

**Agricultural Economics Miscellaneous Report No. 175**

**December 1995**

**Agricultural Economics Miscellaneous Report Series**

# **A Comparison of Sustainable and Conventional Farmers in North Dakota**

**By**

**Randall S. Sell, Gary A. Goreham,  
George A. Youngs, Jr., and David L. Watt**

---

DEPARTMENT OF AGRICULTURAL ECONOMICS  
AGRICULTURAL EXPERIMENT STATION  
NORTH DAKOTA STATE UNIVERSITY  
FARGO, ND 58105-5636

---

**A Comparison of Sustainable and  
Conventional Farmers in North Dakota**

**By  
Randall S. Sell, Gary A. Goreham,  
George A. Youngs, Jr., and David L. Watt**

DEPARTMENT OF AGRICULTURAL ECONOMICS  
AGRICULTURAL EXPERIMENT STATION  
NORTH DAKOTA STATE UNIVERSITY  
FARGO, ND 58105-5636

The analyses and views reported in this paper are those of the author. They are not necessarily endorsed by the Department of Agriculture or by North Dakota State University.

North Dakota State University is committed to the policy that all persons shall have equal access to its programs, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

Information on other titles in this series may be obtained from: Department of Agricultural Economics, North Dakota State University, P.O. Box 5636, Fargo, ND 58105. Telephone: 701-231-7441, Fax: 701-231-7400, or e-mail: [cjensen@ndsuxext.nodak.edu](mailto:cjensen@ndsuxext.nodak.edu).

Copyright © 1996 by Randell S. Sell, Gary A. Goreham, George A. Youngs, Jr., and David L. Watt. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

## **A Comparison of Sustainable and Conventional Farmers in North Dakota**

### **Abstract**

Interviews and mail-out/mail-back surveys were conducted in 1992 with 38 conventional and 41 sustainable North Dakota farmers. The results emphasize the differences and similarities of these two types of farmers. Sustainable farms had more diverse cropping practices and were more likely to raise alternative crops like alfalfa, buckwheat, hay, millet, oats, and rye than conventional farmers. Conventional farmers were more likely to raise traditional crops like barley, sugar beets, sunflowers, and spring wheat. Conventional farmers averaged substantially higher crop yields than sustainable farmers. Three-fourths of the sustainable farmers raised livestock compared with one-half of the conventional farmers. Conventional farmers had greater equity, assets, gross farm income, and net farm income than sustainable farmers. Conventional and sustainable farmers reported nearly the same amount of satisfaction with farming as an occupation, the same stress levels, and the same perceived skill requirements.

**Keywords:** sustainable farms, conventional farms, organic, North Dakota

## **Acknowledgments**

We wish to express our appreciation to F. Larry Leistritz, Tim Petry, and Larry Stearns, Department of Agricultural Economics, North Dakota State University, Fargo, for their thoughtful review of this manuscript. In addition, Bruce Dahl completed a myriad of computer runs necessary for this report.

We are grateful to the farmers and ranchers of North Dakota who provided much time, effort, and information to help us better understand the current situation in farming. The Northern Plains Sustainable Agriculture Society and the Manitoba/North Dakota No-Till Association assisted by encouraging their members to participate in this study.

This project was funded, in part, by a grant from the Northwest Area Foundation Initiative on Sustainable Agriculture. The Northern Plains Sustainable Agriculture Society served as a cooperating agency for the Northwest Area Foundation to complete this project. The National Center for Appropriate Technology, Butte, Montana, funded this report.

## TABLE OF CONTENTS

<u>Item</u>	<u>Page</u>
LIST OF TABLES .....	ii
LIST OF FIGURES .....	iv
HIGHLIGHTS .....	v
INTRODUCTION .....	1
METHODS .....	1
SAMPLE .....	1
LOCATION OF FARMERS .....	2
CLASSIFICATION METHODS .....	4
SURVEY INSTRUMENTS .....	4
RESULTS .....	5
FARM OPERATION CHARACTERISTICS .....	5
CROP ENTERPRISES .....	9
LIVESTOCK ENTERPRISES .....	14
FARM FINANCIAL INDICATORS .....	16
LABOR RESPONSIBILITIES AND REQUIREMENTS .....	24
SALES AND PURCHASE PATTERNS .....	34
CONCLUSIONS AND IMPLICATIONS .....	45
REFERENCES .....	46

## LIST OF TABLES

<u>Table</u>	<u>Page</u>
1	Farm Operation Characteristics of Sustainable and Conventional Farmers (1991) . . . . . 6
2	Average Size of Farming Operation (Mean Number of Acres) of Sustainable and Conventional Farmers (1989 and 1991) . . . . . 7
3	Percent of Sustainable and Conventional Farmers who Raise Selected Crops (1991) . . 10
4	Average Number of Acres of Selected Crops Raised ONLY by Sustainable and Conventional Farmers who Plant the Crops (1991) . . . . . 11
5	Yield of Crops (Mean Number of Units/Acre) Raised ONLY by Sustainable and Conventional Farmers who Plant the Crops (1991) . . . . . 12
6	Livestock Enterprises on Conventional and Sustainable Farms (1991) . . . . . 14
7	Number of Livestock Enterprises on Conventional and Sustainable Farms (1991) . . . . 15
8	Farm Financial Structure and Performance Measures Adjusted for Changes in Inventories: Part I (1991) . . . . . 17
9	Farm Financial Structure and Performance Measures Adjusted for Changes in Inventories: Part II (1991) . . . . . 18
10	Aggregate Financial Indicators for ALL Sustainable and Conventional Farmers (1989 and 1991) . . . . . 19
11	Average per Farm Income for ALL Conventional and Sustainable Farmers, by Source of Income (1989 and 1991) . . . . . 20
12	Percent of Conventional and Sustainable Farmers who had Income in Selected Categories (1991) . . . . . 21
13	Average per Farm Expenses for Conventional and Sustainable Farmers, by Category of Expense (1989 and 1991) . . . . . 22
14	Percent of Conventional and Sustainable Farmers who had Expenses in Selected Categories (1991) . . . . . 23

**LIST OF TABLES (Cont.)**

<u>Table</u>	<u>Page</u>
15	Number of Conventional and Sustainable Farmers with Non-household or Hired Labor (1991) . . . . . 24
16	Number and Percent of Conventional and Sustainable Farms Using Labor, by Type of Laborer (1991) . . . . . 25
17	Average Number of Laborers on Conventional and Sustainable Farms, by Type of Laborer (1991) . . . . . 25
18	Average Number of Hours per Week of Farm Labor Provided by Individuals on Conventional and Sustainable Farms, by Type of Laborer (1991) . . . . . 27
19	Average Number of Hours per Year of Farm Labor Provided by Individuals Working on Conventional and Sustainable Farms, by Type of Laborer and Number of Livestock Enterprises . . . . . 28
20	Average Number of Hours per Year per Acre of Farm Labor Provided by Individuals Working on Conventional and Sustainable Farms, by Type of Laborer and Number of Livestock Enterprises (1991) . . . . . 29
21	Person with Primary Responsibility for Decision-Making on Conventional and Sustainable Farms (1991) . . . . . 30
22	Person with Primary Responsibility to Carry Out Activities on Conventional and Sustainable Farms . . . . . 32
23	Locations of Sales and Purchases by Conventional and Sustainable Farmers (1991) . . . 34
24	Purchase of Inputs Directly from other Farmers During Past 12 Months (1991) . . . . . 36
25	Direct Purchase of Inputs that Were Produced in the Local Area During Past 12 Months (1991) . . . . . 37
26	Average Number and Percent of Goods and Services Purchased by Conventional and Sustainable Farmers in Their Hometowns (1991) . . . . . 38
27	Number and Percent of Conventional and Sustainable Farmers Who Purchase Selected Goods and Services (1991) . . . . . 40

## LIST OF TABLES (Cont.)

<u>Table</u>		<u>Page</u>
28	Average Population of Communities where Conventional and Sustainable Farmers Purchase Selected Goods and Services (1991) . . . . .	41
29	Average Number of Miles Conventional and Sustainable Farmers Travel to Purchase Selected Goods and Services (1991) . . . . .	42
30	Percent of Conventional and Sustainable Farmers who Stated that the Town Where Goods and Services Are Purchased is Closest Town (1991) . . . . .	43
31	Average Number of Miles Conventional and Sustainable Farmers Could Travel to Closest Town to Purchase Selected Goods and Services (1991) . . . . .	44

## LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	Conventional and Sustainable Farmers by Eco-Region, North Dakota, 1991 . . . . .	3
2	Conventional and Sustainable Farm Ownership Status, 1991 . . . . .	8
3	Conventional and Sustainable Farm Size by Type of Acres Controlled, 1991 . . . . .	8
4	Average Number of Crop Enterprises for Conventional and Sustainable Farms, 1991 . . . . .	13
5	Average Yields for Conventional and Sustainable Farms for Farms Planting These Crops, 1991 . . . . .	13
6	Percentage of Conventional and Sustainable Farms by Their Number of Livestock Enterprises, 1991 . . . . .	15
7	Gross and Net Farm Income per Farm and per Acre for Conventional and Sustainable Farms, 1991 . . . . .	20
8	Out-of-State Sales and Purchases for Conventional and Sustainable Farms, 1991 . . . . .	35



## HIGHLIGHTS

*Interviews and mail-out/mail-back surveys were conducted in 1992 with 38 conventional and 41 sustainable North Dakota farmers who had participated in a similar study in 1990. The results emphasize the differences and similarities of these two types of farmers. Following are some of the highlights of that research.*

- ◆ *The majority of the conventional and sustainable farms were individual or family sole proprietorships. Eighteen percent of the conventional farms were partnerships compared with eight percent of sustainable farms.*
- ◆ *The average size of sustainable farms (in number of acres) was somewhat smaller than conventional farms. However, because the acreage varied so greatly, the differences were not statistically significant.*
- ◆ *Sustainable farms had more diverse cropping practices. They raised about five crops on average compared with 3.8 crops for conventional farms. Sustainable farmers were more likely to raise alternative crops like alfalfa, buckwheat, hay, millet, oats, and rye than conventional farmers. Conventional farmers were more likely to raise traditional crops like barley, sugar beets, sunflowers, and spring wheat.*
- ◆ *Sustainable farmers averaged nearly twice as many acres of alfalfa than conventional farmers; conventional farmers averaged three times more acres of soybeans and 2.5 times more acres of spring wheat than sustainable farmers.*
- ◆ *Conventional farmers averaged substantially higher yields of barley, corn, flax, oats, sunflowers, durum wheat, and spring wheat than sustainable farmers.*
- ◆ *Three-fourths of the sustainable farmers raised livestock compared with one-half of the conventional farmers. Among those with livestock enterprises, approximately the same percentage of both groups had hog and beef cattle enterprises, but sustainable farmers were more likely to have dairy cattle or poultry enterprises.*
- ◆ *Conventional farmers had greater equity, assets, and gross farm income than sustainable farmers. The net farm income of the conventional farmers was nearly twice that of the sustainable farmers. However, the differences between neither gross nor net incomes per acre were statistically significant.*
- ◆ *The largest source of income for both the conventional and sustainable farmers came from crop sales. The second largest income source for sustainable farmers was livestock, and the second largest income source for conventional farmers was government program payments.*

- ◆ *Conventional farmers' largest expense was for fertilizer, and their second largest expense was for rent of land or animals. Sustainable farmers' largest expense was for depreciation, and their second largest expense was for feed.*
- ◆ *Nearly 60 percent of sustainable farmers had sales out-of-state compared with 35 percent of conventional farmers. Nearly 44 percent of the sustainable farmers reported that local markets were unavailable for their commodities, compared with 13 percent of the conventional farmers. There was little difference in their out-of-state purchases.*
- ◆ *Conventional farmers purchased nearly two-thirds of their farm inputs in their hometowns. Sustainable farmers obtained one-half of their inputs in their hometowns and their total purchases were, by definition (low-input), smaller. The two groups' purchases of other goods and services in their hometowns were nearly the same.*
- ◆ *Sustainable farmers purchased most of their goods and services in somewhat larger communities than the conventional farmers. Although the number of miles sustainable farmers traveled to make purchases was usually greater than the number traveled by conventional farmers, the differences were not statistically significant.*
- ◆ *Conventional and sustainable farmers reported nearly the same amount of satisfaction with farming as an occupation, the same stress levels, and the same perceived skill requirements. However, their goals differed in that conventional farmers' two top goals were profitability and productivity, and sustainable farmers' two top goals were land stewardship and operation diversity.*
- ◆ *Nearly two-thirds of the conventional farmers reported using custom or contract labor compared with 29 percent of the sustainable farms. Labor requirements (hours/year) were about the same for conventional and sustainable farms, and farms with no livestock required fewer hours/year of labor than farms with livestock. The number of hours/year/acre of labor on sustainable farms was somewhat higher than that of conventional farms, although the difference was not statistically significant.*
- ◆ *All of the sustainable farmers used their own on-farm research as a source of information on sustainable agriculture, and three-quarters of them stated that it was "very useful."*

# **A Comparison of Sustainable and Conventional Farmers in North Dakota**

Randall S. Sell, Gary A. Goreham,  
George A. Youngs, Jr., and David L. Watt\*

## **INTRODUCTION**

Farmers, policy makers, environmentalists, and consumers have shown renewed interest in a nutritious, safe, and adequate food supply as well as an environmentally sound food production system. As a result, some farmers have sought alternative production methods to reduce their reliance on commercial chemical inputs. They often do so with the expectation that crop yields and gross income will decrease, but that, as a result of reduced purchased inputs, their net income will be similar to what they would have received had they continued their use of off-farm inputs.

Is it realistic for farmers to expect that they can be both environmentally sound and financially viable? How do the finances of sustainable and conventional farmers compare? In what ways are the incomes and expenses of these two types of farmers similar and different? The objective of this study is to address these questions.

## **METHODS**

### **SAMPLE**

Survey data for this study were collected in 1990 and 1992. The sample consisted of North Dakota farm and ranch operators whose names were obtained from two sources. One group of names was obtained from a panel of farmers who had been selected at random by Leistriz et al. (1989). Leistriz screened these farmers "to ensure that all respondents were less than 65 years old, were operating a farm, considered farming to be their primary occupation, and sold at least \$2,500 of farm products in 1984" (p. 1). This longitudinal panel was contacted by Leistriz in 1985, 1986, and 1988. We contacted them again in 1990 and 1992.

The objective of the 1990 study was to compare conventional and sustainable farmers. Because there was an insufficient number of sustainable farmers represented in the panel to conduct statistical analysis, an already existing group of sustainable farmers was included in the study. Their names were obtained from the membership list of the Northern Plains Sustainable Agricultural Society (NPSAS). The NPSAS list included 71 names to create a total sample size of 534 (panel=463). However, that number fell to 495 when those who were no longer farming or who had no telephone or address listed were dropped from the sample.

---

\*Sell is a research associate and Watt is associate professor, Department of Agricultural Economics; Goreham and Youngs are associate professors, Department of Sociology/Anthropology, North Dakota State University, Fargo.

The farmers were approached in three stages. First, we sent each respondent a letter that explained the nature of the project and indicated that they would be contacted by telephone. Second, we conducted telephone interviews with the farmers. The overall response rate, after eliminating respondents who were no longer farming, was 80 percent (panel, N=340; NPSAS, N=56). Third, we sent a follow-up questionnaire to all of the farmers who responded to the telephone interview. The response rate of the mail-out/mail-back questionnaire relative to the total sample was 56 percent, whereas the response rate relative to the phone interview was 70 percent (mail-out/mail-back: panel, N=230; NPSAS, N=46).

For the 1992 study, each of the 396 participants in the telephone interviews for the 1990 study were assigned scores on a sustainability index (to be discussed later) ranging from more sustainable to less sustainable. Of these, the 60 farmers with the least sustainable scores (all from the original panel) and the 60 with the most sustainable scores (28 from the panel and 32 from the NPSAS group) were selected for the 1992 study. We selected the extreme ends of sustainability distribution to determine the degree to which the ideal types of conventional and sustainable farmers compared.

As in the 1990 study, three stages were used: an initial letter, a telephone interview, and a mail-out/mail-back questionnaire. The overall response rate of the telephone interview was 66 percent (N=79). The telephone interview response rates for the less sustainable group and the more sustainable group were 63 percent (N=38) and 68 percent (N=41), respectively. The mail-out/mail-back response rates relative to the total sample were 53 percent (N=32) and 47 percent (N=28) for the less sustainable and more sustainable groups, respectively. The mail-out/mail-back response rates relative to the telephone interviews were 84 percent and 68 percent for the less sustainable and more sustainable groups, respectively.

## **LOCATION OF FARMERS**

The state of North Dakota was be divided into three eco-regions based on soil and land type, crop diversity, and climate. The eco-regions include the West River, Couteau, and Valley. Figure 1 illustrates the location of the farmers in the study. Twelve conventional farmers and 14 sustainable farmers were from the West River; 16 conventional and 20 sustainable farmers were from the Couteau; and 10 conventional farmers and seven sustainable farmers were from the Valley. Although the conventional and sustainable farmers used in the study are distributed throughout the state, it is important to note that there is variation in income across the state.

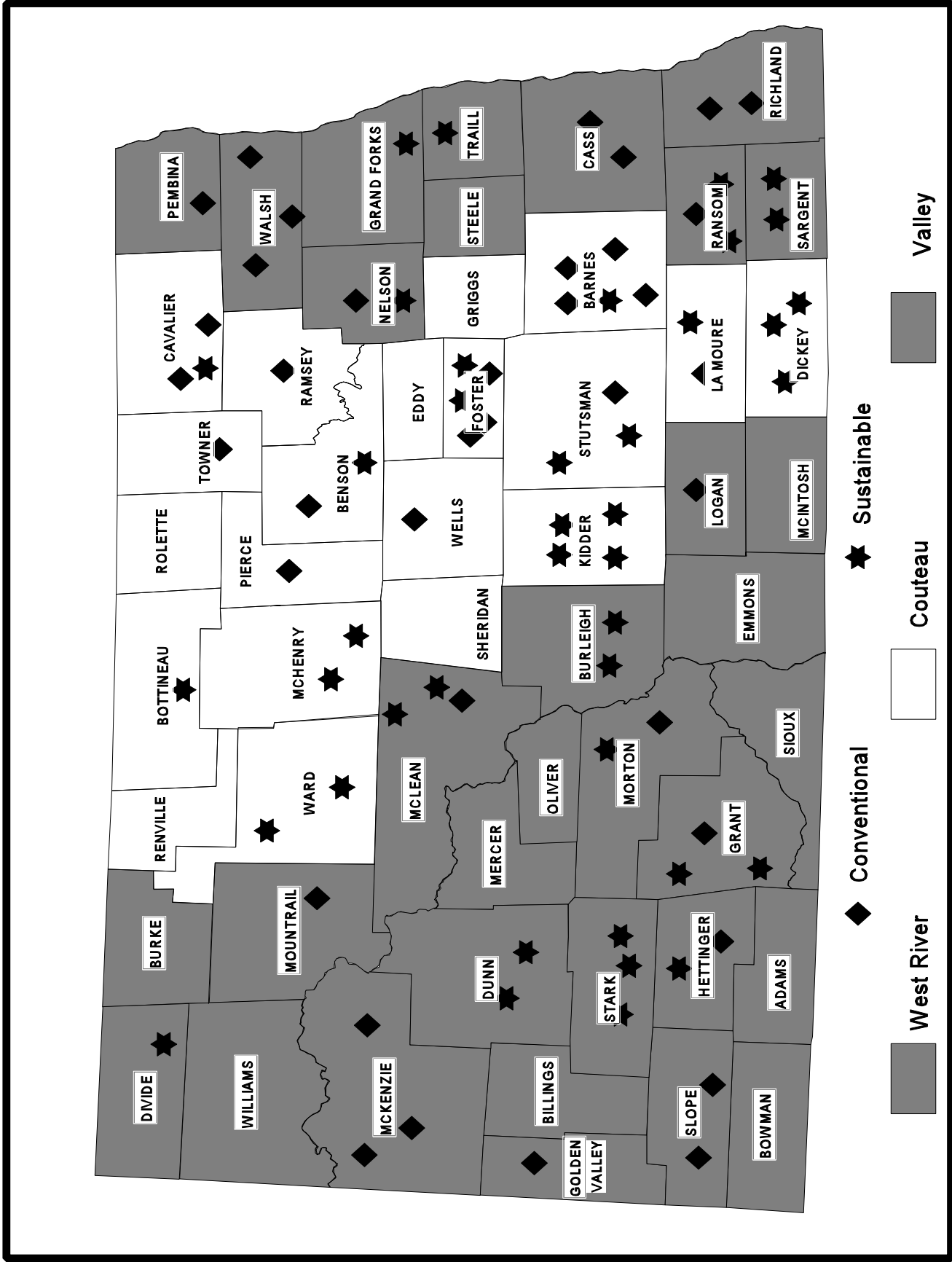


Figure 1. Conventional and Sustainable Farmers by Eco-Region, North Dakota, 1991

## **CLASSIFICATION METHODS**

The sustainability index developed was based on three factors: farming practices, self-identification, and farmer attitudes. Each respondent could have a maximum of six points with four points coming from specific farming practices, one point for self-identification, and one point for farmer attitudes.

First, the farming practices in question were the non-use of herbicides, the non-use of commercial fertilizers, the use of natural fertilizers (green manures and animal wastes), and high cropping diversity. Responses to these four dimensions of farming practices were standardized within a 0-1 range for each of three geographically distinct regions. This was done to control for some of the natural variability in climate and topography across the state.

Second, farmers were asked to classify themselves based on their farming inputs. They were asked, "Which of the following best describes your present farm/ranch operation?" The options were: (1) "My operation relies on such purchased inputs as fertilizer, pesticide, and/or energy inputs"; (2) "My operation is actively reducing reliance on such purchased inputs as fertilizer, pesticide, and/or energy inputs"; and (3) "My operation primarily relies on low-input practices." Farmers who selected the last option received 1 point; all others received 0 points.

Third, farmers' attitudes were measured with two seven-point Likert scale items that were derived from the work of Beus and Dunlap (1990). Farmers were asked the degree to which they agreed or disagreed with the following statements: "The domination of nature by humans should be maintained through chemicals and scientific advances," and "Farmers should reduce their reliance on external sources of energy and inputs." Farmers who disagreed with the chemical and scientific advances statement (scores of 5 through 7) received .5 points toward the sustainability index, and those who agreed with the energy and inputs statement (scores of 1 through 3) received .5 points toward the index. Other responses received 0 points (Watt et al. 1992).

## **SURVEY INSTRUMENTS**

Two instruments were used in this study, a telephone interview schedule and a mail-out/mail-back questionnaire. The telephone interview form for the less sustainable or conventional farmers consisted of 46 items, and the telephone interview form for the more sustainable farmers consisted of 50 items. The items pertained to crop and livestock information, farming practices, future plans, and financial information.

Both the conventional and sustainable farmers were sent the same mail-out/mail-back questionnaire form. It consisted of 19 items dealing with opinions, purchase patterns, personal stress, labor practices, and concern with various sustainability issues. Most of the items were Likert-scale or open-ended.

## RESULTS

The following analyses compare less sustainable or conventional farmers with more sustainable, or simply, sustainable farmers. These two groups will be compared using several items from the questionnaires. The general topics to be covered include the following:

Farm Operation Characteristics	Farm Income and Expenses
Crop Enterprises	Labor Responsibilities and Requirements
Livestock Enterprises	Sales and Purchase Patterns

Significance tests will be used as a general guide for the impartial identification of substantial differences between conventional and sustainable farmers. However, these tests only indicate what would have been statistically significant if the farmers in each group had been selected at random from the entire populations of such farmers. Perhaps it could be argued that the conventional farmers are a random sample of a larger population of conventional farmers in North Dakota because they were originally selected at random in Phase I, but the sustainable farmers clearly are not a random sample. Thus, the significance tests are suggestive of important differences, but not definitive evidence of such differences.

### FARM OPERATION CHARACTERISTICS

Farms differ in a variety of ways, including number of acres, types of equipment, methods of management, crop/livestock mix, participation in government programs, methods of marketing products, and purchasing patterns. Some of the differences in farms are due to geographic location while others are a result of, or an extension of, farm managers' personal philosophy. Farms in the Red River Valley tend to be smaller than farms in the western part of the state. Farms size in the Red River Valley ranged from 836 to 1,313 acres in 1992 while average farm size in western North Dakota ranged from 1,009 to 3,729 acres (Census of Agriculture, 1994). A lower percentage of farms in the Valley have livestock than farms in western North Dakota.

Farms also differed by type of farmer. The average age of farm owner/operators is also steadily increasing and roughly the same for conventional and sustainable farmers (Table 1). Also, conventional and sustainable operators have farmed nearly the same number of years; however, the farms of conventional operators have been in their families longer than those of the sustainable operators. More of the sustainable operators describe their farms as individual or family sole proprietorships than do the conventional operators; more of the conventional operators describe their farms as partnerships than do the sustainable operators (Figure 2). Nearly the same percentage of the sustainable operators as conventional operators stated that farming was their principle occupation.

The average size of sustainable operations (acres owned, acres rented, acres rented out, and total operation size) was consistently smaller than those of conventional operations in 1989 and 1991 (Table 2 and Figure 3). However, the difference in operation size between sustainable and conventional farms was statistically significant for only one component--acres rented. In addition to the mean averages, standard deviations are also listed for each variable. The high numbers listed for most standard deviations suggests high variability within the group of conventional farmers and within the group of sustainable farmers. Often, there was more variation within each group than between them.

**Table 1. Farm Operation Characteristics of Sustainable and Conventional Farmers (1991)**

<u>Characteristic</u>	<u>Conventional</u>		<u>Sustainable</u>		<u>X<sup>2</sup></u>
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	
<u>Age of Farmer</u>					
Less than 30	0	0.0	1	4.0	
30-39	6	20.7	6	24.0	
40-49	11	37.9	7	28.0	
50 or more	<u>12</u>	<u>41.4</u>	<u>11</u>	<u>44.0</u>	
Total	29	100.0	25	100.0	0.84
Mean	48.4		46.1		
<u>Number Years Operator Has Farmed</u>					
Less than 15	9	23.7	8	19.5	
15-29	13	34.2	16	39.0	
30 or more	<u>16</u>	<u>42.1</u>	<u>17</u>	<u>41.5</u>	
Total	38	100.0	41	100.0	0.29
Mean	24.6		25.4		
<u>Number Years Farm Was in Family</u>					
Less than 40	8	22.2	13	31.7	
40-69	9	25.0	14	34.2	
70 or more	<u>19</u>	<u>52.8</u>	<u>14</u>	<u>34.2</u>	
Total	36	100.0	41	100.1	2.72
Mean	63.1		56.0		
<u>Ownership Status</u>					
Indiv. sole proprietor	12	31.6	15	37.5	
Family sole proprietor	12	31.6	21	52.5	
Partnership	7	18.4	3	7.5	
Family corporation	2	5.3	1	2.5	
Other	<u>5</u>	<u>13.2</u>	<u>0</u>	<u>0.0</u>	
Total	38	100.0	40	100.0	9.68**
<u>Farming Principle Occupation</u>					
Yes	36	97.3	37	90.2	
No	<u>1</u>	<u>2.7</u>	<u>4</u>	<u>9.8</u>	
Total	37	100.0	41	100.0	2.70

\*p&lt;.10; \*\*p&lt;.05; \*\*\*p&lt;.01



**Table 2. Average Size of Farming Operation (Mean Number of Acres) of Sustainable and Conventional Farmers (1989 and 1991)<sup>1</sup>**

<u>Acreage Type</u>	<u>Conventional</u>		<u>Sustainable</u>		<u>Between Group Differences</u>	
	<u>1989</u>	<u>1991</u>	<u>1989</u>	<u>1991</u>	<u>1989</u>	<u>1991</u>
					<u>t</u>	<u>t</u>
	-- Averages calculated for ALL observations -- <sup>2</sup>					
Acres Owned	1,321	1,185	818	911	1.25	0.90
(SD)	2,424	1,746	854	862		
Acres Rented	1,459	1,399	847	781	1.46	1.84*
(SD)	1,931	1,720	1,787	1,246		
Acres Rented Out	92	160	48	42	0.64	1.44
(SD)	392	494	172	168		
Total Operation Size	2,689	2,425	1,617	1,650	1.58	1.63*
(SD)	3,699	2,371	2,184	1,785		
	(N=38)	(N=38)	(N=41)	(N=41)		
	--Averages calculated ONLY for those who own, rent, or rent out acres-- <sup>2</sup>					
Acres Owned	1,521	1,408	959	1,037	1.21	1.05
(SD)	2,546	1,821	849	845		
	(N=33)	(N=32)	(N=35)	(N=36)		
Acres Rented	1,680	1,519	1,120	1,033	1.13	1.25
(SD)	1,982	1,742	1,986	1,432		
	(N=33)	(N=35)	(N=31)	(N=31)		
Acres Rented Out	580	380	395	435	0.43	0.15
(SD)	900	179	354	192		
	(N=6)	(N=16)	(N=5)	(N=4)		

\*p<.10; \*\*p<.05; \*\*\*p<.01

<sup>1</sup>Averages are calculated for the same farms for the 1989 and 1991 data sets.

<sup>2</sup>Averages for ALL observations include those who did not have land in a particular category, averages calculated for only those who had land in that particular category.

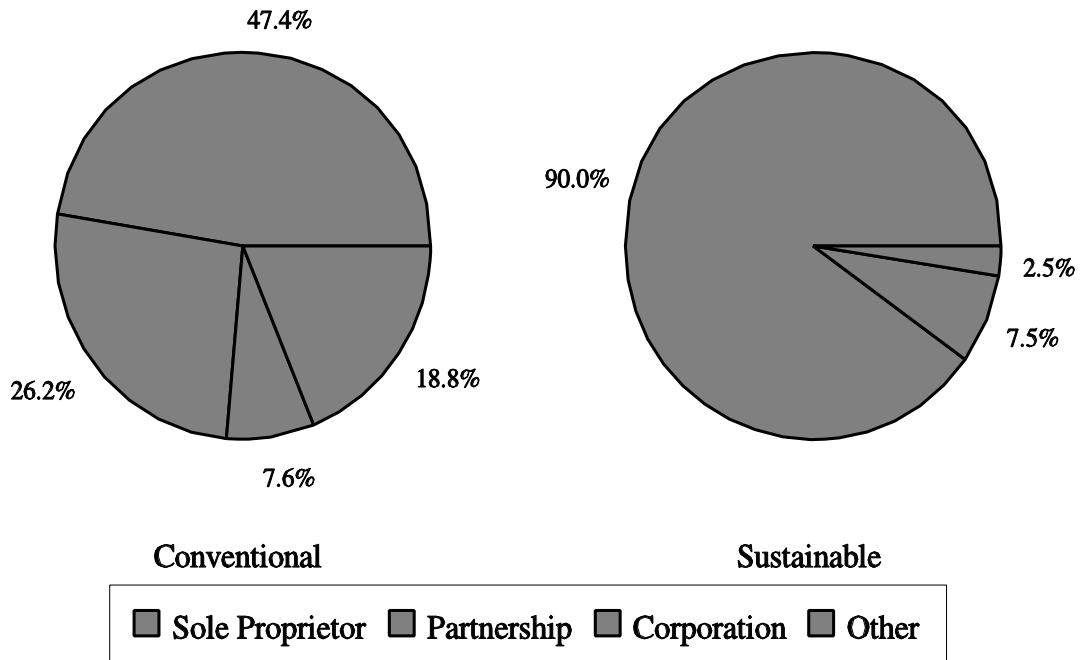


Figure 2. Conventional and Sustainable Farm Ownership Status, 1991

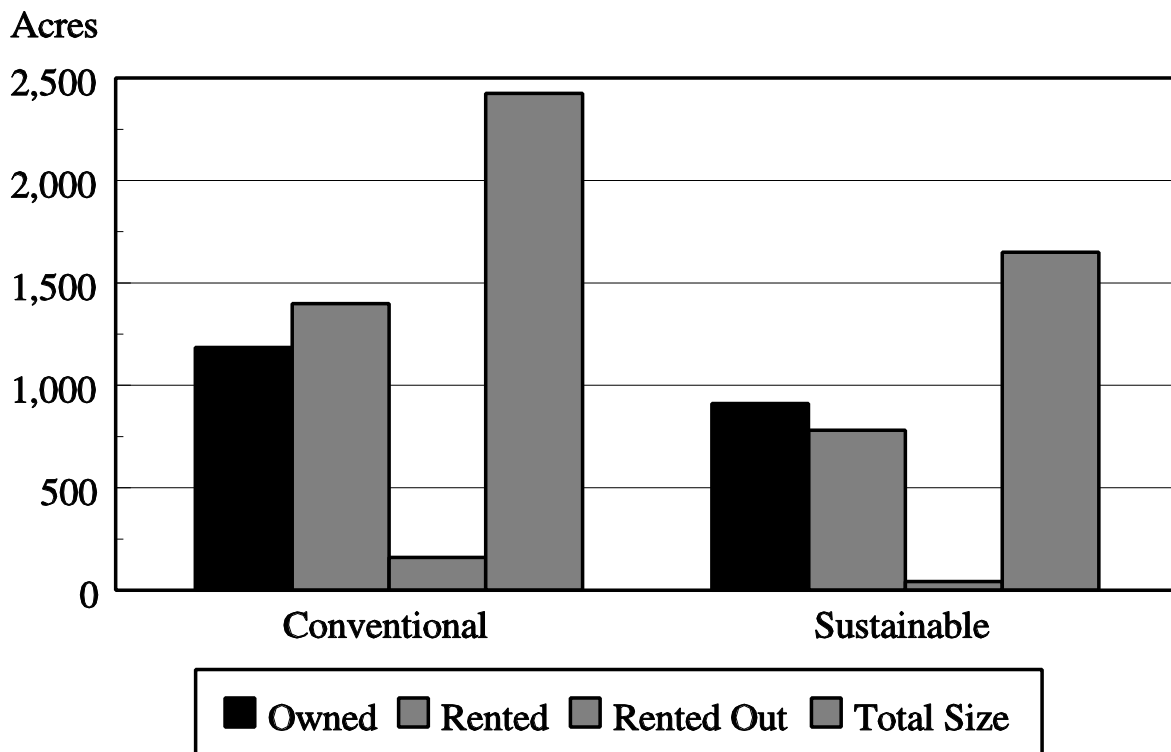


Figure 3. Conventional and Sustainable Farm Size by Type of Acres Controlled, 1991

## **CROP ENTERPRISES**

Certain cropping and cultural practices are an integral part of any type of farm but are especially critical in the case of a sustainable farm. Common elements of crop management on sustainable farms typically include: legume-based rotations, green manures, crop residues, cover crops, animal manures, rock dust, and small amounts of organic fertilizers. Thus, sustainable farms may be better suited to a more diversified production scheme.

However, crop specialization has increased for most farms as farm size has increased. One reason for specializing may be the importance of volume discounts to lower costs and increase revenues (Krause and Kyle 1970). New technology also increases agricultural specialization; that is, it reduces diversification in agriculture. This is especially true for new technology which requires a major capital investment. Acquisition of this technology encourages specializing in producing the commodities involved with that investment (Babb 1979).

In our sample, sustainable farms had an average of five different crop enterprises versus 3.8 for the conventional farms (Table 3, Figure 4). A significantly larger percentage of conventional farmers raised barley, sugar beets, sunflowers, and spring wheat than sustainable farmers. Alternatively, a significantly larger percentage of sustainable farmers raised alfalfa, buckwheat, hay, millet, oats, and rye than conventional farmers.

Conventional farmers who planted soybeans, durum wheat, and spring wheat raised significantly more acres of those crops than sustainable farmers who planted those crops (Table 4). Sustainable farmers who planted alfalfa raised significantly more acres of that crop than conventional farmers who planted it.

Conventional farmers who planted barley, corn, flax, oats, sunflowers, durum wheat, and spring wheat had significantly greater yields than sustainable farmers who planted those crops (Table 5, Figure 5). Sustainable farmers who planted alfalfa had higher yields than conventional farmers who planted that crop, although the differences were not statistically significant.

**Table 3. Percent of Sustainable and Conventional Farmers who Raise Selected Crops (1991)**

<u>Crop</u>	<u>Conventional</u>	<u>Sustainable</u>	<u>X<sup>2</sup></u>
	----- Percent -----		
Alfalfa	21.0	43.9	-2.21**
Beans, Dry Edible	7.9	9.8	-0.29
Buckwheat	0.0	2.7	-3.68***
Barley	73.7	43.9	2.79***
Corn	21.0	29.3	-0.84
Flax	15.8	29.3	-1.44
Hay, not Alfalfa	15.8	39.0	-2.38**
Millet	0.0	2.2	-3.35***
Oats	23.7	51.2	-2.61***
Peas	0.0	0.2	-1.00
Rye	0.0	0.2	-3.35***
Soybeans	15.8	9.8	0.79
Sugar Beets	0.1	0.0	2.09**
Sunflowers	47.4	24.4	2.16**
Wheat, Durum	26.3	19.5	0.71
Wheat, Spring	92.1	75.6	2.00**
Wheat, Winter	2.6	4.8	-0.52
	----- Number -----		
Mean Number Crops per Farm	3.8 (N=38)	5.0 (N=41)	<u>t-test</u> -2.43**

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 4. Average Number of Acres of Selected Crops Raised ONLY by Sustainable and Conventional Farmers who Plant the Crops (1991)**

Crop	Conventional		Sustainable		t-test
	N	Mean	N	Mean	
Alfalfa	8	35.6	18	67.1	-2.08*
(SD)		(17.8)		(40.7)	
Beans, Dry Edible	3	343.3	4	206.2	0.83
(SD)		(229.4)		(199.8)	
Buckwheat	0	0.0	11	120.6	---
(SD)		(0.0)		(94.9)	
Barley	28	323.7	18	121.2	2.29
(SD)		(367.3)		(90.4)	
Corn	8	273.2	12	143.4	1.23
(SD)		(257.3)		(185.1)	
Flax	6	148.3	12	113.3	0.64
(SD)		(119.6)		(84.1)	
Hay, not Alfalfa	6	135.8	16	192.9	-0.37
(SD)		(107.4)		(365.8)	
Millet	0	0.0	9	176.8	---
(SD)		(0.0)		(128.2)	
Oats	9	112.0	21	101.8	0.26
(SD)		(98.4)		(92.5)	
Peas	0	0.0	1	53.0	---
(SD)		(0.0)		(0.0)	
Rye	0	0.0	9	71.7	---
(SD)		(0.0)		(17.9)	
Soybeans	6	302.2	4	106.0	1.93*
(SD)		(222.7)		(90.0)	
Sugar Beets	4	161.7	0	0.0	---
(SD)		(58.3)		(0.0)	
Sunflowers	18	403.8	10	193.8	1.26
(SD)		(514.8)		(106.6)	
Wheat, Durum	10	414.6	8	196.4	1.94*
(SD)		(261.9)		(214.2)	
Wheat, Spring	35	622.6	31	236.3	2.18**
(SD)		(961.9)		(233.4)	
Wheat, Winter	1	300.0	2	82.5	---
(SD)		(0.0)		(3.5)	
Other	3	136.7	17	110.5	0.30
(SD)		(0.0)		(3.5)	

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 5. Yield of Crops (Mean Number of Units/Acre) Raised ONLY by Sustainable and Conventional Farmers who Plant the Crops (1991)**

---

<u>Crop</u>	<u>Conventional</u>		<u>Sustainable</u>		<u>t-test</u>
	<u>N</u>	<u>Mean</u>	<u>N</u>	<u>Mean</u>	
Alfalfa (tons/acre)	8	1.5	18	2.4	-1.20
(SD)		(1.5)		(2.1)	
Beans, Dry Ed.(lbs/acre)	3	1,115.6	4	768.2	0.55
(SD)		(981.0)		(565.6)	
Buckwheat (bu/acre)	0	0.0	11	11.6	---
(SD)		(0.0)		(6.4)	
Barley (bu/acre)	28	55.6	18	31.6	5.58***
(SD)		(14.6)		(13.8)	
Corn (bu/acre)	8	82.9	12	47.2	1.88*
(SD)		(39.3)		(44.8)	
Flax (bu/acre)	6	19.5	12	11.8	1.74*
(SD)		(9.9)		(6.2)	
Hay, not Alf. (tons/acre)	6	2.0	16	1.4	0.56
(SD)		(2.5)		(1.5)	
Millet (bu/acre)	0	0.0	9	29.2	---
(SD)		(0.0)		(10.0)	
Oats (bu/acre)	9	67.9	21	40.4	3.23***
(SD)		(21.5)		(20.6)	
Peas (lbs/acre)	0	0.0	1	1,300.0	---
(SD)		(0.0)		(0.0)	
Rye (bu/acre)	0	0.0	9	39.6	---
(SD)		(0.0)		(10.1)	
Soybeans (bu/acre)	6	28.7	4	22.0	1.56
(SD)		(6.6)		(6.6)	
Sugar Beets (tons/acre)	4	18.2	0	0.0	---
(SD)		(2.4)		(0.0)	
Sunflowers (lbs/acre)	18	1,404.3	10	878.8	3.14***
(SD)		(267.8)		(452.3)	
Wheat, Durum (bu/acre)	10	35.4	8	23.6	2.42**
(SD)		(4.7)		(14.7)	
Wheat, Spring (bu/acre)	35	33.4	31	23.3	3.64***
(SD)		(12.4)		(10.1)	
Wheat, Winter (bu/acre)	1	0.0	2	26.0	---
(SD)		(0.0)		(5.6)	

---

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Number of Crop Enterprises**

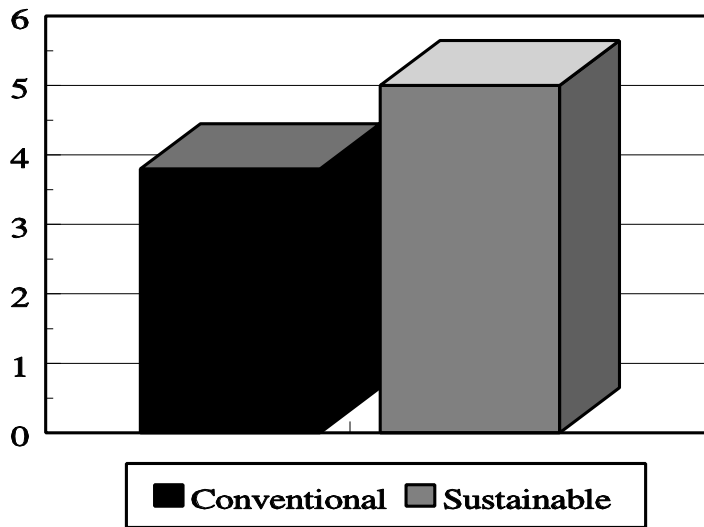


Figure 4. Average Number of Crop Enterprises for Conventional and Sustainable Farms, 1991

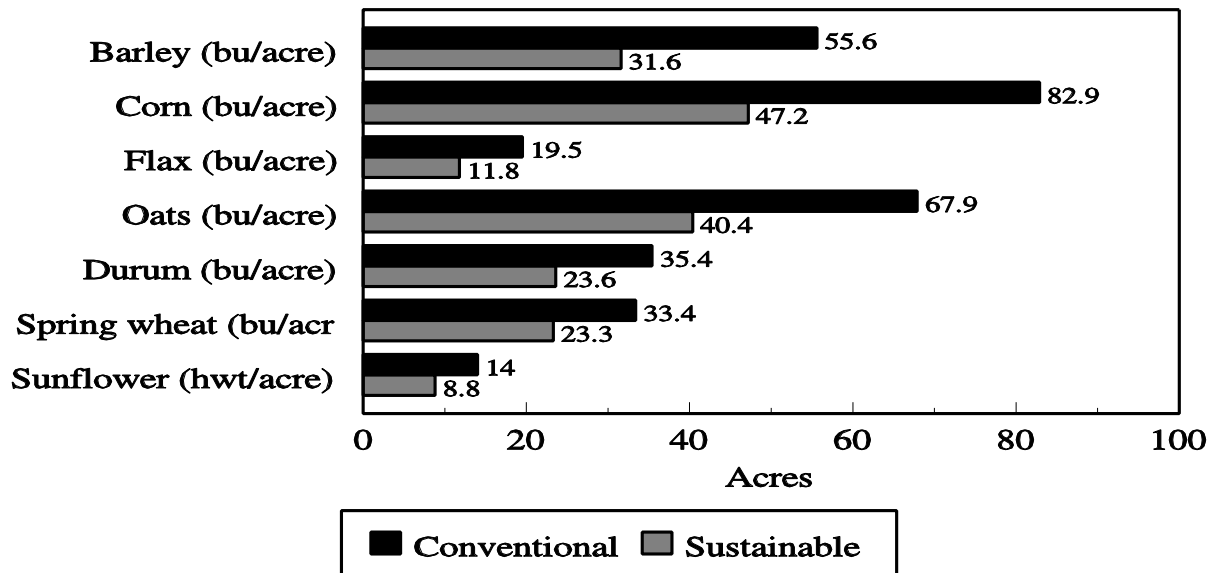


Figure 5. Average Yields for Conventional and Sustainable Farms for Farms Planting These Crops, 1991

## LIVESTOCK ENTERPRISES

Livestock are generally an integral part of sustainable farms. Livestock typically play a role in nutrient recycling and serve as consumers of forage crops and users of marginal cropland (National Research Council 1989). About one-half of the conventional farmers raised livestock, and over three-fourths of the sustainable farmers raised livestock (Table 6 and Figure 6). Significantly more conventional farmers who had livestock were planning to decrease their number than the sustainable farmers. Also, none of the conventional farmers who did not have livestock were planning to add any.

About one-third of both groups of farmers had only one livestock enterprise. Sixteen percent of the conventional farmers and 44 percent of the sustainable farmers had two or more livestock enterprises (Table 7).

**Table 6. Livestock Enterprises on Conventional and Sustainable Farms (1991)**

	<u>Conventional</u>		<u>Sustainable</u>		<u>X<sup>2</sup></u>
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	
<u>Currently Have Livestock</u>					
Yes	20	52.6	31	75.6	
No	<u>18</u>	<u>47.4</u>	<u>10</u>	<u>24.4</u>	
Total	38	100.0	41	100.0	4.55**
----- If They Have Livestock -----					
<u>Plans to Add More Livestock Enterprises</u>					
Yes	3	15.0	5	16.1	
No	<u>17</u>	<u>85.0</u>	<u>26</u>	<u>83.9</u>	
Total	20	100.0	31	100.0	0.01
<u>Plans to Decrease Numbers of Livestock</u>					
Yes	4	20.0	1	3.2	
No	<u>16</u>	<u>80.0</u>	<u>30</u>	<u>96.8</u>	
Total	20	100.0	31	100.0	3.87**
----- If They Do Not Have Livestock -----					
<u>Plans to Add Livestock Enterprises</u>					
Yes	0	0.0	1	16.7	
No	<u>18</u>	<u>100.0</u>	<u>5</u>	<u>83.3</u>	
Total	18	100.0	6	100.0	3.13*

\*p<.10; \*\*p<.05; \*\*\*p<.01



**Table 7. Number of Livestock Enterprises on Conventional and Sustainable Farms (1991)**

Number	Conventional		Sustainable		X <sup>2</sup>
	N	%	N	%	
None	18	47.4	10	25.6	8.13**
One	14	36.8	12	30.8	
Two	4	10.5	8	20.5	
Three or more	2	5.3	9	23.1	
Total	38	100.0	39	100.0	

\* p<.10; \*\* p<.05; \*\*\* p<.01

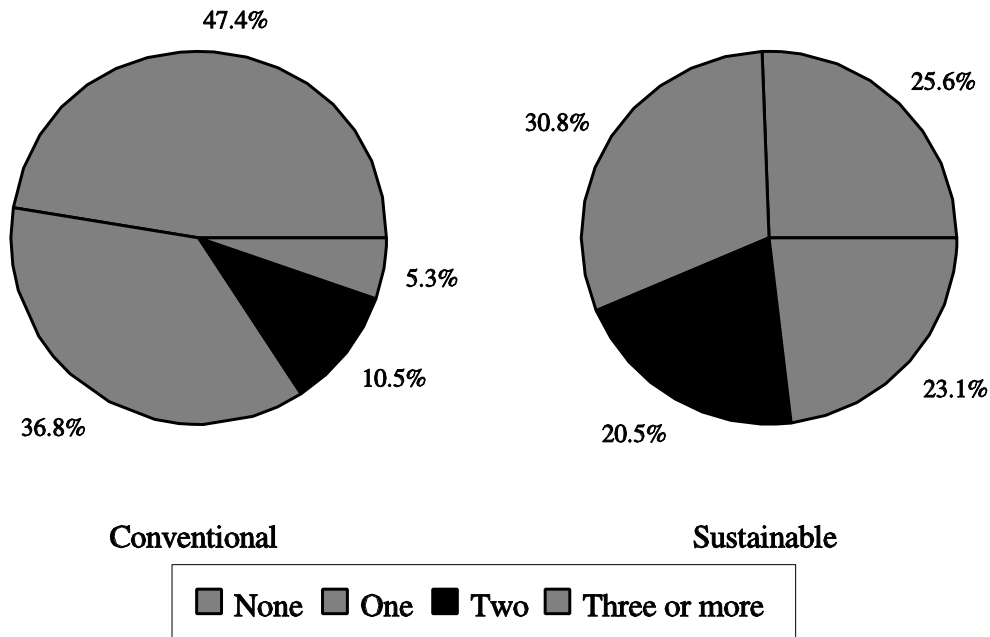


Figure 6. Percentage of Conventional and Sustainable Farms by Their Number of Livestock Enterprises, 1991

## FARM FINANCIAL INDICATORS

Farm respondents were asked to list assets and liabilities and to report income and expenses from their 1989 and 1991 1040F tax forms. This information provided a basis for assessing the financial status of farms by farm type. The conventional and sustainable farms were compared for income, income by source, expenses, net worth, debt-to-asset ratio, net income/asset ratio, return to farm equity, and several other financial performance indicators. Changes in inventory were not included in the 1989 survey, so adjusting farm income for changes in inventory was not possible for the 1989 survey.

Adjustments to gross farm income indicated a large increase in inventories among conventional farmers in 1991. This resulted in conventional farmers having significantly higher gross income per acre than sustainable farmers (Table 8). Charging an opportunity cost for equity (4 percent) and borrowed capital (9 percent) results in negative returns to labor for sustainable farmers.

A significantly lower asset turnover ratio (adjusted gross farm income/total farm assets) for sustainable farmers could greatly affect their ability to obtain credit from banking institutions (Table 9). The higher interest expense ratio (interest cost/adjusted gross farm income) experienced by sustainable farmers also reduces credit worthiness.

Comparisons between the 1989 and 1991 surveys indicated that conventional farms were about one-third larger than sustainable farms in 1989 and 1991 and conventional farmers' equity was twice that of sustainable farmers (Table 10).

Conventional farmers' assets were about 75 percent greater than those of sustainable farmers, although there was not an appreciable difference in the liabilities of the two groups. The average debt-to-asset ratio of the sustainable farmers was somewhat higher than that of the conventional farmers, although the difference was not statistically significant.

The gross income of conventional farmers was over twice that of sustainable farmers. However, when the size of operation is taken into consideration, there was not a statistically significant difference in gross income per acre. Net income of conventional farmers was over twice that of sustainable farmers. But, when the size of operation is taken into consideration, there was not a statistically significant difference in net income per acre.

The largest source of income for both conventional and sustainable farmers was sale of crops. Although crop income for conventional farmers was one-third higher than for sustainable farmers, the difference was not statistically significant. This highlights the variation in incomes reported within each group of the two groups of farmers (Table 11).

**Table 8. Farm Financial Structure and Performance Measures Adjusted for Changes in Inventories: Part I (1991) <sup>1</sup>**

<u>Item</u>	<u>Conventional</u>		<u>Sustainable</u>		<u>t-test</u>
	<u>N</u>	<u>Mean \$</u>	<u>N</u>	<u>Mean \$</u>	
Adjusted gross farm income (SD)	33	205,294 193,801	29	90,913 92,551	2.90***
Adjusted net farm income (SD)	35	41,050 69,515	33	17,649 35,499	1.73*
Adjusted gross farm income per acre (SD)	33	116.80 15.09	29	82.89 15.70	-1.87*
Adjusted net farm income per acre (SD)	35	26.45 42.71	33	15.69 22.89	1.28
Adjusted gross farm income per hour of family labor (SD)	27	48.79 39.34	17	21.04 19.50	3.11***
Adjusted net farm income per hour of family labor (SD)	28	10.37 18.82	18	6.22 10.43	0.96
Return to owner-operator labor <sup>2</sup> (SD)	35	5,653 60,084	33	-2,165 34,062	0.66
Return to owner-operator per acre <sup>2</sup> (SD)	35	8.36 41.98	33	- 3.97 26.22	1.46

\*p<.10; \*\*p<.05; \*\*\*p<.01

<sup>1</sup>Profitability is affected by changes in inventories not reflected in the 1040F tax form. Insufficient information was gathered for 1989 to account for changes in inventories. The 1991 survey included this information.

<sup>2</sup>Includes opportunity costs for equity and borrowed capital.

**Table 9. Farm Financial Structure and Performance Measures Adjusted for Changes in Inventories: Part II (1991) <sup>1</sup>**

<u>Item</u>	<u>Conventional</u>		<u>Sustainable</u>		<u>t-test</u>
	<u>N</u>	<u>Mean</u>	<u>N</u>	<u>Mean</u>	
Return on farm assets <sup>1</sup> (SD)	33	5.64 9.90	31	1.86 16.35	1.13
Return of farm equity <sup>2</sup> (SD)	33	2.96 15.24	30	1.60 61.56	0.12
Operating expense ratio <sup>3</sup> (SD)	33	65.66 31.88	29	116.86 211.06	-1.41
Asset turnover ratio <sup>4</sup> (SD)	31	40.14 27.04	27	24.57 19.10	2.56**
Depreciation expense ratio <sup>5</sup> (SD)	33	9.03 7.66	29	24.35 57.93	-1.51
Net farm income from operations ratio <sup>6</sup> (SD)	33	29.52 51.81	29	-46.73 391.26	1.11
Ratio of government farm program payments to gross income <sup>7</sup> (SD)	33	14.93 9.94	29	15.72 26.31	-0.16

\*p<.10; \*\*p<.05; \*\*\*p<.01

<sup>1</sup>Return on farm assets = (Net return to capital/Average capital investment)

<sup>2</sup>Return of farm equity = (Return to equity/Average net worth)

<sup>3</sup>Operating expense ratio = (Total operating expense/Gross income)

<sup>4</sup>Asset turnover ratio = (Gross income/Average capital investment)

<sup>5</sup>Depreciation expense ratio = (Depreciation expense/Total expense)

<sup>6</sup>Net farm income from operations ratio = (Gross revenue/Net farm income)

<sup>7</sup>Ratio of government farm program payments to gross income = (Farm program payments/Gross Income)

**Table 10. Aggregate Financial Indicators for ALL Sustainable and Conventional Farmers (1989 and 1991)**

Financial Indicator	Conventional			Sustainable			Between Group Differences	
	1989	1991	t	1989	1991	t	1989	1991
Acres	2,689	2,425	.37	1,617	1,650	.07	1.58*	1.63*
(SD)	3,699	2,371		2,184	1,785			
Assets	689,202	716,420	.21	376,226	410,500	.34	1.75*	1.96**
(SD)	938,778	805,338		338,050	336,539			
Liability	157,503	183,097	.62	156,821	149,957	.13	.02	.60
(SD)	171,645	274,046		157,417	142,505			
Equity	533,365	532,676	.09	225,946	260,893	.65	1.83*	2.08**
(SD)	865,922	650,328		320,567	308,286			
Gross farm income	201,065	180,373	.15	87,183	86,641	.33	3.01***	2.57***
(SD)	196,805	185,119		69,126	79,239			
Net farm income	29,507	35,325	.36	12,004	16,666	.98	1.44	2.18**
(SD)	65,109	39,891		15,416	26,028			
Gross farm income/acre	119	99	.66	87	82	.111	.37	.81
(SD)	111	85		79	82			
Net farm income/acre	13	23	1.13	13	18	1.23	.04	.69
(SD)	28	42		20	21			
Debt/Asset ratio	.33	.33	.05	.51	.43	.96	1.87*	1.18
(SD)	.31	.35		.42	.33			
Total interest expenses	--	15,177	--	--	9,221	--	--	1.55
Short term liability as a % of total	--	20.8	--	--	20.9	--	--	-0.01
Pre-tax total household income	--	51,616	--	--	36,600	--	--	1.13
		(N=34)			(N=30)			

\*p<.10; \*\*p<.05; \*\*\*p<.01

<sup>1</sup>For this table only, farmers who provided financial information for both 1989 and 1991 are included. As a result, figures for the two years are from the same farmers.

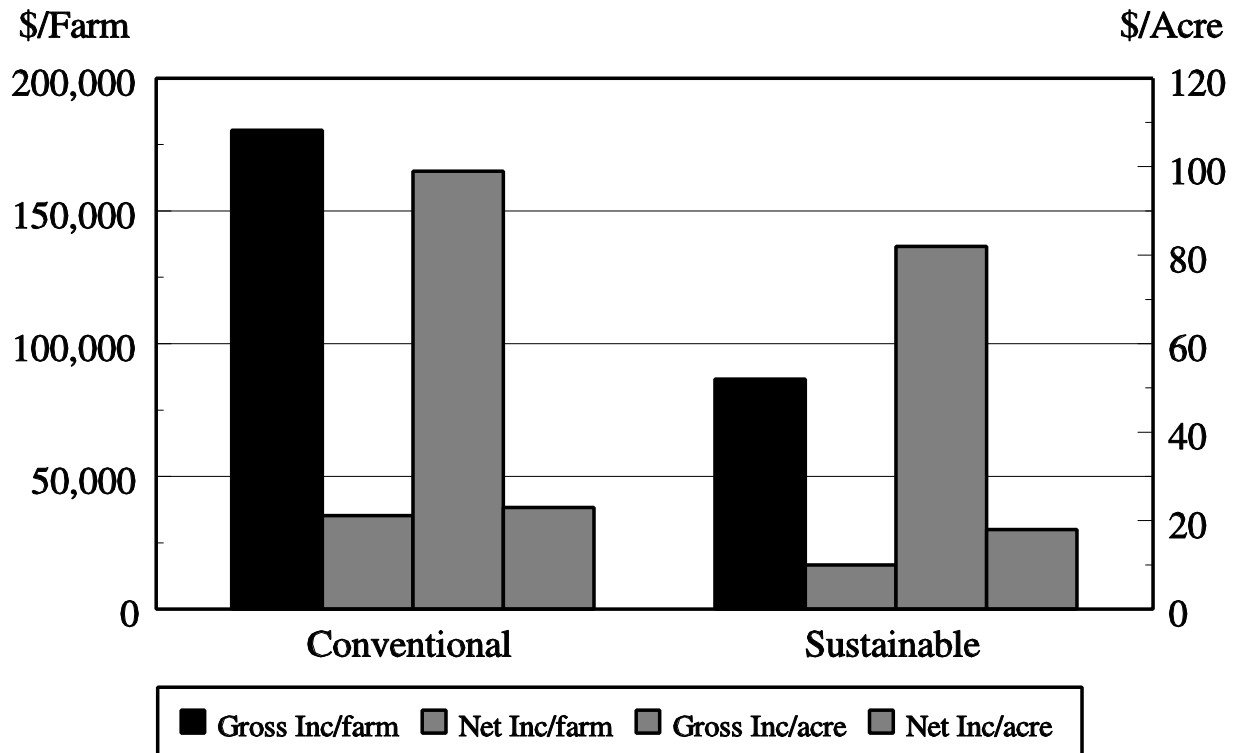


Figure 7. Gross and Net Farm Income per Farm and per Acre for Conventional and Sustainable Farms, 1991

Table 11. Average per Farm Income for ALL Conventional and Sustainable Farmers, by Source of Income (1989 and 1991)

Farm Income	Conventional			Sustainable			Between Group Differences	
	1989	1991	t	1989	1991	t	1989	1991
	-- \$1,000 --			-- \$1,000 --				
Livestock (resale)	7.0	5.2	.39	6.9	8.7	.62	.01	.52
Livestock (raised)	5.8	4.5	.30	18.4	15.5	.12	2.44**	2.11**
Sale of crops (raised)	81.6	75.9	.36	48.0	48.5	.12	1.41	1.35
Dist. from coops	0.7	0.7	.14	1.2	0.5	.84	.78	.66
Ag. program payments	11.8	16.6	1.34	10.6	5.8	2.45**	.45	3.40***
Crop insurance proceeds	4.7	1.8	1.39	6.8	0.6	1.71*	.51	1.48
Custom hire	2.4	1.6	.67	1.1	1.1	.23	1.05	.58
Other farm income	1.1	2.1	1.23	4.9	1.6	1.44	2.25**	.48
	(N=34)			(N=30)				

\*p<.10; \*\*p<.05; \*\*\*p<.01

The second largest source of income for sustainable farmers was from the sale of livestock. Sustainable farmers' income from livestock raised was three times that of conventional farmers. The second largest source of income for conventional farmers was from agricultural program payments. Although these payments were the same for conventional and sustainable farmers in 1989, the average payment increased by 50 percent in 1991 for the conventional farmers and fell by 50 percent over the same period for sustainable farmers.

Comparing the percentage of farmers in each category who have income from specific sources indicated that nearly three-quarters of the sustainable farmers received income from livestock they raised compared with only one-third of the conventional farmers (Table 12). The majority of conventional and sustainable farmers (94 percent and 73 percent, respectively) received income from the sale of crops they raised. The majority of conventional and sustainable farmers (82 percent and 73 percent, respectively) received some income in the form of agricultural program payments. One-half of the conventional farmers received income from custom hire, but only one-quarter of the sustainable farmers received income from this source.

**Table 12. Percent of Conventional and Sustainable Farmers who had Income in Selected Categories (1991)**

Categories	Conventional		Sustainable		X <sup>2</sup>
	N	%	N	%	
Livestock (resale)	7	21.2	10	33.3	1.17
Livestock (raised)	12	36.4	21	72.4	8.06***
Sale of crops (raised)	31	93.9	27	73.3	0.02
Distributions from coops	27	81.8	23	79.3	0.06
Ag. program payments	27	81.8	22	73.3	0.66
Crop insurance proceeds	13	39.4	9	30.0	0.61
Custom hire	16	48.5	8	26.7	3.17*
Other farm income	26	78.8	23	76.7	0.04
	(N=33)		(N=30)		

\*p<.10; \*\*p<.05; \*\*\*p<.01

The largest farm expense for conventional farmers was for fertilizers and lime (Table 13). This expense was negligible for sustainable farmers. As indicated previously, part of the classification strategy was the non-use of commercial fertilizers and herbicides. Therefore, the lack of herbicide and fertilizer expense for the sustainable farms compared to the conventional is really the result of how the farms were classified.

The largest expense for sustainable farmers was for depreciation. This amount was nearly the same as that for conventional farmers. Sustainable farmers' second largest expense was for feed. The amount paid for feed by conventional farmers was negligible. Conventional farmers' second largest expense was for rent of land and/or animals. The amount they paid in rent was three times the amount paid by sustainable farmers.

**Table 13. Average per Farm Expenses for Conventional and Sustainable Farmers, by Category of Expense (1989 and 1991)**

Farm Expenses	Conventional			Sustainable			Between Group Differences	
	1989	1991	t	1989	1991	t	1989	1991
	-- \$1,000 --			-- \$1,000 --			t	t
Cost of livestock	4.5	2.2	.69	3.9	13.7	.95	.15	.95
Breeding fees	0.0	0.0	.47	0.3	0.3	.15	1.48	1.65*
Chemicals	6.3	6.3	.08	0.5	0.9	.68	3.72***	.24***
Conservation expenses	0.0	0.1	1.61	0.1	0.1	.10	0.62	.82
Custom hire	4.2	3.7	.22	1.6	1.5	.10	1.56*	1.06
Depreciation	12.8	9.0	1.08	13.0	10.8	.42	.03	.63
Feed	1.3	2.4	.76	12.6	9.6	.24	2.29**	1.95*
Fertilizers and lime	17.4	15.5	.24	1.4	0.6	1.31	2.28**	1.86*
Freight and trucking	0.5	0.8	.58	1.6	1.7	.16	1.69*	1.22
Gas, fuel, oil	6.1	6.1	.00	4.9	5.2	.59	.88	.73
Insurance	3.9	4.1	.37	2.5	2.2	.26	1.98**	3.07***
Interest	10.0	9.8	.25	6.7	8.5	.70	1.45	.46
Hired labor	4.2	3.3	.55	0.7	2.8	1.34	2.29**	.30
Rent of machinery, equip.	0.7	1.1	.60	0.6	0.3	1.05	1.64*	1.30
Rent of land, animals	14.3	14.9	.05	4.8	4.5	.27	2.38**	2.54**
Repair and maintenance	8.4	9.0	.27	7.1	5.4	.93	.58	1.55
Seed	5.0	5.1	.08	3.8	3.1	.04	.86	1.48
Storage	0.3	0.1	.97	0.1	0.1	.16	.99	.72
Supplies	1.8	1.9	.21	2.9	3.5	.93	1.26	1.64*
Taxes	1.7	2.1	.42	1.4	2.1	1.73*	.66	.13
Utilities	1.3	1.9	1.55	2.1	2.1	.29	1.85*	.37
Veterinary fees	0.2	0.5	1.32	0.9	0.8	.16	2.20**	.83

\*p<.10; \*\*p<.05; \*\*\*p<.01



More sustainable farmers than conventional farmers reported expenses for livestock, feed, trucking, and veterinary services (Table 14). More conventional farmers than sustainable farmers reported expenses for chemical, fertilizer and lime, custom hire, hired labor, and rent of land and animals. Nearly all farmers in both groups reported expenses in the categories of depreciation, gas, fuel, and oil, insurance, interest, seed, supplies, taxes, and utilities.

**Table 14. Percent of Conventional and Sustainable Farmers who had Expenses in Selected Categories (1991)**

Categories	Conventional		Sustainable		X <sup>2</sup>
	N	%	N	%	
Cost of livestock	5	15.1	12	40.0	4.93***
Breeding fees	2	6.1	5	16.7	1.79
Chemicals	31	93.9	10	33.3	25.40***
Conservation expenses	5	15.2	3	10.0	0.38
Custom hire	29	87.9	19	63.3	5.22**
Depreciation	32	97.0	27	90.0	1.28
Feed	13	39.4	23	76.7	8.91***
Fertilizers and lime	30	90.9	9	30.0	24.72***
Freight and trucking	9	27.3	20	66.7	9.82***
Gas, fuel, oil	31	93.9	28	93.3	0.01
Insurance	33	100.0	29	96.7	1.11
Interest	30	90.9	28	93.3	0.13
Hired labor	24	72.7	15	50.0	3.44*
Rent of machinery, equip.	8	24.2	4	13.3	1.21
Rent of land, animals	28	84.8	17	56.7	6.11***
Repair and maintenance	33	100.0	29	96.7	1.11
Seed	30	90.9	26	86.7	0.29
Storage	7	21.2	3	10.0	1.48
Supplies	29	87.9	28	93.3	0.54
Taxes	27	81.8	27	90.0	0.86
Utilities	33	100.0	29	96.7	1.11
Veterinary fees	15	45.4	22	73.3	5.04**
	(N=33)		(N=30)		

\* p<.10; \*\* p<.05; \*\*\* p<.01

## LABOR RESPONSIBILITIES AND REQUIREMENTS

Farm management becomes more complex and demanding if farmers produce their own nitrogen, control weeds without chemical inputs, or produce livestock without antibiotics, hormones, and steroid growth implants. Sustainable farming requires more management expertise to handle crop rotations and livestock enterprises, to reduce potential pest problems, and to maximize complementarity among enterprises. Conventional farmers need not be as concerned with nitrogen use during a given year because they can rely on the application of nitrogen before planting the next crop. A shift to sustainable farming from conventional farming suggests that sustainable farms will have increased labor requirements and possibly some differences for assigning labor responsibilities (Sell et al. 1991).

The amount of labor required to produce an acre of wheat has decreased steadily since the 1800s. In 1830, about 55 hours of field labor was required to raise an acre of wheat; in 1990 only one to two hours of field labor was required to raise an acre of wheat (Promersberger and Lucken 1990). The biggest substitute for labor throughout this period was mechanization, gasoline and diesel engines, powerful large tractors, and field implements reduced labor requirements.

Respondents were asked about the types of labor used in their farming operation. About two-thirds of all the farmers in the study used non-household or hired labor. There were no statistically significant differences between conventional and sustainable farmers (Table 15). Conventional and sustainable farmers use farm operator, spouse, and other household members for farm labor at about the same proportion (Table 16). Nearly two-thirds of the conventional farmers used custom or contract labor compared to 29 percent of the sustainable farmers. Between four and five family members, on average, provided labor on conventional and sustainable farms (Table 17). Both types of farms used an average of two non-household member laborers.

**Table 15. Number of Conventional and Sustainable Farmers with Non-household or Hired Labor (1991)**

Has Non-household or hired labor	Conventional		Sustainable		$\chi^2$
	N	%	N	%	
Yes	18	62.1	17	73.9	
No	11	37.9	6	26.1	
Total	29	100.0	23	100.0	0.81

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 16. Number and Percent of Conventional and Sustainable Farms Using Labor, by Type of Laborer (1991)**

	Conventional		Sustainable		$\chi^2$
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	
Farm operator	29	96.7	24	96.0	0.02
Spouse	24	77.4	18	72.0	0.22
Other household members (not operator or spouse)	18	58.1	15	60.0	0.02
Custom/contract labor	21	65.6	8	28.6	8.21***
Non-household labor (not custom/contract)	18	62.1	17	73.9	0.82

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 17. Average Number of Laborers on Conventional and Sustainable Farms, by Type of Laborer (1991)<sup>1</sup>**

<u>Type of Laborer</u>	Conventional		Sustainable		<u>t-test</u>
	<u>N</u>	<u>Ave.</u>	<u>N</u>	<u>Ave.</u>	
Number of Family Workers	30	4.5	25	4.2	0.55
Number of Family Members with Ownership Interest	30	5.5	25	4.8	0.73
Number of Non-household Hired labor	11	2.4	6	1.5	0.83
Number of Non-household with Ownership Interest	10	3.3	6	2.3	1.18

<sup>1</sup>Averages for each category of laborer are calculated based on ALL of the farms in the study.

\*p<.10; \*\*p<.05; \*\*\*p<.01

Household members provided about 110 hours of farm labor per week during the summer months and between 51 and 60 hours per week during the winter months for both groups (Table 18). Non-household individuals provided between 40 and 68 hours of farm labor per week during the summer months and between 17 and 29 hours per week during the winter months. Differences between conventional and sustainable farmers were not significant. Although labor requirements in terms of hours/year on sustainable and conventional farms were nearly equal, there were differences between the groups when livestock were included as part of the farming operations (Table 19).

These data were then adjusted for acres farmed. Although the differences in numbers of hours/year/acre of labor on conventional and sustainable farms were not always statistically significant, they were higher in each category for sustainable farmers (Table 20). The amount of variability among farms of the same type in terms of amount of mechanization, size of farm implements, and type of livestock enterprises may have overwhelmed labor differences due to farm type.

Each of the farmers in the study were asked “In your farming operation who has primary responsibility for making decisions about \_\_\_\_\_?” For each of the areas listed, farmers stated that they had primary responsibility to make the decisions (Table 21). Only in the area of bookkeeping and records did the farmers' spouses have a substantial role (greater than 25 percent) in making decisions. However, in the area of investments and securing financing, the farmer and the spouse together played a substantial role (greater than 25 percent) in making decisions. There were no significant differences between the sustainable and conventional farmers.

Furthermore, each of the farmers were asked who had the primary responsibility for carrying out the decisions. For each of the areas listed, farmers stated that they had primary responsibility to carry out those activities (Table 22). Only in the area of bookkeeping and records did the farmers' spouses have a substantial role (greater than 25 percent) in carrying out those activities. However, in the area of investments and securing financing, both the farmer and the spouse played a substantial role (greater than 25 percent) in carrying out those activities. Again, in the area of responsibility for carrying out various activities, there was essentially no difference between the sustainable and conventional farmers.

**Table 18. Average Number of Hours per Week of Farm Labor Provided by Individuals on Conventional and Sustainable Farms, by Type of Laborer (1991)<sup>1</sup>**

	<u>Conventional</u>		<u>Sustainable</u>		<u>t-test</u>
	<u>N</u>	<u>Ave.</u>	<u>N</u>	<u>Ave.</u>	
Farm operator					
Summer Hrs/Wk	30	62.9	23	59.3	0.59
Winter Hrs/Wk	30	30.2	22	35.1	-0.83
Entire Year Hrs/Wk	30	52.0	23	50.1	0.22
Spouse					
Summer Hrs/Wk	26	16.5	20	25.8	-1.43*
Winter Hrs/Wk	25	8.6	19	14.4	-1.27
Entire Year Hrs/Wk	26	13.8	20	21.8	-1.42*
Family <sup>2</sup>					
Summer Hrs/Wk	30	110.5	24	109.9	0.06
Winter Hrs/Wk	30	50.7	23	58.5	-0.59
Entire Year Hrs/Wk	30	90.6	24	91.8	-0.08
Non-household					
Summer Hrs/Wk	10	67.8	6	40.3	1.14
Winter Hrs/Wk	10	31.0	6	17.2	0.83
Entire Year Hrs/Wk	10	55.6	6	32.6	1.09
All Laborers					
Summer Hrs/Wk	31	128.7	24	119.6	0.46
Winter Hrs/Wk	31	59.1	23	63.0	-0.25
Entire year Hrs/Wk	31	105.6	24	99.9	0.33

<sup>1</sup>Averages for each category of laborer are calculated ONLY for farms that use that category of laborer.

<sup>2</sup>Includes farm operator, spouse, and other family members.

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 19. Average Number of Hours per Year of Farm Labor Provided by Individuals Working on Conventional and Sustainable Farms, by Type of Laborer and Number of Livestock Enterprises<sup>1</sup>**

<u>Number of Livestock Enterprises</u>	<u>Conventional</u>		<u>Sustainable</u>		<u>t-test</u>
	<u>N</u>	<u>Ave.</u> - hrs/yr -	<u>N</u>	<u>Ave.</u> - hrs/yr -	
<u>Farm Operator</u>					
None	14	2,130	6	2,242	-0.21
One or Two	14	3,059	12	2,882	0.53
Three or More	<u>2</u>	<u>4,239</u>	<u>4</u>	<u>2,389</u>	1.92*
Total	30	2,704	22	2,618	0.29
<u>Spouse</u>					
None	12	533	6	844	-0.92
One or Two	12	649	9	1,788	-2.47**
Three or More	<u>2</u>	<u>2,210</u>	<u>4</u>	<u>373</u>	14.33***
Total	26	716	19	1,192	-1.59*
<u>All Household Members<sup>2</sup></u>					
None	14	3,124	6	4,705	-0.89
One or Two	14	5,707	13	4,986	0.80
Three or More	<u>2</u>	<u>8,841</u>	<u>4</u>	<u>4,586</u>	1.49
Total	30	4,711	23	4,843	-0.18
<u>Non-household Labor</u>					
None	5	992	2	1,257	-0.27
One or Two	5	4,788	3	2,439	1.47
Three or More	<u>0</u>	<u>---</u>	<u>1</u>	<u>347</u>	---
Total	10	2,890	6	1,697	1.09
<u>All Labor<sup>3</sup></u>					
None	15	3,247	6	1,668	-1.57*
One or Two	14	7,417	13	5,549	1.42
Three or More	<u>2</u>	<u>8,841</u>	<u>4</u>	<u>4,673</u>	1.46
Total	31	5,491	23	5,286	0.22

<sup>1</sup>Averages for each category of laborer are calculated based ONLY on farms in that category.

<sup>2</sup>Includes farm operator, spouse, and other family members.

<sup>3</sup>Includes all household and all non-household farm labor.

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 20. Average Number of Hours per Year per Acre of Farm Labor Provided by Individuals Working on Conventional and Sustainable Farms, by Type of Laborer and Number of Livestock Enterprises (1991)<sup>1</sup>**

<u>Number of Livestock Enterprises</u>	<u>Conventional</u>		<u>Sustainable</u>		<u>t-test</u>
	<u>N</u>	<u>Ave.</u> - hrs/acre -	<u>N</u>	<u>Ave.</u> - hrs/acre -	
<u>Farm Operator</u>					
None	14	2.2	6	2.4	-0.20
One or Two	14	1.8	12	2.6	-1.26
Three or More	<u>2</u>	1.1	<u>4</u>	3.7	-1.16
Total	30	1.9	22	2.8	-1.59
<u>Spouse</u>					
None	12	0.5	6	0.7	-0.63
One or Two	12	0.4	9	1.5	-1.92*
Three or More	<u>2</u>	0.6	<u>4</u>	0.6	-0.01
Total	26	0.5	19	1.1	-1.91*
<u>All Household Members</u> <sup>2</sup>					
None	14	3.2	6	4.6	-1.03
One or Two	14	3.1	13	4.2	-0.98
Three or More	<u>2</u>	2.2	<u>4</u>	5.9	-1.27
Total	30	3.1	23	4.6	-1.92
<u>Non-household Labor</u>					
None	5	0.8	2	1.0	-0.41
One or Two	5	1.4	3	2.8	-0.90
Three or More	<u>0</u>	---	<u>1</u>	0.5	---
Total	10	1.1	6	1.9	-0.72
<u>All Labor</u> <sup>3</sup>					
None	15	3.1	6	4.6	-1.12
One or Two	14	3.3	13	4.4	-0.96
Three or More	<u>2</u>	2.2	<u>4</u>	5.9	-1.27
Total	31	3.3	23	5.0	-2.07*

<sup>1</sup>Averages for each category of laborer are calculated based ONLY on farms in that category.

<sup>2</sup>Includes farm operator, spouse, and other family members.

<sup>3</sup>Includes all household and all non-household farm labor.

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 21. Person with Primary Responsibility for Decision-Making on Conventional and Sustainable Farms (1991)**

Decision-making Responsibility	Conventional		Sustainable	
	N	%	N	%
<u>Investments and securing financing</u>				
Self Only	24	63.2	24	58.5
Self, Spouse, &/or Children	11	29.0	13	31.7
Self & Professional/Non-partner/Employee/Partner	2	5.1	3	7.3
Spouse Only OR Spouse and Children/Professional	0	0.0	0	0.0
Partner/Contract/Professional/Employee	0	0.0	0	0.0
Partner Only or with Others	<u>1</u>	<u>2.6</u>	<u>1</u>	<u>2.4</u>
Total	38	99.9	41	99.9
<u>Bookkeeping and records</u>				
Self Only	19	50.0	22	53.7
Self, Spouse, &/or Children	7	18.4	6	15.0
Self & Professional/Non-partner/Employee/Partner	1	2.6	1	2.5
Spouse Only OR Spouse and Children/Professional	10	26.3	11	27.5
Partner/Contract/Professional/Employee	1	2.6	0	0.0
Partner Only or with Others	<u>0</u>	<u>0.0</u>	<u>0</u>	<u>0.0</u>
Total	38	99.9	41	100.0
<u>Crop nutrient practices</u>				
Self Only	31	88.6	34	85.7
Self, Spouse, &/or Children	2	5.7	3	7.5
Self & Professional/Non-partner/Employee/Partner	2	5.7	2	5.0
Spouse Only OR Spouse and Children/Professional	0	0.0	1	2.5
Partner/Contract/Professional/Employee	0	0.0	0	0.0
Partner Only or with Others	<u>0</u>	<u>0.0</u>	<u>0</u>	<u>0.0</u>
Total	35	100.0	40	100.0
<u>Purchase of farm inputs</u>				
Self Only	31	81.6	29	70.7
Self, Spouse, &/or Children	3	7.9	6	14.6
Self & Professional/Non-partner/Employee/Partner	2	5.3	4	9.8
Spouse Only OR Spouse and Children/Professional	1	2.6	1	2.4
Partner/Contract/Professional/Employee	0	0.0	1	2.4
Partner Only or with Others	<u>1</u>	<u>2.6</u>	<u>0</u>	<u>0.0</u>
Total	38	100.0	41	99.9

--- Continued ---



**Table 21. Continued**

Decision-making Responsibility	Conventional		Sustainable	
	N	%	N	%
<u>Livestock care and monitoring</u>				
Self Only	12	66.7	20	60.6
Self, Spouse, &/or Children	3	16.7	8	24.2
Self & Professional/Non-partner/Employee/Partner	2	11.1	2	6.1
Spouse Only OR Spouse and Children/Professional	0	0.0	1	3.0
Partner/Contract/Professional/Employee	0	0.0	1	3.0
Partner Only or with Others	<u>1</u>	<u>5.6</u>	<u>1</u>	<u>3.0</u>
Total	18	100.1	33	99.9
<u>Tillage and planting activities</u>				
Self Only	31	81.6	31	75.6
Self, Spouse, &/or Children	2	5.6	7	17.1
Self & Professional/Non-partner/Employee/Partner	3	8.3	2	4.9
Spouse Only OR Spouse and Children/Professional	0	0.0	1	2.4
Partner/Contract/Professional/Employee	0	0.0	0	0.0
Partner Only or with Others	<u>0</u>	<u>0.0</u>	<u>0</u>	<u>0.0</u>
Total	36	100.0	41	99.9
<u>Mechanical weed control and herbicide applications</u>				
Self Only	32	88.9	27	73.0
Self, Spouse, &/or Children	2	5.6	4	10.8
Self & Professional/Non-partner/Employee/Partner	1	2.8	4	10.8
Spouse Only OR Spouse and Children/Professional	0	0.0	1	2.7
Partner/Contract/Professional/Employee	0	0.0	1	2.7
Partner Only or with Others	<u>1</u>	<u>2.8</u>	<u>0</u>	<u>0.0</u>
Total	36	100.1	39	100.0
<u>Forage handling and pasture management activities</u>				
Self Only	13	65.0	25	73.5
Self, Spouse, &/or Children	3	15.0	5	14.7
Self & Professional/Non-partner/Employee/Partner	3	15.0	3	8.8
Spouse Only OR Spouse and Children/Professional	0	0.0	1	2.9
Partner/Contract/Professional/Employee	0	0.0	0	0.0
Partner Only or with Others	<u>1</u>	<u>5.0</u>	<u>0</u>	<u>0.0</u>
Total	20	100.0	34	99.9

**Table 22. Person with Primary Responsibility to Carry Out Activities on Conventional and Sustainable Farms**

Work <u>Responsibility</u>	<u>Conventional</u>		<u>Sustainable</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
<u>Investments and securing financing</u>				
Self Only	24	64.9	27	67.5
Self, Spouse, &/or Children	10	27.0	7	17.5
Self & Professional/Non-partner/Employee/Partner	2	5.4	4	10.0
Spouse Only OR Spouse and Children/Professional	0	0.0	2	5.0
Partner/Contract/Professional/Employee	0	0.0	0	0.0
Partner Only or with Others	<u>1</u>	<u>2.7</u>	<u>0</u>	<u>0.0</u>
Total	38	99.9	41	99.9
<u>Bookkeeping and records</u>				
Self Only	13	35.1	20	50.0
Self, Spouse, &/or Children	9	24.3	7	17.5
Self & Professional/Non-partner/Employee/Partner	1	2.7	2	5.0
Spouse Only OR Spouse and Children/Professional	13	35.1	11	27.5
Partner/Contract/Professional/Employee	1	2.7	0	0.0
Partner Only or with Others	<u>0</u>	<u>0.0</u>	<u>0</u>	<u>0.0</u>
Total	37	99.9	40	100.0
<u>Crop nutrient practices</u>				
Self Only	29	82.9	32	80.0
Self, Spouse, &/or Children	1	2.9	4	10.0
Self & Professional/Non-partner/Employee/Partner	4	11.4	2	5.0
Spouse Only OR Spouse and Children/Professional	0	0.0	1	2.5
Partner/Contract/Professional/Employee	1	2.9	1	2.5
Partner Only or with Others	<u>0</u>	<u>0.0</u>	<u>0</u>	<u>0.0</u>
Total	35	100.0	40	100.0
<u>Purchase of farm inputs</u>				
Self Only	30	81.1	29	72.5
Self, Spouse, &/or Children	3	8.1	6	15.0
Self & Professional/Non-partner/Employee/Partner	3	8.1	3	7.5
Spouse Only OR Spouse and Children/Professional	0	0.0	1	2.5
Partner/Contract/Professional/Employee	0	0.0	1	2.5
Partner Only or with Others	<u>1</u>	<u>2.7</u>	<u>0</u>	<u>0.0</u>
Total	37	100.0	40	99.9

--- Continued ---

**Table 22. Continued**

Work Responsibility	<u>Conventional</u>		<u>Sustainable</u>	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
<u>Livestock care and monitoring</u>				
Self Only	11	64.7	18	54.6
Self, Spouse, &/or Children	3	17.6	9	27.3
Self & Professional/Non-partner/Employee/Partner	2	11.8	3	9.1
Spouse Only OR Spouse and Children/Professional	0	0.0	2	6.1
Partner/Contract/Professional/Employee	0	0.0	1	3.0
Partner Only or with Others	<u>1</u>	<u>5.9</u>	<u>0</u>	<u>0.0</u>
Total	17	100.1	33	99.9
<u>Tillage and planting activities</u>				
Self Only	24	68.6	24	70.7
Self, Spouse, &/or Children	3	8.6	8	19.5
Self & Professional/Non-partner/Employee/Partner	6	17.1	4	9.8
Spouse Only OR Spouse and Children/Professional	0	0.0	0	0.0
Partner/Contract/Professional/Employee	2	5.7	0	0.0
Partner Only or with Others	<u>0</u>	<u>0.0</u>	<u>0</u>	<u>0.0</u>
Total	35	100.0	41	99.9
<u>Mechanical weed control and herbicide applications</u>				
Self Only	25	71.4	28	73.0
Self, Spouse, &/or Children	2	5.7	6	15.8
Self & Professional/Non-partner/Employee/Partner	3	8.6	3	7.9
Spouse Only OR Spouse and Children/Professional	0	0.0	1	2.7
Partner/Contract/Professional/Employee	4	11.4	0	0.0
Partner Only or with Others	<u>1</u>	<u>2.9</u>	<u>0</u>	<u>0.0</u>
Total	35	100.0	39	100.0
<u>Forage handling and pasture management activities</u>				
Self Only	12	66.7	21	61.8
Self, Spouse, &/or Children	2	11.1	8	23.5
Self & Professional/Non-partner/Employee/Partner	3	16.7	3	8.8
Spouse Only OR Spouse and Children/Professional	0	0.0	1	2.9
Partner/Contract/Professional/Employee	0	0.0	1	2.9
Partner Only or with Others	<u>1</u>	<u>5.6</u>	<u>0</u>	<u>0.0</u>
Total	20	100.0	34	99.9

## SALES AND PURCHASE PATTERNS

Examining sales and purchase patterns of various goods and services is a method to compare levels of community support (Goldschmidt, 1978; Korsching, 1984; Goreham et al. 1986). Some arguments have been made that suggest sustainable agriculture may help stabilize, or reverse, some of the adverse economic and social trends in rural communities (Lockeretz 1986, Flora 1990). To determine the amount of community support and establish any differences by farm type, survey respondents were asked a variety of questions related to the amount of goods and services purchased and sold within their local communities and abroad. The results of these questions are presented in this section.

About one-third of the conventional farmers had sales out of the state; nearly 60 percent of the sustainable farmers had sales outside of the state (Table 23 and Figure 8). Of the conventional farmers who sold products out of the state, slightly less than one-half stated that they lacked markets in-state. Of the sustainable farmers who made out-of-state sales, nearly 80 percent stated that they lacked in-state markets. There was not a statistically significant difference in purchases made out of the state between the two groups of farmers.

**Table 23. Locations of Sales and Purchases by Conventional and Sustainable Farmers (1991)**

	<u>Conventional</u>		<u>Sustainable</u>		<u>X<sup>2</sup></u>
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	
<u>Sales Out-of-State</u>					
Yes	13	35.1	24	58.5	
No	<u>24</u>	<u>64.9</u>	<u>17</u>	<u>41.5</u>	
Total	37	100.0	41	100.0	4.27**
<u>If Yes, Out-of-state sales were because of lack of available markets in-state</u>					
Yes	6	46.2	19	79.2	
No	<u>7</u>	<u>53.8</u>	<u>5</u>	<u>20.8</u>	
Total	13	100.0	24	100.0	
<u>Purchases Out-of-State</u>					
Yes	6	17.0	11	26.8	
No	<u>30</u>	<u>83.0</u>	<u>30</u>	<u>73.2</u>	
Total	36	100.0	41	100.0	2.27
<u>If Yes, Out-of-state purchases were because of unavailability of item in-state</u>					
Yes	3	50.0	8	72.7	
No	<u>3</u>	<u>50.0</u>	<u>3</u>	<u>27.3</u>	
Total	6	100.0	11	100.0	

\*p<.10; \*\*p<.05; \*\*\*p<.01

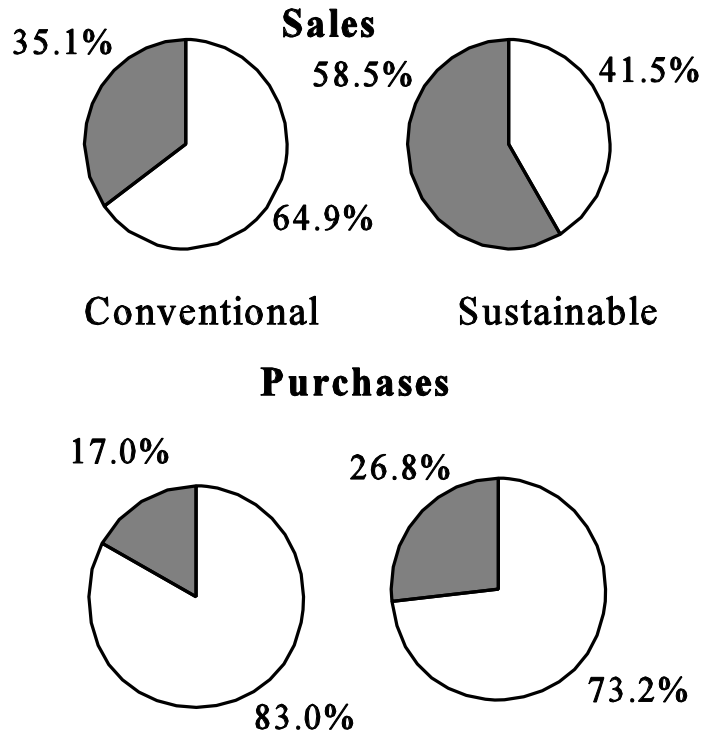


Figure 8. Out-of-State Sales and Purchases for Conventional and Sustainable Farms, 1991 (Shaded area is percentage of farmers with out-of-state sales or purchases.)

Less than one-half of the two groups of farmers purchased inputs directly from other farmers during the preceding 12 months (Table 24). Of those who purchased inputs directly from other farmers, seed was the input listed most often.

Only two-of-ten farmers in the study purchased inputs that were not only sold but also produced in their local areas. Of those who purchased inputs that were produced in their local areas, sustainable farmers were likely to purchase feed and conventional farmers were likely to purchase seed (Table 25).

Conventional farmers purchased about two-thirds of their farm inputs in their local hometowns, whereas sustainable farmers purchased about one-half of their farm inputs in their hometowns (Table 26). Although conventional farmers purchased more of their goods and services in their local hometowns than did the sustainable farmers, these differences were not statistically significant.

**Table 24. Purchase of Inputs Directly from other Farmers During Past 12 Months (1991)**

	<u>Conventional</u>		<u>Sustainable</u>		<u>X<sup>2</sup></u>
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	
<u>Purchase Inputs Directly</u>					
Yes	14	36.8	18	43.9	0.41
No	<u>24</u>	<u>63.2</u>	<u>23</u>	<u>56.1</u>	
Total	38	100.0	41	100.0	
<u>If Yes, Inputs Purchased</u>					
Hay/alfalfa	1		3		
Livestock (feeder pigs, boars, cattle, breeding stock, etc.)	0		2		
Straw	1		1		
Oats	0		2		
Seed (all types)	10		12		
Wheat	2		0		
Sorghum	0		1		
Corn	0		3		
Flax	0		1		
<u>Number of Dollars Spent</u>					
Mean <sup>1</sup>	4,308		3,779		<u>t-test</u>
(SD)	10,359		6,334	0.17	
Median <sup>1</sup>	1,250		1,295		
	(N=14)		(N=18)		
Mean <sup>2</sup>	1,587		1,659		-0.06
(SD)	6,492		4,545		
Mean/acre <sup>2</sup>	0.7		2.1		-1.16
(SD)	1.4		7.8		
	(N=38)		(N=41)		

<sup>1</sup>Includes ONLY farmers who purchased items directly from other farmers.

<sup>2</sup>Includes ALL farmers.

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 25. Direct Purchase of Inputs that Were Produced in the Local Area During Past 12 Months (1991)**

	<u>Conventional</u>		<u>Sustainable</u>		<u>X<sup>2</sup></u>
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	
<u>Purchase Inputs Directly</u>					
Yes	6	15.8	9	22.0	
No	<u>32</u>	<u>84.2</u>	<u>32</u>	<u>78.0</u>	
Total	38	100.0	41	100.0	0.49
<u>If YES, Inputs Purchased</u>					
Feed (includes Milled Feed Concentrates, Premixes, Roasted Soybeans, Feed Supplements, and Corn or Beans)	2		7		
Black medic Seed, Seed Oats (All Types)	1		0		
	4		1		
Alfalfa/Hay	0		1		
Corn	0		1		
<u>Mean Number of Dollars Spent</u>					<u>t-test</u>
	20,751.5		9,424.2		0.86
	(N=6)		(N=9)		

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 26. Average Number and Percent of Goods and Services Purchased by Conventional and Sustainable Farmers in Their Hometowns (1991)<sup>1</sup>**

	<u>Conventional</u>	<u>Sustainable</u>	<u>t-test</u>
<u>Farm Inputs<sup>2</sup></u>			
Average Number of Inputs Purchased	2.9	2.0	5.11***
Average Number of Inputs Purchased in Hometown	1.9	1.0	2.85***
Hometown Farm Input Purchases as a Percent of All Farm Input Purchases	65.5	50.0	
<u>Consumer Goods/Services<sup>3</sup></u>			
Average Number of Inputs Purchased	4.0	4.0	1.00
Average Number of Inputs Purchased in Hometown	1.8	1.4	0.81
Hometown Consumer Input Purchases as a Percent of All Consumer Input Purchases	45.0	35.0	
<u>All Goods/Services<sup>4</sup></u>			
Average Number of Inputs Purchased	19.3	18.8	0.67
Average Number of Inputs Purchased in Hometown	8.2	6.5	0.94
Hometown Goods/Service Input Purchases as a Percent of All Goods/Service Purchases	42.5	34.6	

<sup>1</sup>Based on ALL farmers in the study.

<sup>2</sup>Including seeds, herbicides, and fertilizer.

<sup>3</sup>Including groceries, clothing, hardware, and personal banking.

<sup>4</sup>Based on a list of 24 goods and services.

\*p<.10; \*\*p<.05; \*\*\*p<.01



All of the conventional and sustainable farmers purchased seed, tractor fuel, farm machinery, groceries, hardware, medical and hospital care, and personal banking services (Table 27). More of the conventional farmers purchased herbicides and insecticides, fertilizer, custom spraying services, and crop insurance than sustainable farmers. More of the sustainable farmers purchased livestock, livestock supplies, and veterinary services than conventional farmers.

Sustainable farmers purchased seed, fertilizer, feed, livestock supplies, tractor fuel, farm machinery, veterinary supplies, and crop scouting services in larger communities than did conventional farmers (Table 28).

Sustainable farmers travel an average of 8.8 more miles to purchase groceries than conventional farmers. No other statistically significant differences were noted regarding the distance conventional and sustainable farmers travel to purchase goods and services (Table 29).

Most farmers purchase goods and services at the town closest to them that has those products. However, farmers are somewhat more likely to bypass a town in order to purchase farm machinery and automobiles, clothing and groceries, and hospital and medical care (Table 30). Conventional farmers are somewhat more likely to bypass a town for hospital care, whereas sustainable farmers are somewhat more likely to bypass a town for feed purchases and operating loans.

Few differences between conventional and sustainable farmers were found in the average number of miles they could have traveled to the closest town to purchase selected goods and services (Table 31). The number of farmers responding to this question prevents further analysis.

**Table 27. Number and Percent of Conventional and Sustainable Farmers Who Purchase Selected Goods and Services (1991)**

	<u>Conventional</u>		<u>Sustainable</u>		<u>X<sup>2</sup></u>
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	
<u>Farm Inputs</u>					
Operating loans	26	81.2	19	67.9	1.43
Seed	32	100.0	28	100.0	--
Fertilizer	31	96.9	14	50.0	17.50***
Herbicide/Insecticide	31	96.9	14	50.0	17.50***
<u>Livestock Purchases</u>					
Livestock	13	40.6	17	60.7	2.41*
Livestock feed	16	50.0	22	78.6	5.25**
Livestock supplies	16	50.0	22	78.6	5.25**
Veterinary services	16	50.0	21	75.0	3.95**
<u>Machinery Purchases</u>					
Farm machinery	32	100.0	28	100.0	--
Machinery repair	29	90.6	27	96.4	0.81
Tractor fuel	32	100.0	28	100.0	--
<u>Farm Services</u>					
Agricultural consulting	12	37.5	10	35.7	0.02
Crop scouting	6	18.8	4	14.3	0.21
Custom spraying	20	62.5	7	25.0	8.49***
Crop insurance	30	93.8	22	78.6	2.98*
<u>Consumer Goods</u>					
Groceries	32	100.0	28	100.0	--
Clothing	31	96.9	28	100.0	0.89
Hardware	32	100.0	28	100.0	--
Automobile purchases	31	96.9	28	100.0	0.89
Automobile repair	30	93.8	28	100.0	1.81
<u>Consumer Services</u>					
Physicians	32	100.0	28	100.0	--
Hospitals	32	100.0	28	100.0	--
Personal banking	32	100.0	28	100.0	--
Library	23	71.9	19	67.9	0.12
	(N=38)		(N=41)		

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 28. Average Population of Communities where Conventional and Sustainable Farmers Purchase Selected Goods and Services (1991)**

	<u>Conventional</u>		<u>Sustainable</u>		<u>t-test</u>
	<u>N</u>	<u>Population</u>	<u>N</u>	<u>Population</u>	
<u>Farm Inputs</u>					
Operating loans	23	6,890	19	7,874	-0.25
Seed	28	2,069	24	5,468	-1.89*
Fertilizer	29	2,081	11	9,701	-2.75***
Herbicide/Pesticide	28	2,269	12	6,095	-1.64
<u>Livestock Purchases</u>					
Livestock	11	11,514	13	21,968	-1.27
Livestock feed	13	3,272	20	11,706	-2.20**
Livestock supplies	15	5,586	20	18,805	-2.42**
Veterinary services	14	4,242	20	13,463	-2.12**
<u>Machinery Purchases</u>					
Farm machinery	26	3,946	26	8,576	-1.98**
Machinery repair	26	5,661	23	7,342	-0.46
Tractor fuel	29	1,592	26	5,763	-1.86*
<u>Farm Services</u>					
Agricultural consulting	11	14,225	10	14,011	0.02
Crop scouting	5	1,183	4	17,150	-2.67**
Custom spraying	18	3,018	6	9,046	-1.62
Crop insurance	29	7,151	21	10,323	-0.77
<u>Consumer Goods</u>					
Groceries	29	8,998	27	16,224	-1.57
Clothing	30	25,331	27	27,306	-0.33
Hardware	29	7,720	26	14,005	-1.44
Automobile purchases	28	10,986	24	17,409	-1.37
Automobile repair	28	9,128	25	9,516	-0.10
<u>Consumer Services</u>					
Physicians	30	22,050	27	18,555	0.60
Hospitals	31	23,581	27	19,757	0.68
Personal banking	30	5,986	28	8,559	-0.74
Library	22	13,399	18	9,344	0.77
	(N=38)		(N=41)		

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 29. Average Number of Miles Conventional and Sustainable Farmers Travel to Purchase Selected Goods and Services (1991)**

	<u>Conventional</u>		<u>Sustainable</u>		<u>t-test</u>
	<u>N</u>	<u>Miles</u>	<u>N</u>	<u>Miles</u>	
<u>Farm Inputs</u>					
Operating loans	26	16.9	18	17.9	-0.28
Seed	31	10.5	25	12.9	-1.21
Fertilizer	31	9.6	12	12.4	-1.43
Herbicide/Insecticide	31	11.0	14	11.8	-0.36
<u>Livestock Purchases</u>					
Livestock	11	34.9	16	49.7	-0.76
Livestock feed	16	12.0	22	27.0	-1.22
Livestock supplies	15	23.3	22	33.4	-0.73
Veterinary services	16	21.4	21	39.3	-1.38
<u>Machinery Purchases</u>					
Farm machinery	28	22.2	26	23.3	-0.25
Machinery repair	28	15.8	24	15.9	-0.06
Tractor fuel	32	23.0	28	12.1	0.88
<u>Farm Services</u>					
Agricultural consulting	11	21.1	10	32.4	-0.63
Crop scouting	6	13.2	4	19.5	-0.61
Custom spraying	19	11.0	7	16.9	-1.23
Crop insurance	29	17.0	21	20.8	-1.14
<u>Consumer Goods</u>					
Groceries	31	14.7	28	23.5	-2.27**
Clothing	29	35.5	28	37.0	-0.24
Hardware	29	15.1	28	18.2	-1.01
Automobile purchases	28	27.7	26	32.1	-0.66
Automobile repair	30	21.1	26	16.5	1.15
<u>Consumer Services</u>					
Physicians	31	34.3	27	26.5	1.32
Hospitals	31	37.2	26	29.6	1.25
Personal banking	31	14.8	28	18.1	-1.02
Library	22	20.6	19	18.3	0.44
	(N=38)		(N=41)		

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 30. Percent of Conventional and Sustainable Farmers who Stated that the Town Where Goods and Services Are Purchased is Closest Town (1991)**

	<u>Conventional</u>		<u>Sustainable</u>		<u>X<sup>2</sup></u>
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	
<u>Farm Inputs</u>					
Operating loans	20	80.0	9	56.2	2.66*
Seed	25	80.6	18	78.3	0.05
Fertilizer	27	90.0	10	83.3	0.36
Herbicide/Insecticide	26	83.9	13	92.9	0.67
<u>Livestock Purchases</u>					
Livestock	9	81.8	8	57.1	1.72
Livestock feed	15	93.8	15	71.4	2.95*
Livestock supplies	14	93.3	17	81.0	1.12
Veterinary services	15	93.8	18	90.0	0.16
<u>Machinery Purchases</u>					
Farm machinery	19	65.5	17	68.0	0.04
Machinery repair	25	86.2	21	87.5	1.56
Tractor fuel	24	77.4	21	77.8	0.00
<u>Farm Services</u>					
Agricultural consulting	9	81.8	9	90.0	0.29
Crop scouting	5	100.0	3	100.0	--
Custom spraying	16	84.2	6	85.7	0.01
Crop insurance	20	69.0	13	61.9	0.27
<u>Consumer Goods</u>					
Groceries	23	74.2	17	63.0	0.85
Clothing	16	53.3	17	65.4	0.84
Hardware	24	82.8	23	85.2	0.06
Automobile purchases	19	63.3	14	56.0	0.31
Automobile repair	24	82.8	23	85.2	1.45
<u>Consumer Services</u>					
Physicians	19	61.3	15	55.6	0.20
Hospitals	18	58.1	21	80.8	3.37*
Personal banking	25	80.6	20	74.1	0.36
Library	18	81.8	16	88.9	0.39
	(N=38)		(N=41)		

\*p<.10; \*\*p<.05; \*\*\*p<.01

**Table 31. Average Number of Miles Conventional and Sustainable Farmers Could Travel to Closest Town to Purchase Selected Goods and Services (1991)**

	<u>Conventional</u>		<u>Sustainable</u>		<u>t-test</u>
	<u>N</u>	<u>Miles</u>	<u>N</u>	<u>Miles</u>	
<u>Farm Inputs</u>					
Operating loans	5	8.2	4	19.2	-1.55
Herbicide/Insecticide	5	5.0	1	6.0	-0.38
Seed	6	7.6	3	12.0	-2.55*
Fertilizer	3	7.5	1	12.0	-4.50**
<u>Livestock Purchases</u>					
Livestock	2	18.5	4	32.2	-0.71
Livestock feed	1	7.0	5	56.2	-0.45
Livestock supplies	0	0.0	4	11.0	---
Veterinary services	0	0.0	1	5.0	---
<u>Machinery Purchases</u>					
Farm machinery	8	15.9	6	14.0	0.37
Machinery repair	4	18.2	0	0.0	---
Tractor fuel	6	11.1	6	10.7	0.17
<u>Farm Services</u>					
Agricultural consulting	2	21.0	1	18.0	0.74
Crop scouting	0	0.0	0	0.0	---
Custom spraying	3	16.7	1	22.0	-0.63
Crop insurance	8	10.0	6	16.7	-1.27
<u>Consumer Goods</u>					
Groceries	7	11.0	9	13.7	-0.54
Clothing	13	26.0	7	23.7	0.21
Hardware	4	13.5	3	13.0	0.16
Automobile purchases	8	21.2	8	27.6	-0.66
Automobile repair	4	15.2	3	21.0	-0.51
<u>Consumer Services</u>					
Physicians	11	24.5	11	28.4	-0.45
Hospitals	12	26.1	4	35.8	-1.13
Personal banking	6	8.3	5	19.8	-2.00*
Library	4	35.8	1	1.5	0.84
	(N=38)		(N=41)		

\*p<.10; \*\*p<.05; \*\*\*p<.01

## CONCLUSIONS AND IMPLICATIONS

We found very few statistical significant differences between the conventional and sustainable farms. This suggests that there is more variation within each of the farm types than between them. However, there are some very general trends that were fairly consistent.

Sustainable farms:

- were smaller in acreage,
- had more diverse cropping patterns,
- had lower crop yields,
- had fewer assets, lower equity, lower gross, and net incomes,
- had crop and livestock sales as first and second sources of income versus crop sales and government program payments as first and second for conventional farms,
- had depreciation and feed as their two top expenses versus fertilizer and rent of land/animals for conventional farms,
- made more out-of -state sales, primarily due to unavailability of in-state markets,
- were less likely to purchase inputs from local markets,
- and had more hours/acre/year in labor.

At least four implications stem from these findings. First, sustainable farmers purchased fewer of their needed inputs from local sources and they sold fewer of their products locally than did their conventional counterparts. They reported that the reason for this difference was the lack of local markets and input sources to meet their specific needs. More local markets and sources of input supplies may need to be developed.

Second, sustainable farmers' incomes (whether net, gross, per farm, or per acre) typically lag behind those of conventional farmers. If they are to achieve similar income levels with their conventional counterparts, sustainable farmers must develop additional sources of income.

Third, sustainable farmers are less likely to receive similar levels of government farm payments than conventional farmers. An increase in number of sustainable farmers could result in a reduced need for some government farm programs, and in reverse, reductions in farm programs may result in an increase in the number of farmers using sustainable methods. If this occurs, educational and governmental agencies will need to anticipate this change and be ready to assist farmers make this transition.

And fourth, sustainable farms typically are more diversified in their farming operations and include more livestock enterprises than conventional farmers. This added diversity of sustainable farms may help to decrease the variability of their annual income.

## REFERENCES

- Babb, E. M. 1979. *Some Causes of Structural Change in U.S. Agriculture*. In *Structure Issues of American Agriculture*. Washington, DC: U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service.
- Beus, Curt E. and Riley E. Dunlap. 1990. "Conventional versus Alternative Agriculture: The Paradigmatic Roots of the Debate." *Rural Sociology* 55: 590-616.
- Bureau of the Census. 1994. *1992 Census of Agriculture: North Dakota*. Washington, DC: GPO.
- Flora, Cornelia Butler. 1990. Sustainability of agriculture and rural communities. In *Sustainable Agriculture in temperate zones*, ed. Charles A. Francis, Cornelia Butler Flora, and Larry D. King. New York: John Wiley & Sons. P 343-360.
- Goldschmidt, Walter. 1978. *As You Sow: Three Studies in the Social Consequences of Agribusiness*. Allenheld, Osmun. Montclair, NJ.
- Goreham, Gary A., F. Larry Leistritz, and Richard W. Rathge. 1986. *Trade and Marketing Patterns of North Dakota Farm and Ranch Operators*. Agricultural Economics Miscellaneous Report No. 98. North Dakota State University, Department of Agricultural Economics, Fargo.
- Korsching, Peter F. 1984. Farm Structural Characteristics and Proximity of Purchase Location of Goods and Services. In *Research in Rural Sociology and Development 1*. Edited by Frank A. Fear and Harry K. Schwarzweller. JAI Press Inc., Greenwich, CT. p 261-87.
- Krause, K. R. and L. R. Kyle. 1970. Economic Factors Underlying the Incidence of Large Farming Units: The Current Situation and Probable Trends. *American Journal of Agricultural Economics*. 52:788-760.
- Leistritz, F. Larry, Brenda L. Ekstrom, Janet Wanzek, and Timothy L. Mortensen. 1989. *Outlook of North Dakota Farm Households: Results of the 1988 Longitudinal Farm Survey*. Agricultural Economics Report No. 246. Fargo, N.Dak.: Department of Agricultural Economics, North Dakota State University.
- Lockeretz, William. 1986. Alternative Agriculture.: In *New directions for Agriculture and Agricultural research: Neglected Dimensions and emerging Alternatives*. Edited by Kenneth A. Dahlberg. Rowman & Allanheld. Totowa, NJ. p 291-311.
- National Research Council. 1989. *Alternative Agriculture*. Washington, DC: National Academy Press.



- Promersberger, William J. and Charlene Lucken. 1990. *Mechanizing North Dakota Agriculture*. North Dakota Farm Research. North Dakota State University Agricultural Experiment Station. Vol. 48, No. 1, p. 17-20.
- Sell, Randall S., Bruce L. Dahl, Roy M. Jacobsen, Larry D. Stearns, David L. Watt, and George A. Youngs, Jr. 1991. *Sustainable Agriculture and the Structure of North Dakota Agriculture*. Agricultural Economics Report No. 274. Department of Agricultural Economics, North Dakota State University, Fargo.
- Watt, David L., Bruce L. Dahl, Gary A. Goreham, George A. Youngs, Jr., Randall S. Sell, and Larry D. Stearns. 1992. *Characteristics of Farms Using Sustainable Practices: North Dakota, 1989*. Final Report, Phase I for the Northwest Area Foundation Initiative. Fargo, N.Dak.: Department of Agricultural Economics, North Dakota State University.