices and yields concerning dairy milk production?

No significant difference between dairy milk yields was found (see Table 13). The cows on Mennonite farms yielded 10.5 kg, the cows on non-Mennonite farms yielded 9.0 kg of milk per day.

There was a significant difference between the breed of cows: 89 percent of the Mennonites had pure bred cows as compared to 17 percent of the non-Mennonites (Table 14). One Mennonite said that he had cows of native breed, the others declared their cows to be pure bred (Holstein). Four of the non-Mennonite farmers described their cows as crossbred (Criolla X Holstein), one said that he owned native breed and pure bred cows.

The following data concerning numbers and milking of cows were calculated from the research and are not shown in a table: Dairy cows are a typical part of the Mennonite farm. Only one of the 19 interviewed Mennonites had no dairy cows. The other 18 respondents had a mean of 10.2 cows. Of these, 6.9 were lactating at any given time. Five of seventeen interviewed non-Mennonites (29%) had no dairy cows. Seven non-Mennonites had cows for other purposes. The remaining five non-Mennonites had a mean of 14.4 cows, of which 10 were lactating at any given time. All Mennonite and non-Mennonite dairy farmers milked their cows twice a day (94% of the Mennonites and 80% of the non-Mennonites milked by hand and 17% and 20%, respectively, milked by machine).

10. Do the Mennonites and non-Mennonites differ significantly in feeding and veterinary practices concerning dairy cows?

Table 15 illustrates the answers about the different kinds of feeds. Grain and pasture were the main feeds; there was no significant difference in cow feeding.

Table 16 features various veterinary practices concerning dairy cows. Although more Mennonites used bulls of other herds for breeding their cows and consulted veterinarians, there was no significant difference in the occurrence of these veterinary practices.

Table 13. Quantity of dairy milk production in kilogram on Mennonites' and non-Mennonites' farms.

| Quantities                        | <u>Mennonites</u> |  | <u>non-Mennonites</u> |  |
|-----------------------------------|-------------------|--|-----------------------|--|
|                                   | N=16              |  | N=5                   |  |
| Mean quantity of milk/cow/day, kg | 10.5              |  | 9.0                   |  |
| Total quantity of milk/day, kg    | 78.6              |  | 92.0                  |  |

t-value for mean quantity of milk/cow/day = 1.330  
t-value for total quantity of milk/day = 0.115  
t-value at 0.05 significance level and 19 df = 2.093

df = degrees of freedom

Table 14. Numbers and percentages of Mennonites and non-Mennonites reporting cow breeds.

| Types of cattle (owned) | <u>Mennonites</u> |     |    | <u>non-Mennonites</u> |     |    |
|-------------------------|-------------------|-----|----|-----------------------|-----|----|
|                         | N                 | No. | %  | N                     | No. | %  |
| Cows of native breed    | 18                | 1   | 6  | 12                    | 6   | 50 |
| Pure bred cows          | 18                | 17  | 89 | 12                    | 2   | 17 |
| Cross bred cows         | 18                | 0   | 0  | 12                    | 4   | 33 |

chi-square for cow breed = 16.296  
chi-square at 0.05 significance level and 2 df = 5.991

df = degrees of freedom

Table 15. Numbers and percentages of Mennonites and non-Mennonites reporting use of selected feeds for dairy cows on their farms.

| Feed       | Mennonites<br>N=18 |     | non-Mennonites<br>N=12 |     |
|------------|--------------------|-----|------------------------|-----|
|            | No.                | %   | No.                    | %   |
| Pasture    | 12                 | 67  | 12                     | 100 |
| Green feed | 5                  | 28  | 1                      | 8   |
| Silage     | 4                  | 22  | 1                      | 8   |
| Hay        | 3                  | 17  | 4                      | 33  |
| Grain      | 18                 | 100 | 12                     | 100 |

chi-square for feeds = 3.968

chi-square at 0.05 significance level and 4 df = 9.488

df = degrees of freedom

Table 16. Numbers and percentages of Mennonites and non-Mennonites reporting use of selected veterinary practices for dairy cows on their farms.

| Veterinary practice     | Mennonites<br>N=18 |     | non-Mennonites<br>N=12 |    |
|-------------------------|--------------------|-----|------------------------|----|
|                         | No.                | %   | No.                    | %  |
| Artificial insemination | 0                  | 0   | 0                      | 0  |
| Bull of other herd      | 14                 | 78  | 4*                     | 36 |
| Government veterinarian | 6                  | 33  | 0                      | 0  |
| Private veterinarian    | 18                 | 100 | 6                      | 50 |
| Vaccinations            | 18                 | 100 | 10                     | 83 |
| Medicines               | 18                 | 100 | 11                     | 92 |
| Supplements             | 13                 | 72  | 7*                     | 64 |

chi-square for veterinary practices = 4.854

chi-square at 0.05 significance level and 6 df = 12.592

df = degrees of freedom

\* = number of respondents = 11

## CHAPTER 5

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to compare the agricultural practices used by the Mennonite and non-Mennonite farmers in Chihuahua, Mexico, relative to the production of corn (*Zea mays* L.), beans (*Phaseolus* spp.), and dairy milk. Answers to the following research questions were sought:

1. Do the Mennonites and non-Mennonites differ significantly in their family and total farm sizes and in hectarages of corn, beans, and pasture grown?

2. Do the Mennonites and non-Mennonites differ significantly in the extent of mechanization on their farms?

3. Do the Mennonites and non-Mennonites differ significantly in the application of soil-related practices on their farms?

4. Do the Mennonites and non-Mennonites differ significantly in the application of agricultural practices concerning corn and bean production on their farms?

5. Do the Mennonites and non-Mennonites differ significantly in their plant protection practices?

6. Do the Mennonites and non-Mennonites differ significantly in seeking advice for crop problems?

7. Do the Mennonites and non-Mennonites differ significantly in the amount of human labor input on their farms?

8. Do the Mennonites and non-Mennonites differ significantly in the corn and bean yields of their farms?

9. Do the Mennonites and non-Mennonites differ significantly in their agricultural practices and yields concerning dairy milk production?

10. Do the Mennonites and non-Mennonites differ significantly in feeding and treatments of dairy cows?

#### Summary of Findings

The findings were summarized as follows:

1. Family and farm sizes and hectarages of corn and beans were not greatly different between Mennonites and non-Mennonites. Corn and bean fields were almost entirely rainfed.

2. Mennonites owned more mechanical farm implements than non-Mennonites.

3. Soil improvement practices (manure use, ploughing under of residues, and yearly crop rotation) were applied by more Mennonites than non-Mennonites, but the difference was not statistically significant.

Soil preparation practices (ploughing, disking, and fertilizing at planting) were applied by nearly all respondents.

4. Planting months for corn were May/June (Mennonites) and April/May (non-Mennonites). Planting months for beans were June/July for both groups. Planting method for corn and beans was 100 percent by mechanical planter for both groups.

Mennonites preferred hybrid corn seed, non-Mennonites preferred selected corn seed. Both groups used bean seed from last year's harvest and selected bean seed.

Weed control for corn was done chemically by more Mennonites than non-Mennonites, and manually by more non-Mennonites than Mennonites, as well as mechanically by both groups. Weed control for beans was done manually and mechanically by both groups.

Harvest months for corn were October, November, December for both groups, harvest months for beans were September, October, November for Mennonites and October, November for non-Mennonites. In the corn harvest, more Mennonites used machines, and more non-Mennonites used manual labor, while the bean harvest was done manually and mechanically by both groups.

5. Plant protection practices (use of insecticides, rodenticides, other rodent control, and bird control) were used in a similar manner by Mennonites and non-Mennonites. Insecticides were used by most respondents.

6. Sources of advice for crop problems for Mennonites were mainly a chemical company, a respected farmer, and the experimental farm, while for non-Mennonites, they were mainly the bank agronomist and a chemical company.

7. Mennonites worked more hours per day than non-Mennonites. Mennonites used more unpaid (family) labor and paid laborers than non-Mennonites.

8. Mennonites had significantly higher corn and bean yields than non-Mennonites.

9. Dairy milk yields were similar on Mennonites' and non-Mennonites' farms. Mennonites owned more pure bred cows than non-Mennonites, who owned more native bred and cross bred cows. Dairy cows were owned by 18 Mennonites, but only by 5 non-Mennonites.

10. Feeding of cows was similar in both groups, with grain and pasture as main feeds. Veterinary practices concerning cows were also similar in both groups.

### Conclusions

Based on the findings of this study, the following conclusions were drawn:

1. Mennonites' farms were more productive in terms of their corn and bean crop yields.

2. The Mennonites' higher corn yield may be associated with their higher usage of hybrid seed, chemical weed control and machinery.

3. The Mennonites' higher bean yield, however, cannot be associated with the same factors that were associated with higher corn yield.

4. Mennonites tend to be more intensive in their work patterns than the non-Mennonites and use more family labor. The greater labor input in a given period of time perhaps contributed to higher yields through enhanced timeliness of operations.

5. Both Mennonites and non-Mennonites reportedly produced similar quantities of milk from their dairy cows, even though the Mennonites used more pure bred animals.

#### Recommendations

These recommendations are based on the study's findings and the observations of the author:

1. The use of hybrid corn seed is recommended to the non-Mennonites in the study area.

2. The findings of this study may be interesting to agricultural extension workers, experimental farm employees, bank agronomists, and other persons engaged in agricultural consulting in the study area.

3. Because this study was limited to corn, beans, and dairy milk production, the author recommends that further research about Mennonites' and non-Mennonites' agricultural practices concerning other common crops may be of interest.

## APPENDIX 1

### INTERVIEW SCHEDULE

1. a) Number of family members living at home:  
b) Total farm size in hectare:  
c) Cultivated land in hectare:
2. Hectares  
of corn: a)total: b)rained: c)irrigated:
3. Hectares  
of beans: a)total: b)rained: c)irrigated:
4. Hectares  
of pasture: a)total: b)rained: c)irrigated:
5. Which mechanical farm implements do you own?
  - a)Tractor
  - b)Cultivator
  - c)Rotary hoe
  - d)Blade hoe
  - e)Manure spreader
  - f)Bailer/bundle binder
  - g)Sprayer
  - h)Hammer mill
  - i)Hay bailer/press
  - j)Plow
  - k)Harrow
  - l)Seed drill.
  - m)Planter
  - n)Grinder
  - o)Sheller
  - p)Combine harvester
  - q)Thresher
  - r)Irrigation equipment
6. Soil improvement practices:
  - a)Do you use manure?
  - b)Do you plough under residues?
  - c)Do you rotate crops every year?
  - d)Do you practice subsoil ploughing?
  - e)Do you plant legumes?
  - f)Do you conduct soil analysis?
  - g)Do you apply lime?
  - h)Do you apply gypsum?
  - i)Do you apply other soil amendments? (specify)
  - j)Other soil improvement practice (specify):





## APPENDIX 2

### INTERVIEW SCHEDULE, GERMAN

1. a) Anzahl der Familienmitglieder, die zuhause wohnen:  
b) Gesamtgroesse des Bauernhofes in Hektar:  
c) Bebautes Land in Hektar:
2. Hektar  
unter Mais: a)gesamt: b)Regenbau: c)bewaessert:
3. Hektar  
unter Bohnen: a)gesamt: b)Regenbau: c)bewaessert:
4. Hektar  
unter Weide: a)gesamt: b)Regenbau: c)bewaessert:
5. Welche landwirtschaftlichen Geraete und Maschinen besitzen Sie?
  - a)Trecker
  - b)Kultivator
  - c)Bodenfraese
  - d)Hackfraese
  - e)Duengerstreumaschine
  - f)Maehmaschine
  - g)Spritzgeraet
  - h)Maishaecksler
  - i)Heupresse
  - j)Pflug
  - k)Egge
  - l)Saemaschine
  - m)Pflanzmaschine
  - n)Kornmuehle
  - o)Enthuelser
  - p)Maehdreschmaschine
  - q)Dreschmaschine
  - r)Bewaesserungsausruestung
6. Bodenverbesserungsmassnahmen
  - a)Benutzen Sie Dung?
  - b)Pfluegen Sie Ernterueckstaende unter?
  - c)Betreiben Sie jedes Jahr Fruchtwechsel?
  - d)Untergrundpfluegen Sie?
  - e)Pflanzen Sie Huelsenfruechte?
  - f)Fuehren Sie Bodenanalysen durch?
  - g)Bringen Sie Kalk aus?
  - h)Bringen Sie Gips aus?
  - i)Verwenden Sie andere Bodenverbesserungszusaetze?
  - j)Sonstige Bodenverbesserungsmassnahmen? (welche?)





APPENDIX 3

INTERVIEW SCHEDULE, SPANISH

1. a) Numero de miembros familiares viviendo en casa:  
b) Tamano total del rancho/parcela, hectareas:  
c) Tierra cultivada, hectareas:
2. Hectareas  
de maiz: a)total: b)temporal: c)riego:
3. Hectareas  
de frijol: a)total: b)temporal: c)riego:
4. Hectareas  
de pastizal:a)total: b)temporal: c)riego:
5. Que maquinaria y equipo posee Ud.?  
a)Tractor  
b)Cultivadora  
c)Azadon rotatorio  
d)Rastra de discos  
e)Distribuidor de estiercol  
f)Engaviadora  
g)Aspersora  
h)Molino de martillos  
i)Empacadora  
j)Arado  
k)Rastra  
l)Sembradora de rodillos  
m)Sembradora  
n)Moledora  
o)Desgranadora  
p)Combinada  
q)Trilladora  
r)Equipo de riego
6. Practicas de mejoramiento de suelo:  
a)Usa Ud. estiercol?  
b)Incorpora residuos de cultivos?  
c)Rota los cultivos cada ano?  
d)Practica subsoleo?  
e)Siembra leguminosas?  
f)Analiza su suelo?  
g)Aplica cal?  
h)Aplica yeso?  
i)Aplica otros mejoradores de suelo? (especifique)  
j)Otras practicas de mejoramiento del suelo:



18. Mes de cosecha: a) Maiz: b) Frijol:
19. Metodo de cosecha, maiz: a) a mano  
b) con maquinaria  
c) con animales
20. Metodo de cosecha, frijol: a) a mano  
b) con maquinaria  
c) con animales
21. Rendimiento promedio por hectarea (kg): a) Maiz:  
b) Frijol:
22. Produccion lechera:
- a) Nula
  - b) Numero de vacas
  - c) Raza - criolla
  - d) Pura raza
  - e) Raza mixta
  - f) Numero de vacas en produccion
  - g) Cantidad de leche/vaca/dia (kg)
  - h) Cantidad de leche total/dia (kg)
  - i) Frecuencia de ordena/dia
  - j) Ordena a mano
  - k) Ordena con maquina
23. Alimento de vacas:
- a) Pastura
  - b) Forraje verde
  - c) Silo
  - d) Heno
  - e) Granos
24. Procedimientos veterinarios del ganado: Usa Ud.
- a) Inseminacion artificial
  - b) Semental
  - c) Veterinario empleado del gobierno
  - d) Veterinario privado
  - e) Vacunas
  - f) Medicinas para ganado
  - g) Otros (especifique)

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