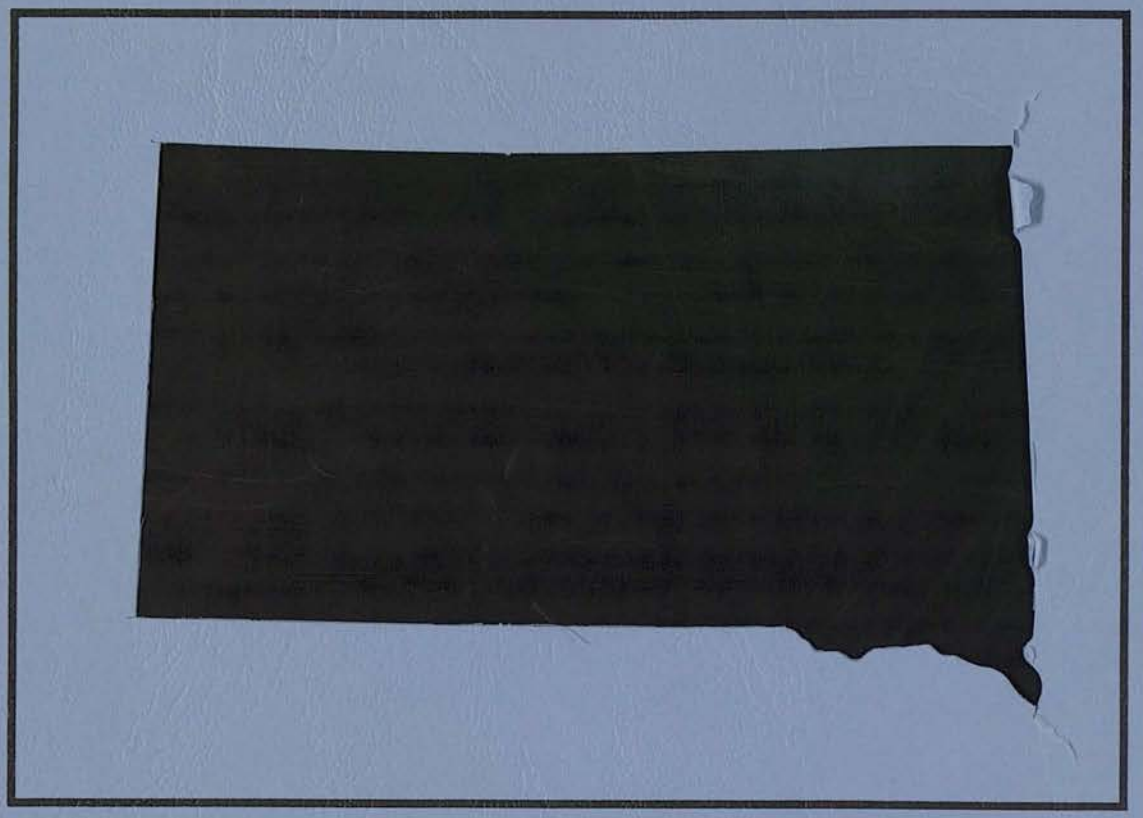

ECONOMICS DEPARTMENT

South Dakota State University
Brookings, South Dakota

RURAL ECONOMY IMPLICATIONS OF FARMS CONVERTING TO SUSTAINABLE AGRICULTURE PRACTICES: SOME ESTIMATES FOR SOUTH DAKOTA

by

Thomas L. Dobbs and John D. Cole*

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*Dobbs is a Professor of Agricultural Economics and Cole is a Research Assistant, both in the Department of Economics at SDSU, Brookings, SD.

PREFACE

This is one of a series of reports by South Dakota State University (SDSU) agricultural economists on economic aspects of sustainable agriculture. Previously released reports have covered the economic profitability of various types of crop and livestock systems and the implications of public policies for relative profitabilities of different systems. The present report focuses on some of the **rural economy** implications of conversions from "conventional" to "sustainable" farming systems in five areas of South Dakota. We regard this research effort as an important beginning -- rather than the last word -- in understanding the effects on rural communities of a gradual changeover to more "sustainable" farming systems.

The research leading to this report was supported by the SDSU Agricultural Experiment Station and by Grant No. 88-56 from the Northwest Area Foundation (in St. Paul, MN). We wish to thank Donald Taylor and David Becker for their careful reviews of a draft version of this report. The computer assistance of Scott Van Der Werff is greatly appreciated, also. In addition, thanks are extended to Mrs. Verna Clark for patiently and accurately typing the manuscript. Finally, but not least, we thank the farmers and others in South Dakota who provided information leading to our earlier reports; data from those earlier reports were essential for much of the analysis reported herein.

TLD and JDC
February 1991

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RURAL ECONOMY IMPLICATIONS OF FARMS CONVERTING TO SUSTAINABLE AGRICULTURE PRACTICES: SOME ESTIMATES FOR SOUTH DAKOTA

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Introduction

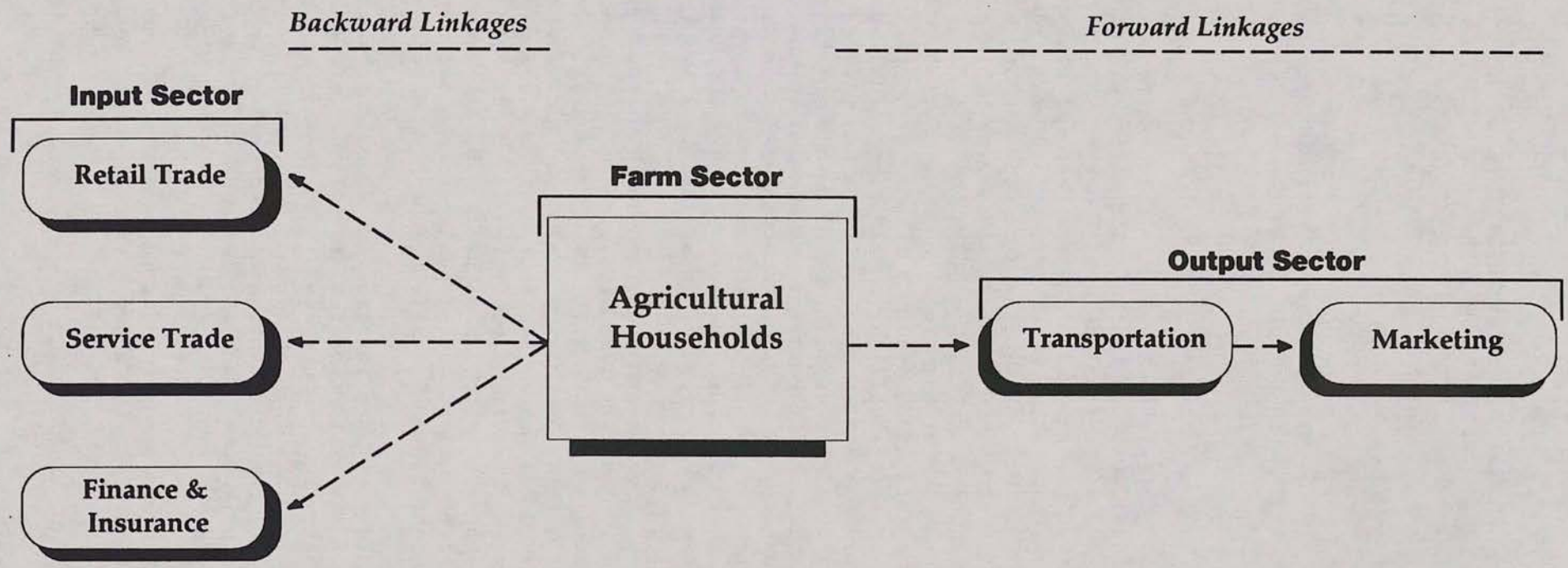
Environmental and farm profitability concerns have stimulated major debate since the mid-1980s over the relative merits of "conventional" and "sustainable" farming systems in the United States. "Conventional" farming systems can be viewed as ones which utilize cropping patterns, tillage practices, and commercial chemical fertilizer and pesticide application rates which are typical for their particular agro-climatic areas. "Sustainable" systems [sometimes referred to as "low-input/sustainable agriculture" (LISA), "low-input", or "regenerative" systems], on the other hand, either eliminate or greatly reduce the use of commercial chemical fertilizers and pesticides. They emphasize crop rotations, legumes, tillage practices, and cover crops as means of maintaining soil fertility, controlling weeds, and preventing soil erosion. The debate has centered primarily on how the different farming systems fare in terms of yields, farm profits, and environmental effects. In addition, the effects of different systems on rural economies are sometimes brought into the debate. Critics of "sustainable" systems often contend that farm conversions from "conventional" to "sustainable" systems would adversely affect rural economies, primarily because of fewer purchased inputs by "sustainable" system farmers from local agricultural supply firms.

The purpose of the research reported in this monograph is to examine the hypothesis implied in that argument, i.e., that adoption of sustainable farming systems would adversely affect rural economies. Effects examined can be conceptualized in terms of the "backward" and "forward" linkages shown in Figure 1. The direct (or primary) effect of a conversion from conventional to sustainable farming systems in a local area is the effect on net incomes of agricultural households. Agricultural households are defined here as farm proprietors and their families and hired laborers. Secondary effects result from "backward" and "forward" linkages to the farm sector.

Backward linkage effects involve farm input purchases from retail firms (e.g., purchases of commercial chemical fertilizers and pesticides), service firms (e.g., machinery repair purchases), and finance and insurance firms (e.g., interest payments to financial institutions). Net incomes change in the input sector as a result of increases or decreases in purchases; the net income changes are only some fraction of the total changes in purchases, however.

Similar net income changes occur due to forward linkages when changes in output result from a switch to different farming practices. If output of some

Figure 1. Conceptualization of Conventional and Sustainable Agriculture Effects on Local Economies.



grains were to decline as a result of switches from conventional to sustainable farming systems, for example, there may be less trucking of grain to local elevators and less grain being stored and marketed by the elevators. We would then expect reduced profits and labor earnings by truckers and elevators.

The backward and forward linkage effects just described can be considered "first round" secondary effects. Additional effects on local net incomes which can result from changes in consumer purchases by agricultural households and by owners and workers of input and output sector firms will be described later in this monograph.

A set of case study farms in South Dakota was used in this research to estimate direct and secondary effects on rural economies of conversions from conventional to sustainable farming systems. Whole-farm budgets for case conventional and sustainable farms in several agro-climatic areas of the State were compared to estimate increases or decreases in purchases (backward linkages) and sales (forward linkages) associated with conversions to sustainable systems. Data from a variety of sources were utilized in making estimates of proportions of purchases made "locally", proportions of firms' receipts which translate into "personal income", and so forth. Details of the various procedures utilized are explained in applicable sections of this monograph.

Any quantitative analysis, including this one, has its limitations. Implications for rural economies of differences in the livestock components of conventional and sustainable farms are not fully accounted for in this analysis. Also, the potential effects, over time, of conversions to sustainable systems on farm size and tenurial structure are not analyzed quantitatively in this monograph. Some attention was given to these and other possible implications for rural economies -- including possible implications for tax revenues generated. However, more complete treatment of some of these important concerns awaits further research by us or others at another time. Nevertheless, we feel that the research reported in this monograph constitutes an important beginning of attempts to understand some of the implications for Northern Great Plains rural economies of a changeover from what are now considered "conventional" farming systems to systems currently labeled "sustainable".

The case farms which are used for comparison purposes are described in the next section of this monograph. First-round direct and secondary effects on rural economies of a conversion to sustainable farming systems are presented in the subsequent section. Following that, more complete multiplier effects -- which include additional effects resulting from changes in consumers purchases -- are presented. Some other possible effects on rural economies are then discussed in the next-to-last section of the monograph. The summary section of the monograph includes a highly tentative aggregation of direct and secondary effects to county levels.

Case Farms Compared

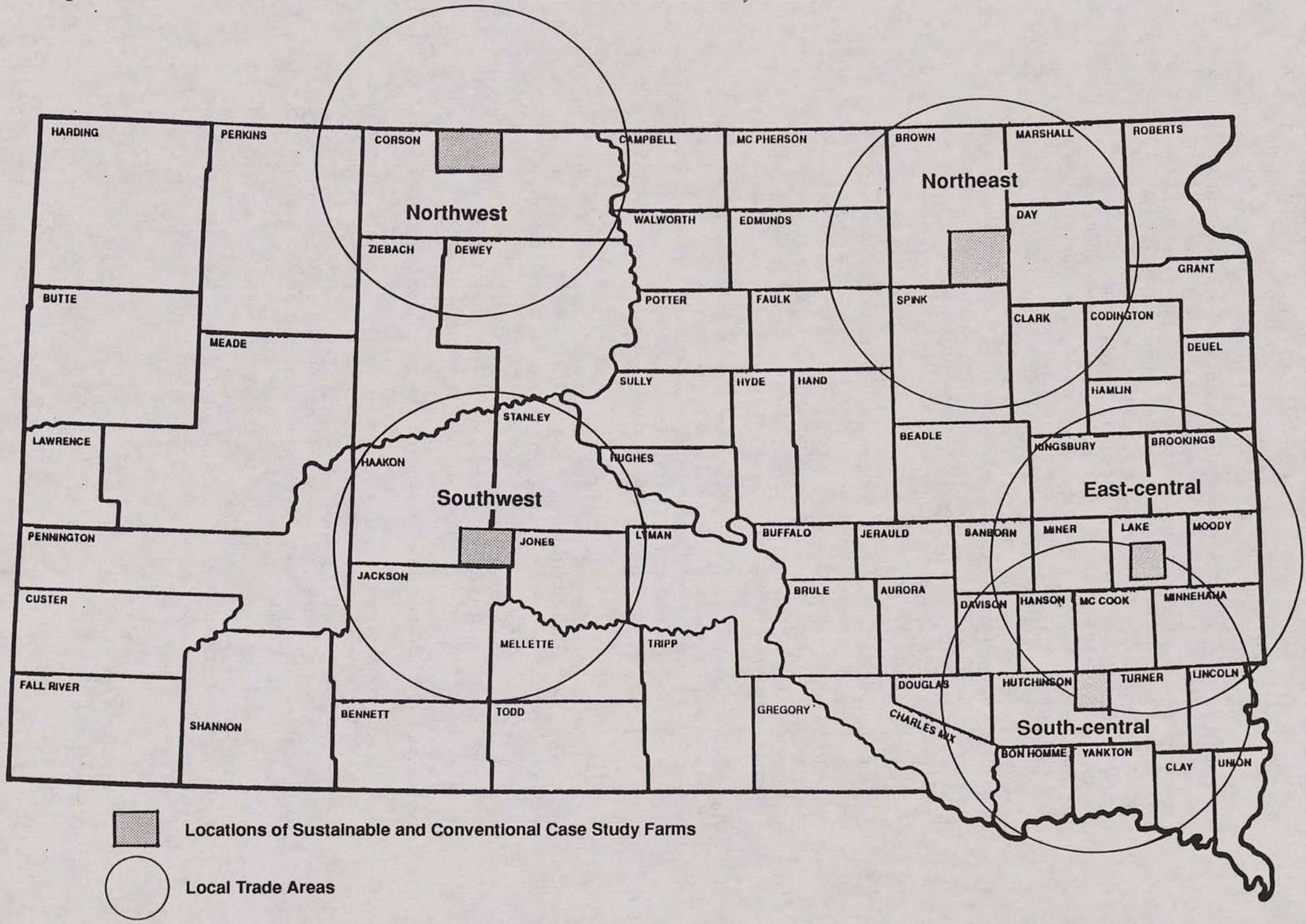
Case study sustainable farms in this analysis are the ones also being used in a broad economic and policy study of sustainable agriculture in South Dakota. Detailed crop, livestock, and related economic information on twenty-two sustainable farms in different areas of South Dakota was collected through on-farm interviews in early 1989 (Taylor, et al., 1989a). Whole-farm crop system economic analyses subsequently were carried out for twelve of those sustainable farms (Becker, et al., 1990). The contributions of livestock to net farm incomes were analyzed and reported by Taylor, et. al. 1990). Effects of public policies on the relative profitabilities of sustainable and conventional farms have been conducted, using five of those twelve sustainable farms as case studies (Dobbs, et al., 1990a). Those same five farms are used as cases for the analysis reported in this monograph; they represent sustainable systems in different agro-climatic areas within South Dakota.

For purposes of the research reported in this monograph, as well as the above mentioned policy analyses (Dobbs, et al., 1990a), these five sustainable farms are compared with five conventional farms, one of which (in the east-central area) is an actual operating farm and four of which are synthetic. Locations of the five pairs of sustainable and conventional case farms are shown in Figure 2. Detailed longitudinal analysis of yields and economic returns on the east-central conventional and sustainable (actual operating) farms has been reported elsewhere (Dobbs, et al., 1990b). For other areas of the State, in which we did not have actual operating conventional farms under study as "controls", a variety of information sources was used to construct hypothetical ("synthetic") conventional farms to compare with the actual sustainable farms. Agricultural Census data, Cooperative Extension and Soil Conservation Service reports, and interviews with key informants were among the information sources used (Cole and Dobbs, 1990).

Detailed information about the crop rotations, cultural practices, and costs and returns associated with the five case sustainable farms is found in Taylor, et al. (1989a) and Becker, et al. (1990). Readers can refer to Rotations D, H, S, T, and V in those reports. Similar information about the five case conventional farms is found in Cole and Dobbs (1990). Information from the whole-farm crop system budgets in those studies has been grouped and summarized in Annex A. The five tables in that annex contain information on costs (by sector category), net income over all costs except management, and labor use by the case sustainable and conventional farms in each area. (Labor 1 in those tables is machine-related labor and Labor 2 is labor for hand-weeding operations.) In the last columns of Annex Tables A-1 through A-5, the changes (in costs, net income, and labor use) that would be associated with a conversion of 100 acres of farm land from conventional to sustainable rotations and practices are shown. These data form the building blocks of much of the rural economy analysis reported in this monograph. In these and other tables throughout this monograph, parentheses are used to indicate negative numbers.

Brief overviews of some of the key features of the case farms in each area are shown in Figures 3 through 8. Grain production is greater -- per 100

Figure 2. Locations of Local Trade Areas and South Dakota Case Study Farms.



acres of farm land -- on the conventional farms in all five areas (Figure 3). (For Figure 3, as well as the other figures in this series, farm land includes farm program set-aside, fallow, and green manure acres, as well as acres planted to harvested crops and rotated hay.) Hay production per 100 acres of farm land is higher for the sustainable farms in the east-central and northeast areas, but higher for the conventional farms in the south-central and southwest areas (Figure 4); the south-central case sustainable farm did not have any hay land. No production of hay is shown for either the sustainable or the conventional farm in the northwest area, because the alfalfa hay land in that pair of cases was considered more or less "permanent" -- on land not included in the rest of the respective rotations. Thus, for purposes of analyzing the effects of changeovers from conventional to sustainable rotations and systems, it was not necessary to include that alfalfa hay land in the analysis. Likewise, in all five agro-climatic areas, hay harvested from permanent grass/pasture land was excluded from the analysis.

As indicated in Figure 5, except in the northwest area, only the conventional case farms use commercial fertilizer. The commercial fertilizer used by the northwest case sustainable farm is an organic fertilizer of naturally mined trace minerals. The commercial fertilizer cost per 100 acres of farmland is greater there for the sustainable farm than for its conventional counterpart.

Of the case sustainable farms, only the east-central and the south-central (a nearly unnoticeable cost per 100 acres) farms use commercial pesticides (Figure 6). The east-central sustainable farm uses some chemical herbicides on a small portion of its land. Some spot-spraying of chemical herbicides is done on spring wheat on the south-central sustainable farm.

Fuel and lubrication expenses are higher for the conventional farms than for the sustainable farms in all but the east-central area (Figure 7). The differences range from 63 percent higher for the conventional farm in the northwest area to 30 percent lower for the conventional farm in the east-central area. Sustainable farms are often perceived to use more tillage (for weed control) and, hence, perhaps more fuel. However, a variety of factors contribute to overall fuel use per unit of farmland, including the mix of crops grown and the management of set-aside and fallow acres. In all of the case comparisons except one, the net result of all these effects on fuel and lubrication expenses from converting to sustainable practices is negative.

Labor use shows a pattern somewhat similar to fuel use. Labor use is higher on the conventional farms in three of the five areas (Figure 8). The differences range from 57 percent higher for the conventional farm in the northwest area to 34 percent lower for the conventional farm in the east-central area. The principal use of labor for crop production on South Dakota farms is in operation of machinery. Machine time, as reflected in part by fuel and labor use, appears to be greater on the conventional farms in the majority of cases. Readers should keep in mind that these comparisons, including comparisons of labor use, do not include livestock operations of either the sustainable or the conventional farms.

Figure 3.

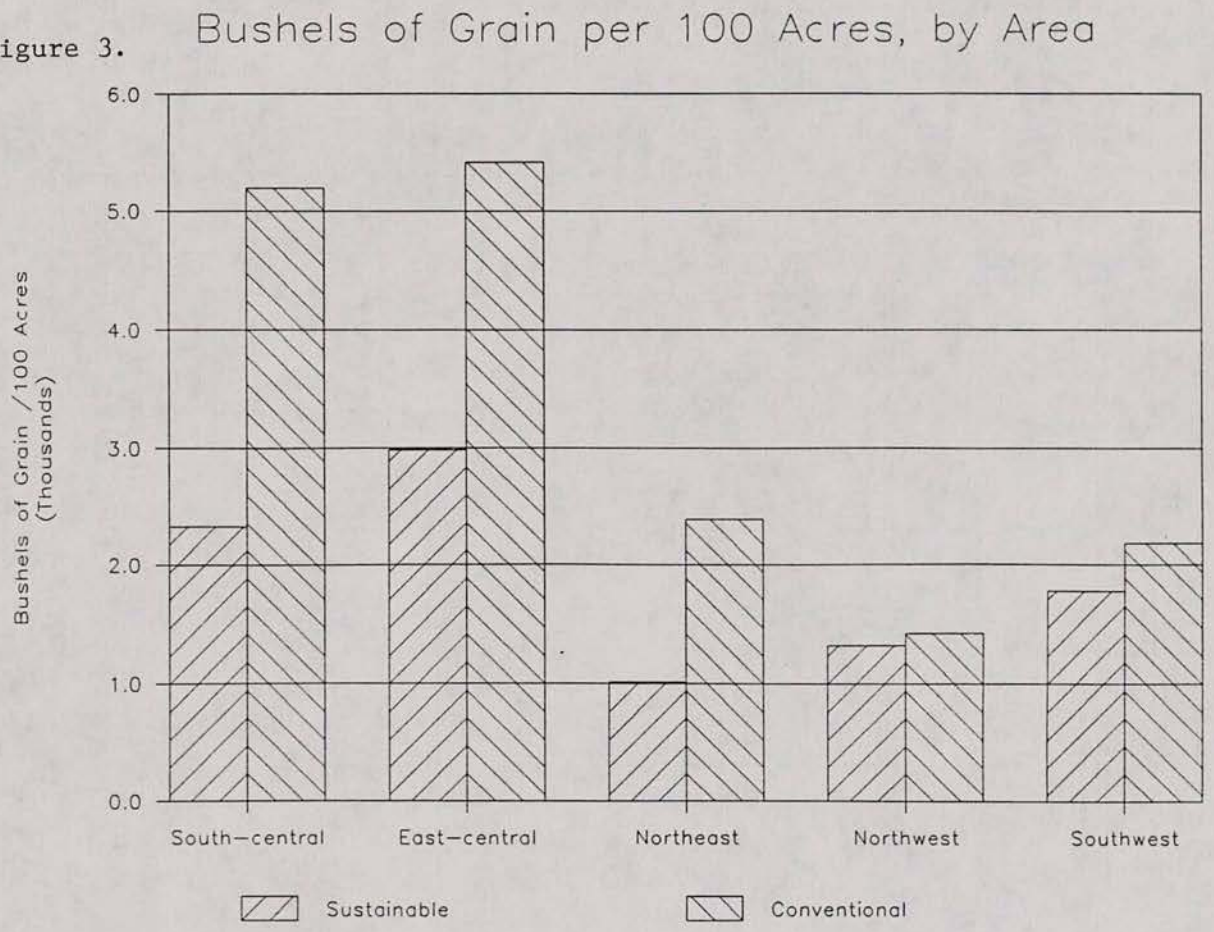


Figure 4.

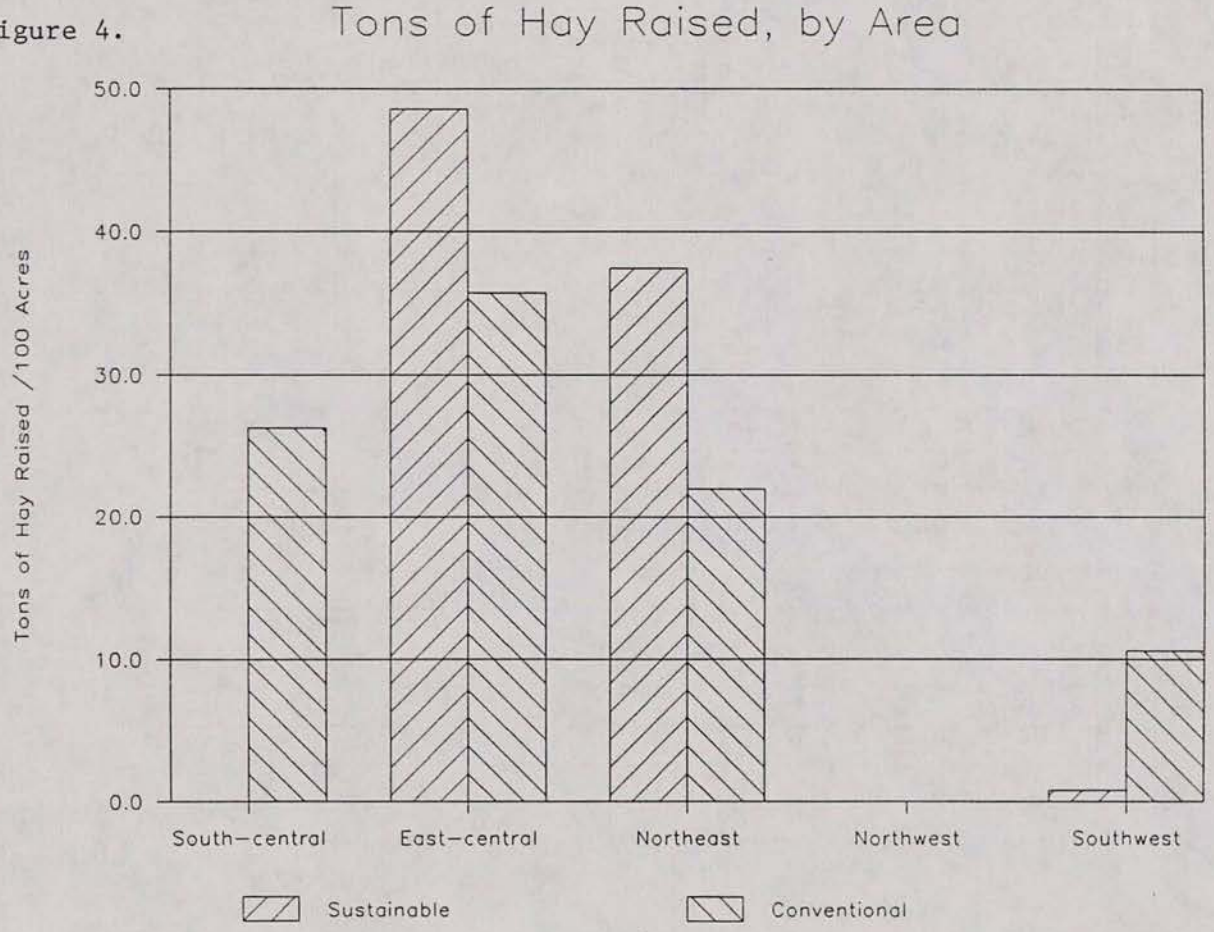


Figure 5. Commercial Fertilizer Expense, by Area

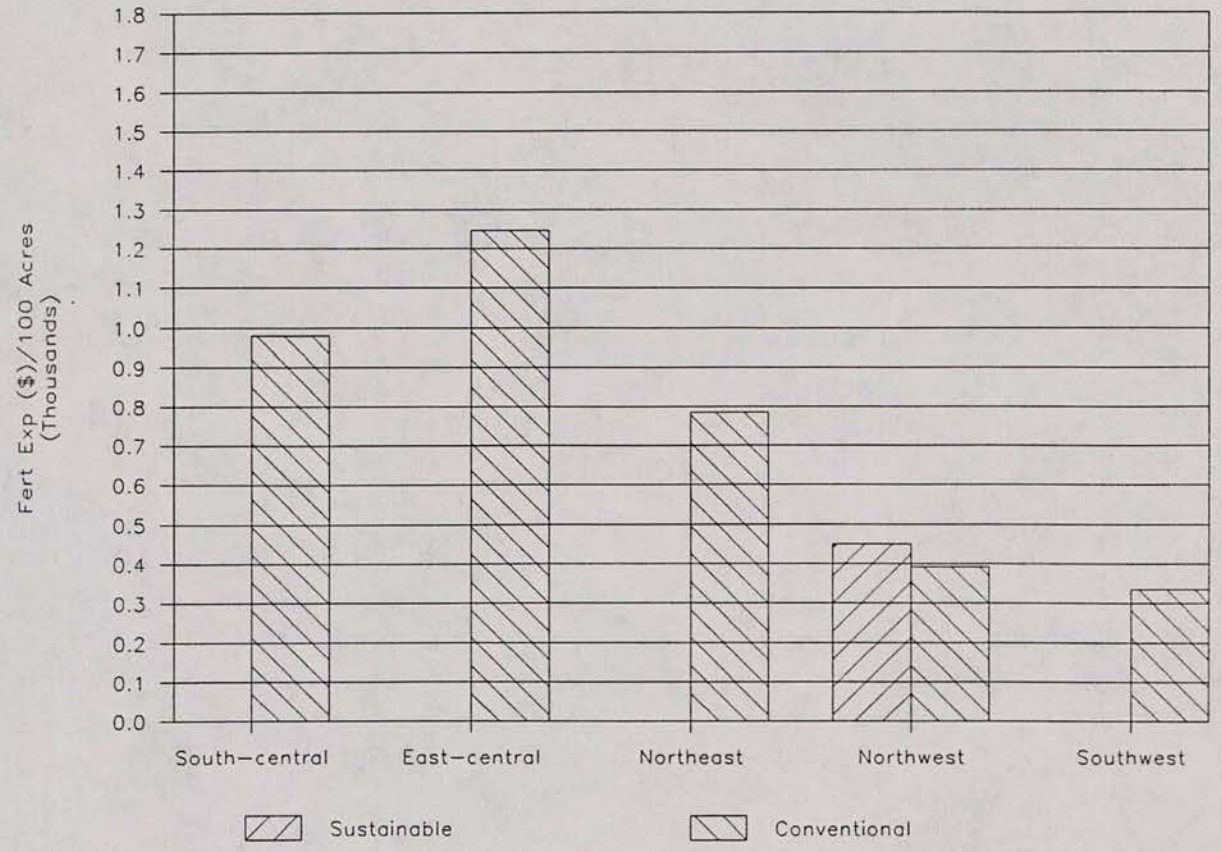


Figure 6. Commercial Pesticide Expense, by Area

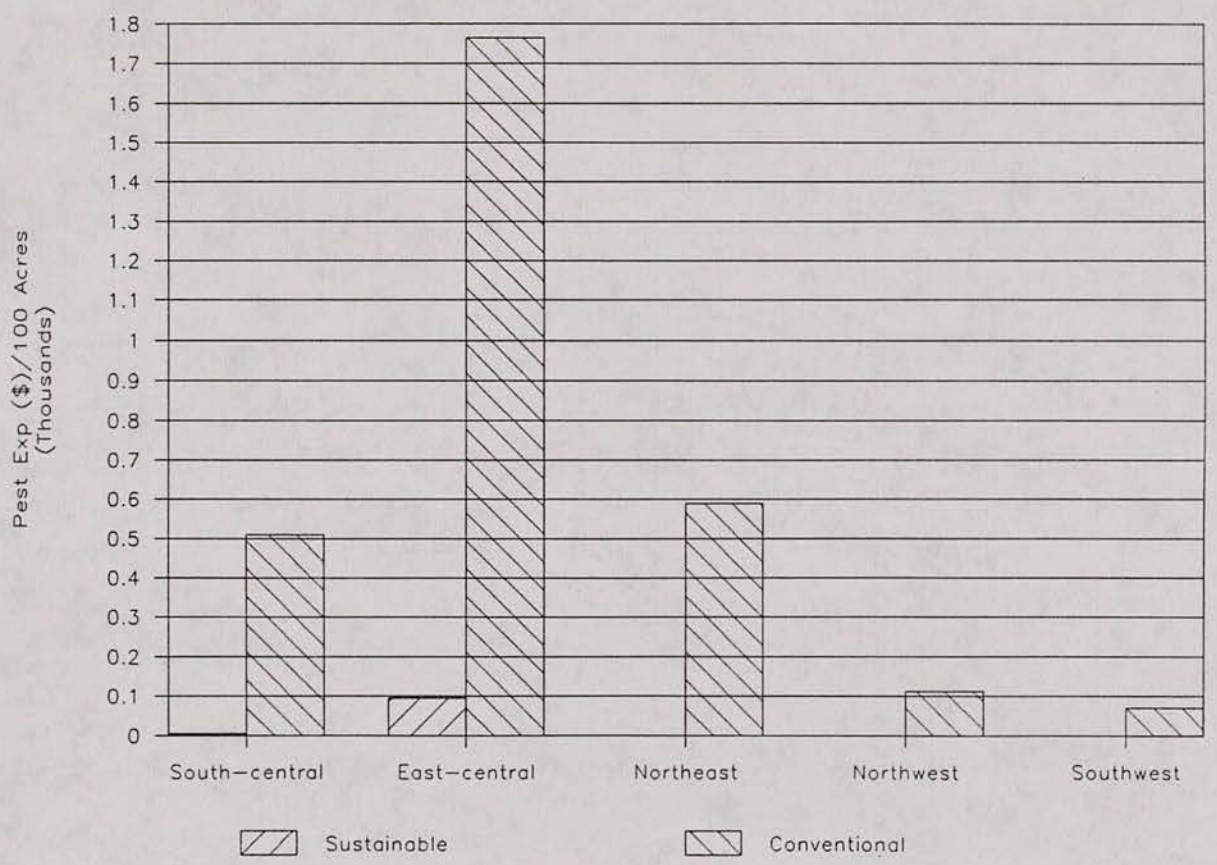


Figure 7. Fuel and Lubrication Expense, by Area

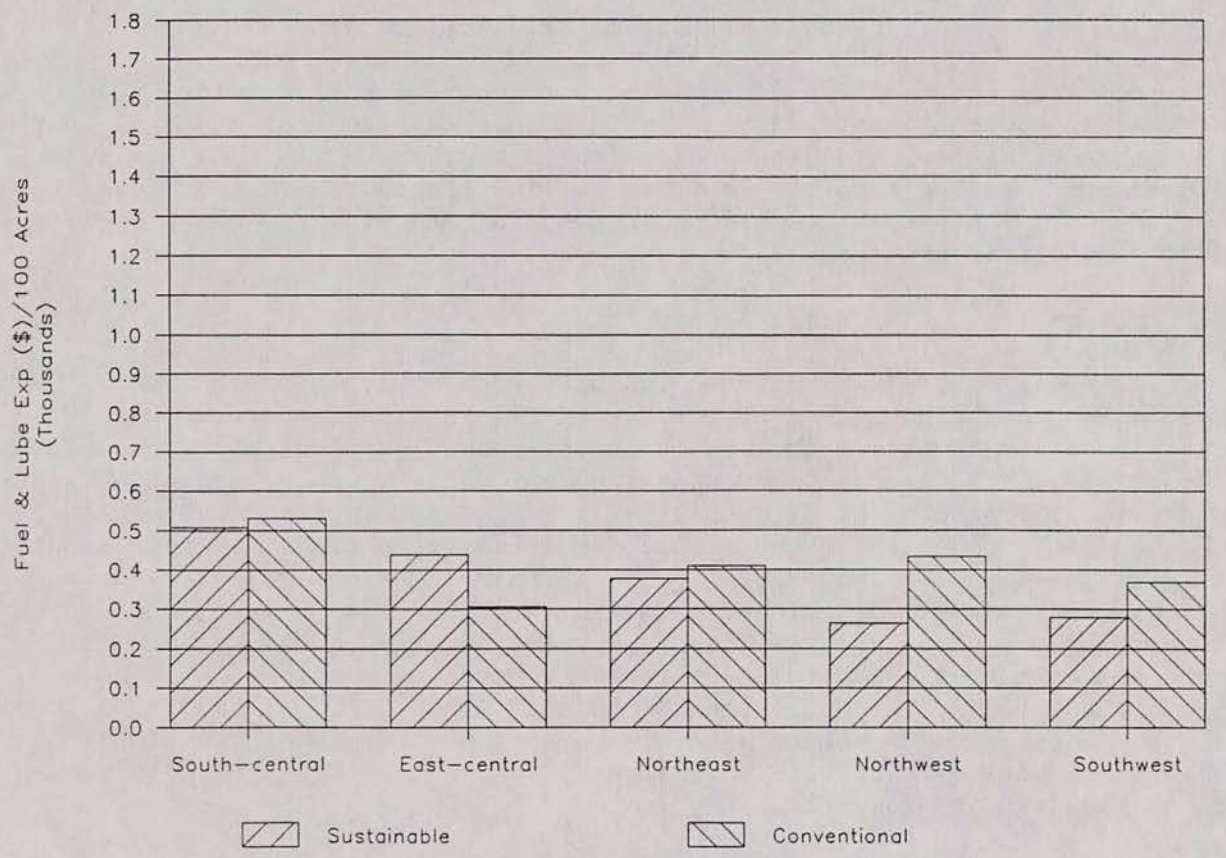
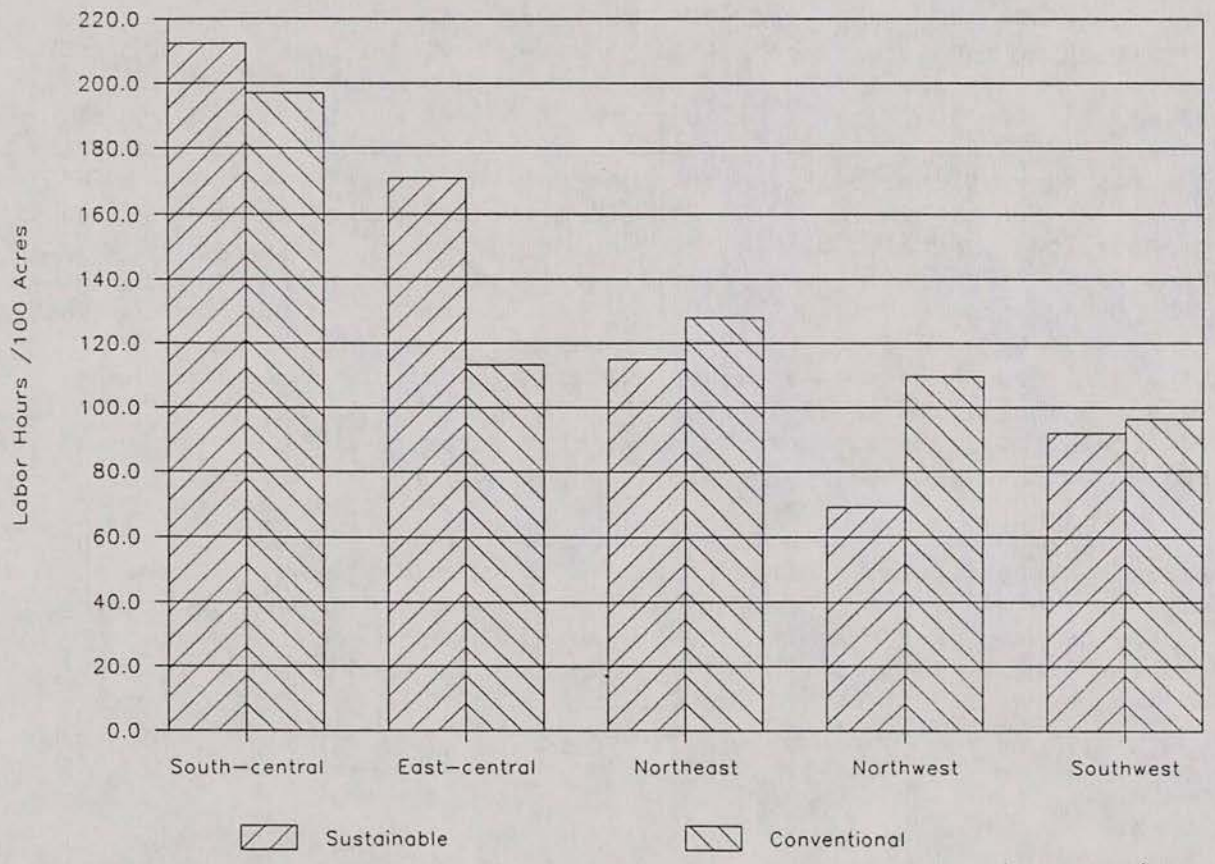


Figure 8. Labor Hours Required, by Area



First-round Effects on the Rural Economy

The first-round effects on the local economy of a conversion from conventional to sustainable farming systems covered here include: (a) changes in earnings of agricultural households (the direct effect); (b) changes in employer and employee earnings in firms selling inputs directly to farms; and (c) changes in employer and employee earnings of trucking and elevator firms handling the first stage of grain and hay sales.

Trade Area and Personal Income Assumptions

The local trade areas assumed to surround each set of case farm comparisons are circumscribed by circles on Figure 2. Each circle was drawn with a 50-mile radius from the center of the shaded area where the case farms are located. This distance represents approximately a 1-hour drive for goods and services, depending on directness of roads to particular towns and on road conditions. Within each of those circular local trade areas are approximately the following numbers of towns: (a) south-central -- 100; (b) east-central -- 100; (c) northeast -- 75; (d) northwest -- 45; and (e) southwest -- 30. South Dakota's largest city, Sioux Falls, is within the trade areas of both the south-central and east-central case farms. Aberdeen, the State's third largest city, is within the northeast circular trade area. In addition to there being fewer towns within each of the northwest and southwest trade areas, there are no towns within those areas which even begin to approach the size of Aberdeen or Sioux Falls.

To estimate backward linkage effects occurring within these local trade areas, it was necessary to make assumptions about the proportions of input purchases made within each area. Consideration was given to such factors as natural barriers to transportation (such as rivers), towns and cities within and surrounding each trade area, and typical travel distances for particular kinds of goods and services. Evidence from North Dakota and South Dakota in Dobbs (1979), Goreham, et al. (1986), Leistritz, et al. (1987), and Owens and Vangsness (1973) was reviewed in determining our assumptions for each trade area. Our assumptions for "proportions consumed locally" are shown under the heading "PCL (Farm)" in Table 1. PCL (Farm) is defined as the proportion of each input item purchased within the local trade area. For example, it is assumed that 0.80 of commercial fertilizer is purchased within the local trade area by case farms in the south-central, east-central, and northeast areas, but only 0.70 by case farms in the northwest and southwest areas. Agricultural household inputs (labor and management) are assumed to be provided entirely from local sources [PCL (Farm) coefficients of 1.00]. In effect, this implies that there is no migrant labor on the case farms and that no custom work is provided by people from outside the local area.

A similar set of assumptions was made about grain and hay marketing (forward linkages). Those assumptions are shown under the "PML (Farm)" heading in Table 1. PML (Farm) stands for the proportion marketed through local businesses. For example, it is assumed that 0.95 of the grain sold by case farms in the south-central area goes initially to elevators within the local trade area if it is sold conventionally and that none (0.00) goes first

Table 1. Proportion of New Income Spent Locally, Input Purchases Made Locally, and Marketing Done Locally

Sector Item	South -central	East -central	Northeast	Northwest	Southwest
			------AREA------		
	----------PCL(Household)----------				
	0.85	0.85	0.80	0.60	0.60
	----------PCL(Farm)----------				
Retail Trade					
Seed	0.80	0.80	0.80	0.80	0.80
Commercial Fertilizer	0.80	0.80	0.80	0.70	0.70
Chemical Pesticide	0.80	0.80	0.80	0.70	0.70
Fuel & Lube	0.90	0.90	0.90	0.85	0.90
Depreciation on Machinery	0.90	0.90	0.85	0.75	0.80
Storage	1.00	1.00	1.00	1.00	1.00
Drying	1.00	1.00	1.00	1.00	1.00
Overhead	1.00	1.00	1.00	1.00	1.00
Service Trade					
Machinery Repair	0.95	0.95	0.90	0.80	0.85
Custom Machine Hire	0.90	0.90	0.90	0.80	0.80
Finance & Insurance					
Crop Insurance	0.90	0.90	0.90	0.75	0.80
Interest on Nonlabor Direct Costs	0.95	0.95	0.90	0.80	0.85
Interest, Housing & Insurance on Machinery	0.90	0.90	0.85	0.75	0.80
Ag Households					
Labor Charge	1.00	1.00	1.00	1.00	1.00
Net Income To Management	1.00	1.00	1.00	1.00	1.00
	----------PML(Farm)----------				
Marketing					
County Elevators (when grain sold conventionally)	0.95	0.95	0.90	0.85	0.85
County Elevators (when grain sold organically)	0.00	0.00	0.00	0.00	0.00
Trucking Industry	0.95	0.95	0.90	0.90	0.90

to local elevators or processors if it is sold in organic markets. Also, it is assumed that 0.95 of the hay marketed by south-central case farms is handled by truckers/haulers from within the local trade area.

The coefficients under the heading PCL (Household) are used and explained later in this monograph.

Table 2 contains the next set of assumptions needed for the rural economy analysis. This table shows the proportions of receipts in each sector assumed to be personal income, where personal income consists of profits, wages, and other employee compensation. Evidence from the following sources was reviewed in arriving at the estimates shown in this table: Dobbs, et al. (1979), Devino, et al. (1988), Leistritz, et al. (1989), and the U.S. Department of Commerce (1977, 1989a, 1989b, 1989c, 1989d). Our estimates of the proportion of receipts which constitute personal income, by sector, are: (a) retail trade -- 0.15; (b) service trade -- 0.22; (c) finance and insurance -- 0.20; (d) agricultural households -- 1.00; (e) country elevators -- 0.05; and (f) trucking industry -- 0.20. A coefficient of 0.15 for commercial fertilizer, for example, means that 15 percent of an agricultural supply firm's receipts for sales of fertilizer to farmers was assumed to constitute profits and employee wages and other compensation. The agricultural household coefficients are 1.00 because, by definition, labor charges and net income to management constitute personal income in their entirety.

Agricultural Household and Backward Linkage Effects

Direct effects on ag households and first-round backward linkage effects on local economies are shown in Tables 3 through 7. Figures in parentheses represent negative numbers in those tables. For example, one number in the first column of data in Table 4 indicates that converting 100 acres of land in east-central South Dakota from a conventional to a sustainable system causes approximately a $1,672 reduction in chemical pesticide use. Assuming 80 percent of the pesticides are normally purchased within the local trade area, this means that pesticide receipts by suppliers within the area decline by approximately $1,338 ($1,672.22 x .80 = $1,337.77). With 15 percent of retail sales assumed to be personal income, the decrease in pesticide sales results in approximately a $201 decrease in personal income ($1,337.77 x .15 = $200.67).

First-round ag household and backward linkage effects of a conversion from conventional to sustainable practices result in a total decline in personal income of approximately $1,916 per 100 acres of farmland in the south-central area (Table 3). Of that total, more than three-fourths ($1,499) is due to the decline in ag household income. Most of the rest is associated with personal income declines in the retail trade sector. Fertilizer receipts and income are most affected in that sector.

Overall declines in personal income are also shown for all areas except the northwest (Table 6). Direct effects on ag households constituted most of the declines in these areas--78 percent, 90 percent, 54 percent, and 82

Table 2. Proportion of Receipts Assumed to be Personal Income for All Areas, by Sector

Sector Item	Proportion Assumed to be Personal Income
INPUT SIDE	
Retail Trade	
Seed	0.15
Commercial Fertilizer	0.15
Chemical Pesticide	0.15
Fuel & Lube	0.15
Depreciation on Machinery	0.15
Storage	0.15
Drying	0.15
Overhead	0.15
Service Trade	
Machinery Repair	0.22
Custom Machine Hire	0.22
Finance & Insurance	
Crop Insurance	0.20
Interest on Nonlabor Direct Costs	0.20
Interest, Housing & Insurance on Machinery	0.20
Ag Households	
Labor Charge	1.00
Net Income To Management	1.00
OUTPUT SIDE	
Industry	
Country Elevators	0.05
Trucking Industry	0.20

TABLE 3. First-Round Ag Household and Backward Linkage Effects of Adopting Sustainable Agricultural Practices in South-central SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Assumed Personal Income	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Retail Trade					
Seed	($142.28)	0.80	($113.82)	0.15	($17.07)
Commercial Fertilizer	($979.31)	0.80	($783.45)	0.15	($117.52)
Chemical Pesticide	($505.65)	0.80	($404.52)	0.15	($60.68)
Fuel & Lube	($21.40)	0.90	($19.26)	0.15	($2.89)
Depreciation on Machinery	($183.28)	0.90	($164.95)	0.15	($24.74)
Storage	($315.37)	1.00	($315.37)	0.15	($47.31)
Drying	($471.75)	1.00	($471.75)	0.15	($70.76)
Overhead	($16.51)	1.00	($16.51)	0.15	($2.48)
Subtotal	($2,635.56)		($2,289.64)		($343.45)
Service Trade					
Machinery Repair	($53.68)	0.95	($51.00)	0.22	($11.22)
Custom Machine Hire	$0.00	0.90	$0.00	0.22	$0.00
Subtotal	($53.68)		($51.00)		($11.22)
Finance & Insurance					
Crop Insurance	($50.01)	0.90	($45.01)	0.20	($9.00)
Interest on Nonlabor Direct Costs	($151.26)	0.95	($143.69)	0.20	($28.74)
Interest, Housing & Insurance on Machinery	($134.49)	0.90	($121.04)	0.20	($24.21)
Subtotal	($335.76)		($309.74)		($61.95)
Ag Households					
Labor Charge	($4.74)	1.00	($4.74)	1.00	($4.74)
Net Income To Management	($1,494.27)	1.00	($1,494.27)	1.00	($1,494.27)
Subtotal	($1,499.01)		($1,499.01)		($1,499.01)
TOTAL	($4,524.01)		($4,149.40)		($1,915.63)

TABLE 4. First-Round Ag Household and Backward Linkage Effects of Adopting Sustainable Agricultural Practices in East-central SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Assumed Personal Income	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Retail Trade					
Seed	($506.51)	0.80	($405.21)	0.15	($60.78)
Commercial Fertilizer	($1,246.96)	0.80	($997.57)	0.15	($149.64)
Chemical Pesticide	($1,672.22)	0.80	($1,337.77)	0.15	($200.67)
Fuel & Lube	$132.39	0.90	$119.15	0.15	$17.87
Depreciation on Machinery	$14.05	0.90	$12.64	0.15	$1.90
Storage	($273.52)	1.00	($273.52)	0.15	($41.03)
Drying	($301.65)	1.00	($301.65)	0.15	($45.25)
Overhead	($21.75)	1.00	($21.75)	0.15	($3.26)
Subtotal	($3,876.18)		($3,205.68)		($480.85)
Service Trade					
Machinery Repair	$136.99	0.95	$130.14	0.22	$28.63
Custom Machine Hire	$0.00	0.90	$0.00	0.22	$0.00
Subtotal	$136.99		$130.14		$28.63
Finance & Insurance					
Crop Insurance	($87.32)	0.90	($78.59)	0.20	($15.72)
Interest on Nonlabor Direct Costs	($227.28)	0.95	($215.91)	0.20	($43.18)
Interest, Housing & Insurance on Machinery	$128.28	0.90	$115.46	0.20	$23.09
Subtotal	($186.32)		($179.05)		($35.81)
Ag Households					
Labor Charge	$346.43	1.00	$346.43	1.00	$346.43
Net Income To Management	($4,908.12)	1.00	($4,908.12)	1.00	($4,908.12)
Subtotal	($4,561.69)		($4,561.69)		($4,561.69)
TOTAL	($8,487.20)		($7,816.29)		($5,049.73)

TABLE 5. First-Round Ag Household and Backward Linkage Effects of Adopting Sustainable Agricultural Practices in Northeast SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Assumed Personal Income	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Retail Trade					
Seed	($131.43)	0.80	($105.14)	0.15	($15.77)
Commercial Fertilizer	($785.89)	0.80	($628.71)	0.15	($94.31)
Chemical Pesticide	($589.12)	0.80	($471.30)	0.15	($70.69)
Fuel & Lube	($33.17)	0.90	($29.85)	0.15	($4.48)
Depreciation on Machinery	($309.37)	0.85	($262.96)	0.15	($39.44)
Storage	($186.36)	1.00	($186.36)	0.15	($27.95)
Drying	($110.00)	1.00	($110.00)	0.15	($16.50)
Overhead	($25.35)	1.00	($25.35)	0.15	($3.80)
Subtotal	($2,170.69)		($1,819.68)		($272.95)
Service Trade					
Machinery Repair	($54.83)	0.90	($49.35)	0.22	($10.86)
Custom Machine Hire	$0.00	0.90	$0.00	0.22	$0.00
Subtotal	($54.83)		($49.35)		($10.86)
Finance & Insurance					
Crop Insurance	($105.33)	0.90	($94.80)	0.20	($18.96)
Interest on Nonlabor Direct Costs	($119.63)	0.90	($107.67)	0.20	($21.53)
Interest, Housing & Insurance on Machinery	($287.65)	0.85	($244.50)	0.20	($48.90)
Subtotal	($512.61)		($446.97)		($89.39)
Ag Households					
Labor Charge	($84.29)	1.00	($84.29)	1.00	($84.29)
Net Income To Management	($357.33)	1.00	($357.33)	1.00	($357.33)
Subtotal	($441.62)		($441.62)		($441.62)
TOTAL	($3,179.75)		($2,757.61)		($814.82)

TABLE 6. First-Round Ag Household and Backward Linkage Effects of Adopting Sustainable Agricultural Practices in Northwest SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Assumed Personal Income	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Retail Trade					
Seed	$85.01	0.80	$68.01	0.15	$10.20
Commercial Fertilizer	$57.85	0.70	$40.50	0.15	$6.07
Chemical Pesticide	($112.24)	0.70	($78.57)	0.15	($11.78)
Fuel & Lube	($167.77)	0.85	($142.61)	0.15	($21.39)
Depreciation on Machinery	($100.66)	0.75	($75.50)	0.15	($11.32)
Storage	$33.81	1.00	$33.81	0.15	$5.07
Drying	$0.00	1.00	$0.00	0.15	$0.00
Overhead	($9.24)	1.00	($9.24)	0.15	($1.39)
Subtotal	($213.24)		($163.59)		($24.54)
Service Trade					
Machinery Repair	($70.44)	0.80	($56.35)	0.22	($12.40)
Custom Machine Hire	($30.01)	0.80	($24.00)	0.22	($5.28)
Subtotal	($100.45)		($80.36)		($17.68)
Finance & Insurance					
Crop Insurance	($20.52)	0.75	($15.39)	0.20	($3.08)
Interest on Nonlabor Direct Costs	($13.82)	0.80	($11.06)	0.20	($2.21)
Interest, Housing & Insurance on Machinery	($157.26)	0.75	($117.94)	0.20	($23.59)
Subtotal	($191.60)		($144.39)		($28.88)
Ag Households					
Labor Charge	($260.63)	1.00	($260.63)	1.00	($260.63)
Net Income To Management	$376.31	1.00	$376.31	1.00	$376.31
Subtotal	$115.68		$115.68		$115.68
TOTAL	($389.60)		($272.66)		$44.58

TABLE 7. First-Round Ag Household and Backward Linkage Effects of Adopting Sustainable Agricultural Practices in Southwest SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Assumed Personal Income	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Retail Trade					
Seed	$159.29	0.80	$127.43	0.15	$19.11
Commercial Fertilizer	($335.15)	0.70	($234.60)	0.15	($35.19)
Chemical Pesticide	($70.26)	0.70	($49.18)	0.15	($7.38)
Fuel & Lube	($89.82)	0.90	($80.84)	0.15	($12.13)
Depreciation on Machinery	($1.04)	0.80	($0.83)	0.15	($0.12)
Storage	($44.69)	1.00	($44.69)	0.15	($6.70)
Drying	$0.00	1.00	$0.00	0.15	$0.00
Overhead	($5.74)	1.00	($5.74)	0.15	($0.86)
Subtotal	($387.40)		($288.45)		($43.27)
Service Trade					
Machinery Repair	$25.36	0.85	$21.56	0.22	$4.74
Custom Machine Hire	$0.00	0.80	$0.00	0.22	$0.00
Subtotal	$25.36		$21.56		$4.74
Finance & Insurance					
Crop Insurance	($47.89)	0.80	($38.31)	0.20	($7.66)
Interest on Nonlabor Direct Costs	($24.20)	0.85	($20.57)	0.20	($4.11)
Interest, Housing & Insurance on Machinery	($64.41)	0.80	($51.53)	0.20	($10.31)
Subtotal	($136.50)		($109.20)		($22.08)
Ag Households					
Labor Charge	($30.07)	1.00	($30.07)	1.00	($30.07)
Net Income To Management	($253.55)	1.00	($253.55)	1.00	($253.55)
Subtotal	($283.62)		($283.62)		($283.62)
TOTAL	($782.16)		($659.71)		($344.22)

percent in the south-central, east-central, northeast, and southwest areas, respectively.

It is important to note here that organic premiums are not included in most of the analyses reported in this particular monograph. In actuality, four of the five case sustainable farms (all except the one in the south-central area) receive organic price premiums for some of their grain (Becker, et al., 1990; Dobbs, et al., 1990a). Taking those organic premiums into account reduces the net income to management differential between the east-central case farms, and it actually causes net income to management to be higher on the northeast and southwest sustainable case farms than on the comparable conventional farms in those areas. Also, our more intensive longitudinal (5-years) analysis of the east-central sustainable and conventional farms has shown less difference in net income between the two farms (Dobbs, et al., 1990b). In fact, net income was actually higher for the east-central sustainable farm in at least one year when organic premiums were accounted for.

Baseline (no organic premium) net income to management for the case sustainable farm in the northwest area is higher than it is for the comparable conventional farm (Table 6). In that case, the positive ag household effect more than offsets the negative first-round backward linkage effect. The net direct and backward linkage effect of converting 100 acres of farmland from conventional to sustainable rotations and practices in the northwest area is an **increase** in personal income of approximately $45.

The **retail trade** sector is the backward-linked sector which is most adversely effected by the conversion to sustainable practices in most areas. Interestingly, in two areas (the east-central and the southwest), the **service trade** sector experiences slight increases in personal income as a result of conversions to sustainable practices. This is due to increased machinery repair expenditures. For all five areas, the average change in personal income per 100 acres in each backward-linked sector was: retail trade--a $233 decline; service trade--a $1 decline; and finance and insurance--a $48 decline.

Forward Linkage Effects

First-round forward linkage effects of conversions to sustainable agriculture in each geographic area are summarized in Table 8. The first step in the calculations was to determine the change in volume of grain and hay produced. Grain and hay production comparisons were shown previously in Figures 3 and 4. Data for those figures are presented in Annex Table B-1, as are the computations for the "Amount of Change" column in Table 8.

An "average grain margin" of $0.08/bushel is shown in the next column of Table 8. This margin represents the difference between what the country elevator pays the farmer for a bushel of grain and what the elevator receives for the grain from a central terminal. This estimate was made in part on the basis of information obtained from Devino (1987) and from Suhr (1990). Multiplying this $0.08/bushel margin times the change in bushels of grain

Table 8. First-Round Forward Linkage Effects of Adopting Sustainable Agricultural Practices in SD

	Primary Business Affected	Amount of Change* (bu or ton)	Average Grain Margin (per bu)	Trucking Receipts (per mile per ton)	Change in Receipts, Grain Sales**	Total Change in Receipts	Proport. Receipts Remain in Area (PMLf)	Change in Receipts	Proport. Assumed Personal Income	Changes in Personal Income
		(/100ac)			($/100ac)	($/100ac)		($/100ac)		($/100ac)
South-central Area										
Total of Grain	Country Elevators	(2867.0)	$0.08		($1,710)	($1939)***	0.95	($1,842)	0.05	($92.12)
Total of Hay	Truck Industry	(26.3)		$0.08		($53)***	0.95	($50)	0.20	($9.98)
TOTAL										($102.10)
East-central Area										
Total of Grain	Country Elevators	(2437.3)	$0.08		($8,735)	($8,930)	0.95	($8,484)	0.05	($424.18)
Total of Hay	Truck Industry	12.8		$0.08		$26	0.95	$24	0.20	$4.88
TOTAL										($419.30)
Northeast Area										
Total of Grain	Country Elevators	(1379.0)	$0.08		($3,169)	($3,279)	0.90	($2,951)	0.05	($147.55)
Total of Hay	Truck Industry	15.5		$0.08		$31	0.90	$28	0.20	$5.58
TOTAL										($141.97)
Northwest Area										
Total of Grain	Country Elevators	(99.4)	$0.08		($354)	($362)	0.85	($308)	0.05	($15.40)
Total of Hay	Truck Industry	----		$0.08		$0	0.90	$0	0.20	$0.00
TOTAL										($15.40)
Southwest Area										
Total of Grain	Country Elevators	(406.2)	$0.08		$411	$378	0.85	$322	0.05	$16.09
Total of Hay	Truck Industry	(9.8)		$0.08		($20)	0.90	($18)	0.20	($3.54)
TOTAL										$12.55

* Column numbers from Annex Table B-1, column 3.
** Column numbers from Annex Table B-2, column 3.

*** Country Elevator is (-2867.0 x $0.08) + -1710 = -$1939
*** Trucking Industry is -26.3 x $0.08 per mile x 25 miles = -$53

purchased and sold/100 acres and adding the product to the "change in receipts, grain sales"/100 acres (data for that column taken from Annex Table B-2) results in "total changes in receipts" for grain/100 acres. In the case of the south-central area, that is a negative $1,939. Multiplying that change in receipts times the "proportion of receipts remaining in the area" (0.95, from Table 1) and then multiplying that product times the "proportion assumed to be personal income" (0.05, from Table 2) yields a decrease in personal income of approximately $92 per 100 acres in the south-central area.

Similar calculations are carried out for hay trucking receipts and personal income. Trucking receipts were estimated to be approximately $0.08 per mile per ton, based on various communications (Freeburg Hay Company, 1990; JTI Trucking, 1990; Madsen and Lamp, 1990; Peterson, 1990). Average hay trucking distance was assumed to be 25 miles. For the south-central area, the 26.3-ton decline in hay production associated with converting 100 acres of farmland to a sustainable rotation is multiplied times $0.08 per mile per ton and times the 25 miles, resulting in a $53 decline in trucking receipts. This $53 is then multiplied by 0.95 (proportion of receipts remaining in the area") and by 0.20 ("proportion assumed to be personal income")--from Tables 1 and 2, respectively--yielding a $10 per 100 acres decline in personal income. This $10 is added to the $92 decline in personal income experienced by grain elevator owners and employees, resulting in a total first-round forward-linkage personal income decline of approximately $102 per 100 acres in the south-central area.

Calculations of this kind result in forward-linked personal income declines of approximately $419, $142, and $15 per 100 acres in the east-central, northeast, and northwest areas, respectively. In all cases, the trucking effects are substantially less than the grain elevator effects. The southwest is the only area to show a net positive forward-linked personal income effect. Positive country elevator effects more than offset negative hay trucking effects in that particular area. Although the volume of grain is shown to decline with a conversion to the sustainable rotation in that area (by 406.2 bu/100 acres), the value of grain sales increases, due to a change in the mix of grains produced. The net effect is a positive approximately $378 per 100 acres "total change in receipts" for grain in the southwest area, and a resulting approximately $16 increase per 100 acres in personal income in the country elevator portion of the local economy.

Some other methods and assumptions for calculating the forward-linkage personal income effects are presented and compared in Annex B. Some of the alternative methods account more explicitly for livestock and/or for organic premiums. One can observe in Annex Table B-3 that the results are quite similar to those shown in Table 8 in some instances and rather different in others. The biggest difference from Table 8 is represented by the last column in Annex Table B-3. In that column, organic sales are explicitly accounted for and the increases in ag household personal incomes associated with those organic sales are added to the first-round forward-linked personal income effects.

Combined Agricultural Household and First-Round Backward and Forward Linkage Effects

Effects analyzed in the previous two sections are combined and presented for all five areas in Table 9. The **combined** ag household and first-round backward and forward linkage effects on personal income of converting 100 acres to sustainable practices range from a positive approximately $29 in the northwest area to a negative approximately $5,469 in the east-central area. The average for all five areas is a negative approximately $1,749/100 acres.

Net forward linkage personal income effects are relatively small in comparison to net backward linkage effects, except in the east-central area -- where the backward effects are approximately $488 per 100 acres and the forward effects are approximately $419 per 100 acres. In the south-central, east-central, and southwest areas, ag household effects are much greater than either the backward-linked or the forward-linked effects **and** than the two combined. Retail trade effects are substantially greater than other backward-linked effects in most areas, and country elevator effects substantially exceed trucking industry effects in all areas.

More Complete Multiplier Effects on the Rural Economy

The forgoing effects cover **first-round** effects on sectors linked directly to the farm sector. Additional effects can occur due to changes in (a) **consumer** expenditures by farm households, (b) purchases of supplies by forward- and backward-linked firms, and (c) purchases of consumer goods by owners and employees of firms effected by first-round expenditures and subsequent rounds of expenditures. By including these effects on personal income, in addition to the ag household and first-round effects, more complete potential multiplier effects on rural economies of conversions to sustainable practices can be accounted for.

Method and Assumptions

The approach used in this section follows that of Darling (1990). Similar methods are explained in more detail in Hustedde, et al. (1984). The method involves estimating **direct** and **secondary** effects on personal income, where direct effects -- on ag households -- are defined the same way as in the previous section. Secondary effects include **induced, indirect backward linkage**, and **indirect forward linkage** effects. The meanings of, and computational procedures for, these secondary effects will be explained as we proceed with the analysis.

Some of the assumptions needed for this analysis were presented earlier in this monograph, in Table 1. PCL (Farm) and PML (Farm) were defined earlier and the values assumed for each area were presented in Table 1; in Annex C, these terms are simply labeled PCLf and PMLf. Also shown in Table 1 were assumed values for PCL (Household), which is referred to as PCLh in Annex C. PCLh refers to the proportion of new household income which will be spent locally (Darling, 1990). In the analysis here, "local areas" are defined the same way they were earlier in the monograph (see Figure 2). Darling (1990)

Table 9. Summary of First-Round Effects On Rural Economics

	Change in Personal Income, by Area				
	South-central	East-central	Northeast	Northwest	Southwest
	per 100 acres				
Backward Linkage Effects					
Retail Trade	($343.45)	($480.85)	($272.95)	($24.54)	($43.27)
Service Trade	($11.22)	$28.63	($10.86)	($17.68)	$4.74
Finance & Insurance	($61.95)	($35.81)	($89.39)	($28.88)	($22.08)
Subtotal	($416.62)	($488.03)	($373.20)	($71.10)	($60.61)
Ag Households					
Subtotal	($1,499.01)	($4,561.69)	($441.62)	$115.68	($283.62)
Forward Linkage Effect					
County Elevators	($92.12)	($424.18)	($147.55)	($15.40)	$16.09
Trucking Industry	($9.98)	$4.88	$5.58	$0.00	($3.54)
Subtotal	($102.10)	($419.30)	($141.97)	($15.40)	$12.55
TOTAL EFFECTS	($2,017.73)	($5,469.02)	($956.79)	$29.18	($331.68)

presents PCLh data for Kansas counties. Data for Kansas counties which appear similar to South Dakota areas examined in our study, together with information on the number and sizes of towns and cities in and near the South Dakota local trade areas, were used in arriving at judgments about appropriate PCLh coefficients. The assumed coefficients are shown in the top section of Table 1. Assumed PCLh values are higher in the south-central, east-central, and northeast areas than in the western areas. This is because of more numerous and larger towns and cities in which to shop within each of those three study areas of eastern South Dakota.

The other needed set of assumptions is presented in Table 10. Here, assumed values for PSY are shown, where PSY is defined as the proportion of consumption spending locally which becomes local income (Darling, 1990). (The letters PSY stand for proportion, spending, and income.) PSY takes into account effects on local income which result from **all** rounds of expenditures -- not just the first-round -- to the extent portions of each round remain within the local trade area. Darling (1990) has a concise and excellent discussion of factors influencing the values of PSY, which he summarizes by stating that "PSY is determined by the amount of value added spent locally and this is determined, in part, by backward linkages with other local firms". Darling suggests the following range of PSYs for counties: very low (.25 to .35); low (.36 to .45); medium (.46 to .55); high (.56 to .65); and very high (.66 to .75). He indicates that highly rural counties would typically have very low PSYs.

Keeping in mind the range of values shown by Darling (1990), information on multipliers contained in the U.S. Department of Commerce (1977), and the information on personal income in Table 2 (which accounts only for first-round effects), we decided on the PSY assumptions shown for each area in Table 10. The PSY (Farm) coefficients are applied, as shown, where each round of purchases or sales starts with sector components shown in the rows. For example, each dollar of expenditure on machinery repair (part of the Service Trade sector) in the southwest area, through that and subsequent rounds of input supply and consumer expenditures, results in $0.32 of personal income. That figure is lower than for machinery repair expenditures in the east-central region ($0.42), for example, because of greater expenditure "leakage" in the more rural southwest area. The PSYs in the top row of Table 10 have basically the same meaning as the other PSYs of that table, except that they are applied to ag household income to determine "induced" secondary effects.

Results

Detailed calculations of total multiplier effects for each area are shown in Annex Tables C-1 through C-5. We can use Table C-5, for southwest S.D., as an example. The direct effects on personal income of ag households (negative approximately $284) are the same as shown previously in Table 7. **Induced** secondary effects represent the changes in personal income resulting from consequent changes in consumer expenditures by the ag households. The formula shown under "induced effects" in Table C-5, which includes the PCLh and PSY values (0.60 and 0.30, respectively) for southwest S.D., is applied to the change in ag household personal income -- as shown in the "multiplier

Table 10. Proportion of Local Consumption Which Becomes Income to Local Residents (PSY)

Sector Item	South -central	East -central	Northeast	Northwest	Southwest
	AREA				
	PSY(for "Induced Effect" Formula)				
	0.40	0.40	0.35	0.30	0.30
	PSY(Farm)				
Retail Trade					
Seed	0.35	0.35	0.30	0.25	0.25
Commercial Fertilizer	0.35	0.35	0.30	0.25	0.25
Chemical Pesticide	0.35	0.35	0.30	0.25	0.25
Fuel & Lube	0.35	0.35	0.30	0.25	0.25
Depreciation on Machinery	0.35	0.35	0.30	0.25	0.25
Storage	0.45	0.45	0.40	0.35	0.35
Drying	0.45	0.45	0.40	0.35	0.35
Overhead	0.45	0.45	0.40	0.35	0.35
Service Trade					
Machinery Repair	0.42	0.42	0.37	0.32	0.32
Custom Machine Hire	0.42	0.42	0.37	0.32	0.32
Finance & Insurance					
Crop Insurance	0.25	0.25	0.25	0.25	0.25
Interest on Nonlabor Direct Costs	0.30	0.30	0.27	0.25	0.25
Interest, Housing & Insurance on Machinery	0.30	0.30	0.27	0.25	0.25
Marketing					
County Elevators	0.08	0.08	0.07	0.06	0.06
Trucking Industry	0.40	0.40	0.35	0.30	0.30

total induced effect" row -- to obtain the induced effect estimate (negative approximately $62).

The **indirect backward linkage** effects are calculated by multiplying the changes in receipts in the various business categories (data from Table 7) times the appropriate PCLf and PSY (from Tables 1 and 10, respectively) for each business category and area. For example, the decline in personal income resulting from the decline in commercial fertilizer purchases in the southwest area is estimated to be approximately $59 ($335.15 x 0.70 x 0.25 = $58.65). The estimated total for all indirect backward linkage effects in the southwest area is a negative approximately $98 per 100 acres (Annex Table C-5).

Indirect forward linkage effects are estimated in a similar manner. Again, using the southwest as an example (Table C-5), country elevator changes in receipts (positive $378, from Table 8) are multiplied by the appropriate PMLf (0.85, from Table 1) and then times the appropriate PSY (0.06, from Table 10). The estimated increase in personal income as a result of increased grain sale receipts for local elevators (and consequent increases in related input and consumer purchases) is approximately $19 ($378 x 0.85 x 0.06 = $19.28). Total indirect forward linkage effects, combining elevator and trucking industry effects, are estimated to be approximately $14 per 100 acres.

All secondary effects (induced, indirect backward linkage, and indirect forward linkage) together are estimated to total a negative approximately $146 per 100 acres for the southwest area (Table C-5). Personal income in the southwest area is estimated to decline by approximately $430 per 100 acres, when all **direct** and **secondary** effects of converting 100 acres from conventional to sustainable rotations and practices are combined. The ratio of estimated **total** to **direct** effects is **1.52** (Table C-5).

Direct and secondary personal income effects for all five areas are summarized in Table 11. Total effects per 100 acres are greatest in the east-central and south-central portions of the State. Net direct and secondary personal income effects of conversions to sustainable practices are negative except in the northwest, where positive direct effects more than offset negative secondary effects. Readers should recall, however, that both direct and secondary effects here exclude organic premium considerations. Those considerations are accounted for, in part, in Annex B.

The ratios of **total to direct** effects range from 0.19 in the northwest to 3.45 in the northeast. They average 1.87. Similar ratios were not computed in Table 9, where direct (ag household) and **first-round** -- rather than complete multiplier -- effects on forward- and backward-linked sectors were shown. However, when we make similar calculations of total to direct effects for Table 9, we get the following ratios: (a) south-central -- 1.35; (b) east-central -- 1.20; (c) northeast -- 2.17; (d) northwest -- 0.25 and (e) southwest -- 1.17. The average ratio for Table 9 is 1.23. Thus, depending on whether **only first-round** or **complete multiplier** secondary effects are included, the ratio of total to direct effects may average from around 1.2 to 1.8. One seldom sees responsibly estimated income multipliers for rural areas which are in excess of 2.0 We suspect that even 1.8 may be higher than the

Table 11. Summary of Total Multiplier Effects on Rural Economies

South-central Area			
1. Direct Effect			($1,499.01)
2. Secondary Effects			
a. Induced Effects, Ag Household =		($772.22)	
b. Indirect Effects, Backward Linkages =		($993.83)	
c. Indirect Effects, Foward Linkages =		($167.50)	
	subtotal		($1,933.55)
	TOTAL		($3,432.56)
Ratio of Total Effect to Direct Effect =	($3,432.56) /	($1,499.01)=	2.29
East-Central Area			
1. Direct Effect			($4,561.69)
2. Secondary Effects			
a. Induced Effects, Ag Household =		($2,349.96)	
b. Indirect Effects, Backward Linkages =		($1,176.80)	
c. Indirect Effects, Foward Linkages =		($668.80)	
	subtotal		($4,195.56)
	TOTAL		($8,757.25)
Ratio of Total Effect to Direct Effect =	($8,757.25) /	($4,561.69)=	1.92
Northeast Area			
1. Direct Effect			($441.62)
2. Secondary Effects			
a. Induced Effects, Ag Household =		($171.74)	
b. Indirect Effects, Backward Linkages =		($715.11)	
c. Indirect Effects, Foward Linkages =		($196.81)	
	subtotal		($1,083.66)
	TOTAL		($1,525.28)
Ratio of Total Effect to Direct Effect =	($1,525.28) /	($441.62)=	3.45
Northwest Area			
1. Direct Effect			$115.68
2. Secondary Effects			
a. Induced Effects, Ag Household =		$25.39	
b. Indirect Effects, Backward Linkages =		($100.25)	
c. Indirect Effects, Foward Linkages =		($18.46)	
	subtotal		($93.32)
	TOTAL		$22.36
Ratio of Total Effect to Direct Effect =	$22.36 /	$115.68 =	0.19
Southwest Area			
1. Direct Effect			($283.62)
2. Secondary Effects			
a. Induced Effects, Ag Household =		($62.26)	
b. Indirect Effects, Backward Linkages =		($97.86)	
c. Indirect Effects, Foward Linkages =		$13.88	
	subtotal		($146.24)
	TOTAL		($429.86)
Ratio of Total Effect to Direct Effect =	($429.86) /	($283.62)=	1.52

true average of full multiplier effects for the five areas of South Dakota included in our analysis.

Other Effects on the Rural Economy

The possible effects on rural economies of farms converting to sustainable agricultural practices which have been estimated quantitatively and presented in this monograph are, too some extent, short-term in nature. In the longer-term, a variety of on- and off-farm adjustments might take place which could alter the effects we have estimated and which could cause other effects. Some of the other possible short- and long-term effects on rural economies are discussed in this section.

Tax Effects

Changes in expenditures on inputs as a result of conversions to sustainable agriculture could impact **sales tax** revenues. Possible effects within each of the five trade areas are shown in Annex Table D-1. In that table, the changes in receipts within each trade area for machinery repairs and depreciation are first shown; those data come from the third column in each of Tables 3 through 7. The only agricultural input items to which the South Dakota sales tax applies are equipment (depreciation) and services (in this case, repairs); the 1990 sales tax rate is 3 percent on the former and 4 percent on the latter (Cash, 1990; South Dakota Codified Laws, 1989). Some cities could also apply a sales tax to these input items, so we have shown a column in Table D-1 for that possibility. However, we have not examined the city tax ordinances in each trade area in order to estimate city sales tax effects.

We can see in Annex Table D-1 that the impact of conversions to sustainable agriculture on State sales tax collections **within each trade** area range from a **decrease** of $9.86 (per 100 acres of farm land converted) in the northeast area to an **increase** of $5.58 in the east-central area. Since a portion of machinery equipment and repair expenses occur outside each trade area but within South Dakota, some additional sales tax impacts would also exist.

Since State and local governments in South Dakota do not levy an income **tax**, there are no rural economy impacts due to that form of taxation. However, as farm land values change over time, due largely to increases or decreases in expected farm profitability (net income to management), local **property tax** assessed values are likely to also change, albeit with some lag. This would cause changes in property tax collections for school districts, counties, and cities. We have made no attempt to quantify those impacts here.

Farm Size and Tenurial Structure

Our analyses have ignored any differences in **size** between conventional and sustainable farms that may exist at present or in the future. Because it is generally felt that sustainable farms require more intensive management, we might expect sustainable farms to be smaller, on average, than conventional

farms. Operators of larger farms may purchase more of their inputs in volume, at discount prices, from more distant markets; they may be more likely to truck their grain directly to large elevators or terminals outside the local trade area; and, they may spend more of their disposable income on vacations and consumer goods outside the local area. If differences such as these exist, Table 1 and Table 10 coefficients used for the conventional farms should be different from those used for the sustainable farms. There may be more rural economy "leakage" for large, conventional farms. We should note, however, that SDSU's 1988 mail survey of sustainable farms in South Dakota did not show a clear pattern of sustainable farms generally being smaller than conventional farms (Taylor, et al., 1989b). However, the sample in that survey was rather small (32 useable responses).

The 1988 SDSU survey also gave some attention to tenurial structure. Keeping in mind that the sample was small, there appears to be a tendency for sustainable farmers to lease more of the land they farm than do conventional farmers (Taylor, et al., 1989b). Sustainable farmers appear to be somewhat more conservative in their financial management strategies than are conventional farmers. This pattern of leasing, rather than buying, to acquire access to land during periods of volatile land and financial markets in the 1970s and 1980s is consistent with the more conservative strategy. Whether this tenurial pattern would emerge in a larger survey and whether the pattern is long term are not clear. One might expect higher proportions of leased land to be associated with greater instability in rural economies. However, this may not be the case at all, as long as land remains in crop production by one operator or another. In any event, this monograph does not give attention to quantification of farm size and tenurial structure differences between conventional and sustainable farms or to the possible rural economy implications of any such differences.

Implications of Livestock

Livestock have been accounted for only indirectly in most portions of this manuscript (portions of Annex B constitute the exception). Feed grains and forages produced in the various crop systems used as bases for this rural impact analysis have been priced according to their local market values, which implicitly are influenced by local and national livestock economies. However, for the most part, explicit attention was not given in this monograph to livestock numbers, any differences in type and number of livestock on conventional in comparison to sustainable farms, or impacts of value added through livestock on rural economies.

It is often asserted that sustainable farms are more likely to have livestock than are conventional farms, because of the desire by sustainable farmers to have manure to meet part of their soil fertility needs and because of the frequent presence of forage legumes in their crop rotations. If livestock are present, this provides potential for greater ag household income (it provides potential for greater losses, as well). It also provides potential for additional backward and forward linkage effects on local personal incomes.

Eighty-eight percent of the sustainable farmers who responded to SDSU's 1988 survey raise livestock commercially (Taylor, et al., 1989b). The case sustainable farm in the south-central area is an example of one which does not, however. Some farms, such as that one and the northwest case sustainable farm, use plow-down sweet clover as a key legume in their rotations. (The northwest case farm does have livestock, however). A plow-down green manure requires no livestock to dispose of the forage.

SDSU's sustainable agriculture research team has recently completed a set of livestock budgets for several sustainable farms in South Dakota (Taylor, et al., 1990). Additional research funds are being sought to systematically compare livestock operations and economics on conventional and sustainable farms and ranches. The planned research may include attention to rural economy implications of differences in the livestock component of conventional and sustainable farms.

Other Considerations

The analysis reported in this monograph is based on agricultural technologies as they are presently known and understood. As research intensifies over the next few years on "sustainable" agricultural practices, **relative** economic profitabilities of sustainable systems are likely to be enhanced. Changes in Federal farm programs and energy prices are also likely to increase the relative profitabilities of sustainable practices (Dobbs, et al., 1990a and 1990b). In addition, when organic premiums are included, the relative profitabilities of sustainable systems are enhanced; that phenomenon may not last, however, if large numbers of producers enter organic markets, thereby putting downward pressures on the premiums. A variety of these and other factors are likely to change the mix of available "sustainable" practices and to change the relative profitabilities of sustainable and conventional practices over the next few years. In the context of analysis discussed earlier in this monograph, both **ag household incomes** and **induced secondary effects** would be impacted by those changes. Rural economy effects of conversions from conventional to sustainable agricultural practices are likely to appear more positive (or less negative) than in the relatively short-term comparative analysis of this monograph.

In a longer term, more dynamic context, a variety of other rural economy changes are likely to accompany conversions to sustainable agriculture practices. Some agricultural input suppliers may come to be providers more of **information services** -- such as integrated pest management, fertility management, specialty crop management, etc. -- than of physical products such as chemical pesticides. Thus, as demands for some types of conventional agricultural inputs decline, demands for other, less conventional inputs may increase. Likewise, as farmers diversify into other crops in the process of adopting sustainable rotations, the demand for new and different types of local marketing facilities and services is likely to expand. We are already seeing a felt need in some local areas for more organic marketing facilities and services.

It is difficult to precisely identify all of the types of changes that may occur in rural economies as we move to more sustainable farming practices over the next couple of decades, to say nothing of being able to quantify all of the changes. Nevertheless, it is important to keep in mind that the kinds of effects which have been quantified in this monograph constitute only a short term and partial picture of the rural economy implications of conversions to sustainable agriculture.

Summary

Certain quantifiable effects on rural economies of conversions of farm land from conventional to sustainable rotations and practices have been reported in this monograph. Effects were broken into **agricultural household**, **backward linkage**, and **forward linkage** effects on personal income. Effects on agricultural household personal income (consisting of labor charges and net income to management) generally are of greatest quantitative importance (Table 9 and 11). This means that the **principal** income effect on rural economies depends upon how renumerative the sustainable practices are to farmers and farm workers, relative to conventional practices. To the extent **secondary** effects on local rural economies are important, **backward linkage** effects are usually of much greater magnitude than **forward linkage** effects in South Dakota. Overall rural economy effects were found to be **negative** in four of five areas of South Dakota that were examined with a case farm approach. The ratio of **total** to **direct** personal income effects averages from around 1.2 to 1.8 for all five areas, depending upon how many rounds of local expenditure are included in the analysis.

Additional results shown in Annex Table E-1 constitute a highly tentative attempt to aggregate the rural economy impacts to **county** levels. Local trade areas shown in Figure 2 overlap county boundaries. However, if we assume that crop land acres in the counties in which the case farms are located are generally like those of the case farms, we can multiply the ag household and first-round effects shown in Table 9 times the acres of crop land in each county. Doing that, we get the county-wide direct, first-round secondary, and total effects shown in Annex Table E-1. Total personal income effects of a complete changeover to sustainable rotations and practices range from a negative approximately $13.7 million in Lake County (within the east-central local trade area) to a positive approximately $113 thousand in Corson County (within the northwest local trade area).

Some other factors, not quantified in this monograph, also could have important rural economy implications if there were widespread conversion from conventional to sustainable practices. These factors include possible changes in the local livestock economy, farm size and tenurial structure, and the nature of needed agricultural input services. A variety of changes which may precede or accompany conversions to more sustainable agricultural practices, including advances in the knowledge and techniques of sustainable farming, could substantially alter the estimations of rural economy impacts reported in this monograph.

REFERENCES CITED

Becker, D.L., T.L. Dobbs, and D.C. Taylor. 1990. Crop Enterprise and Principal Rotation Budgets for Sustainable Agricultural Case Farms in South Dakota. Economics Research Report No. 90-2. Brookings, S.D.: South Dakota State University.

Cash, J. Personal Communication. Department of Revenue, Pierre, SD. 57501. November 5, 1990.

Cole, J.D., and T.L. Dobbs. 1990. Crop Enterprise and Whole-farm Budgets for "Conventional" Farming Systems in Five Areas of South Dakota. Economics Research Report No. 90-3. Brookings, S.D.: South Dakota State University.

Darling, D.L. 1990. Estimating the Role of Production Agriculture in a County's Economy. Community Development Series. Manhattan, Kansas: Kansas State University Cooperative Extension Service. September.

Devino, G., D. VanDyne, and C. Braschler. 1987. Potential Impacts of the Conservation Reserve Program on Farm Supply Sales and Grain Merchandising in North Missouri. AER 1987-9. Columbia, MO.: University of Missouri-Columbia.

Dobbs, T.L. 1979. Some Business and Public Sector Effects of Irrigation Development: A Tentative Analysis of the Proposed Forest City Project in Potter County, South Dakota. Brookings, S.D.: South Dakota State University.

Dobbs, T.L., D.L. Becker, and D.C. Taylor. 1990a. Sustainable Agricultural Policy Analyses: South Dakota On-farm Case Studies. Economics Staff Paper No. 90-5. Brookings, SD.: South Dakota State University. Presented at 10th Annual Symposium of the Association for Farming Systems Research-Extension, held in East Lansing, Michigan.

Dobbs, T.L., J.D. Smolik, and C. Mends. 1990b. On-farm research comparing conventional and low input/sustainable agricultural systems in the northern Great Plains. Presented at National Workshop on Sustainable Agricultural Research and Education in the Field. Washington, D.C. April 3-4. Paper to appear in workshop proceedings being published by the National Research Council's Board on Agriculture, National Academy of Science.

Freeburg Hay Company. Personal Communication. Gayville, SD. September 25, 1990.

Goreham, G.A., F.L. Leistritz, and R.W. Rathge. 1986. Trade and Marketing Patterns of North Dakota Farm and Ranch Operators. Agr. Econ. Misc. Rpt. No. 98. Fargo, N.D.: North Dakota State University. pp. 29.

Hustedde, R., R. Shaffer, and G. Pulver. 1984. Community Economic Analysis: A How To Manual. Ames, Iowa: North Central Regional Center for Rural Development.

JTI Trucking. Personal Communication. Sioux Falls, SD. September 25, 1990.

Leistritz, F.L., B.L. Ekstrom, and H.G. Vreugdenhil. 1987. Selected Characteristics of Business Operators in North Dakota Agricultural Trade Centers. Agr. Econ. Rpt. No. 217. Fargo, N.D.: North Dakota State University.

Leistritz, F.L., T. Mortensen, H. Bastow-Shop, J. Braaten-Grabanski, A. Schuler, and J. Fedorenko. 1989. Revitalizing the Retail Trade Sector in Rural Communities: Experiences of 13 North Dakota Towns. Agr. Econ. Rpt. No. 250. Fargo, N.D.: North Dakota State University. pp. 75-76.

Madsen, L., and L. Lamp. 1990. Custom Work Rates Paid in South Dakota, 1989. EMC-917. Brookings, SD: SDSU Coop Ext Serv. May.

Owens, W.W., and E.C. Vangsness. 1973. Trade Areas in North Dakota. Ext. Bul. No. 20. Fargo, N.D.: North Dakota State University. pp. 12-13.

Peterson, D. Personal Communication. Economics Department, Brookings, S.D.: South Dakota State University. September 25, 1990.

South Dakota Codified Laws. 1989 Revision. Volume 4A. Title 10. The Michie Company Law Publishers, Charlottesville, Virginia.

Suhr. A. 1990. Personal Communication. Harvest States, Aberdeen, SD. September 27.

Taylor, D.C., T.L. Dobbs, D.L. Becker, and J.D. Smolik. 1989a. Crop and Livestock Enterprises, Risk Evaluation, and Management Strategies on South Dakota Sustainable Farms. Economics Research Report No. 89-5. Brookings, S.D.: South Dakota State University.

Taylor, D.C., T.L. Dobbs, and J.D. Smolik. 1989b. Sustainable Agriculture in South Dakota. Economics Research Report No. 89-1. Brookings, SD: South Dakota State University.

Taylor, D.C., C. Mends, and T.L. Dobbs. 1990. Livestock Budgets and Whole Farm Economic Analysis: South Dakota Sustainable Agriculture Case Farms. Economics Research Report No. 90-7. Brookings, S.D.: South Dakota State University.

U.S. Department of Commerce. Industry-Specific Gross Output Gross Output Multipliers for BEA Economic Areas. 1977. Bureau of Economic Analysis. Washington, D.C.

U.S. Department of Commerce, U.S. Bureau of the Census. 1989a. 1987 Census of Wholesale Trade, South Dakota.

U.S. Department of Commerce, U.S. Bureau of the Census. 1989b. 1987 Census of Wholesale Trade, U.S. Summary.

U.S. Department of Commerce. U.S. Bureau of the Census. 1989c. 1987 Census of Service Industries, South Dakota.

U.S. Department of Commerce, U.S. Bureau of the Census. 1989d. 1987 Census of Service Industries, U.S. Summary.

Annex A

Changes in Farm Costs Associated with Conversion from Conventional to Sustainable Farming Practices

Annex Table A-1. Changes in Farm Costs Associated with Conversion from Conventional to Sustainable Farming Practices in the South-central Area

	Sector	Sustain. Total	Conv. Total	Changes in Costs
		($/100 ac)		
Direct Costs:				
Seed	Retail	$1,013.08	$1,155.36	($142.28)
Fertilizer	Retail	$0.00	$979.31	($979.31)
Fertilizer application	Retail	$0.00	$0.00	$0.00
Herbicide	Retail	$4.70	$510.36	($505.65)
Herbicide application	Retail	$0.00	$0.00	$0.00
Insecticide	Retail	$0.00	$0.00	$0.00
Insecticide application	Retail	$0.00	$0.00	$0.00
Crop insurance	Fin & Ins	$212.39	$262.39	($50.01)
Storage	Retail	$256.22	$571.59	($315.37)
Drying	Retail	$0.00	$471.75	($471.75)
Overhead	Retail	$492.12	$508.63	($16.51)
Custom machine hire	Service	$0.00	$0.00	$0.00
Fuel and lubrication	Retail	$509.17	$530.58	($21.40)
Machinery repair	Service	$889.93	$943.61	($53.68)
Interest on non labor direct costs	Fin & Ins	$199.88	$351.14	($151.26)
Labor charge	Ag House	$1,220.42	$1,225.16	($4.74)
Fixed Costs:				
Interest, Housing & Ins. on machinery	Fin & Ins	$1,493.28	$1,627.77	($134.49)
Deprec. on machinery and equipment	Retail	$1,585.65	$1,768.94	($183.28)
NET INCOME OVER ALL COSTS EXCEPT MANAGEMENT	Ag House	$1,239.23	$2,733.50	($1,494.27)
		Hours/100 Acres		
LABOR:				
Labor 1		145.8	178.7	(33.0)
Labor 2		66.5	18.2	48.3
Total Labor		212.3	196.9	15.4

Annex Table A-2. Changes in Farm Costs Associated with Conversion from Conventional to Sustainable Farming Practices in the East-central Area

	Sector	Sustain. Total	Conv. Total	Changes in Costs
		($/100 ac)		
Direct Costs:				
Seed	Retail	$978.37	$1,484.88	($506.51)
Fertilizer	Retail	$0.00	$1,246.96	($1,246.96)
Fertilizer application	Retail	$0.00	$0.00	$0.00
Herbicide	Retail	$0.00	$1,767.08	($1,767.08)
Herbicide application	Retail	$94.86	$0.00	$94.86
Insecticide	Retail	$0.00	$0.00	$0.00
Insecticide application	Retail	$0.00	$0.00	$0.00
Crop insurance	Fin & Ins	$170.77	$258.10	($87.32)
Storage	Retail	$327.80	$601.32	($273.52)
Drying	Retail	$286.88	$588.52	($301.65)
Overhead	Retail	$474.58	$496.34	($21.75)
Custom machine hire	Service	$0.00	$0.00	$0.00
Fuel and lubrication	Retail	$438.20	$305.81	$132.39
Machinery repair	Service	$881.83	$744.84	$136.99
Interest on non labor direct costs	Fin & Ins	$216.19	$443.47	($227.28)
Labor charge	Ag House	$1,073.96	$727.53	$346.43
Fixed Costs:				
Interest, Housing & Ins. on machinery	Fin & Ins	$1,444.33	$1,316.05	$128.28
Deprec. on machinery and equipment	Retail	$1,559.52	$1,545.47	$14.05
NET INCOME OVER ALL COSTS EXCEPT MANAGEMENT	Ag House	$1,432.50	$6,340.62	($4,908.12)
		Hours/100 Acres		
LABOR:				
Labor 1		159.6	113.3	46.3
Labor 2		11.5	0.0	11.5
Total Labor		171.1	113.3	57.8

Annex Table A-3. Changes in Farm Costs Associated with Conversion from Conventional to Sustainable Farming Practices in the Northeast Area

	Sector	Sustain. Total	Conv. Total	Changes in Costs
		($/100 ac)		
Direct Costs:				
Seed	Retail	$554.95	$686.38	($131.43)
Fertilizer	Retail	$0.00	$785.89	($785.89)
Fertilizer application	Retail	$0.00	$0.00	$0.00
Herbicide	Retail	$0.00	$589.12	($589.12)
Herbicide application	Retail	$0.00	$0.00	$0.00
Insecticide	Retail	$0.00	$0.00	$0.00
Insecticide application	Retail	$0.00	$0.00	$0.00
Crop insurance	Fin & Ins	$93.29	$198.62	($105.33)
Storage	Retail	$111.24	$297.60	($186.36)
Drying	Retail	$0.00	$110.00	($110.00)
Overhead	Retail	$435.31	$460.67	($25.35)
Custom machine hire	Service	$0.00	$0.00	$0.00
Fuel and lubrication	Retail	$376.94	$410.11	($33.17)
Machinery repair	Service	$723.59	$778.42	($54.83)
Interest on non labor direct costs	Fin & Ins	$135.83	$255.46	($119.63)
Labor charge	Ag House	$737.62	$821.91	($84.29)
Fixed Costs:				
Interest, Housing & Ins. on machinery	Fin & Ins	$1,018.13	$1,305.79	($287.65)
Deprec. on machinery and equipment	Retail	$1,111.13	$1,420.49	($309.37)
NET INCOME OVER ALL COSTS EXCEPT MANAGEMENT	Ag House	($1,438.00)	($1,080.67)	($357.33)
		Hours/100 Acres		
LABOR:				
Labor 1		114.9	128.0	(13.1)
Labor 2		0.0	0.0	0.0
Total Labor		114.9	128.0	(13.1)

Annex Table A-4. Changes in Farm Costs Associated with Conversion from Conventional to Sustainable Farming Practices in the Northwest Area

	Sector	Sustain. Total	Conv. Total	Changes in Costs
		($/100 ac)		
Direct Costs:				
Seed	Retail	$493.90	$408.89	$85.01
Fertilizer	Retail	$450.00	$392.15	$57.85
Fertilizer application	Retail	$0.00	$0.00	$0.00
Herbicide	Retail	$0.00	$112.24	($112.24)
Herbicide application	Retail	$0.00	$0.00	$0.00
Insecticide	Retail	$0.00	$0.00	$0.00
Insecticide application	Retail	$0.00	$0.00	$0.00
Crop insurance	Fin & Ins	$93.91	$114.43	($20.52)
Storage	Retail	$290.54	$256.74	$33.81
Drying	Retail	$0.00	$0.00	$0.00
Overhead	Retail	$379.38	$388.62	($9.24)
Custom machine hire	Service	$8.85	$38.85	($30.01)
Fuel and lubrication	Retail	$265.39	$433.16	($167.77)
Machinery repair	Service	$527.09	$597.53	($70.44)
Interest on non labor direct costs	Fin & Ins	$148.48	$162.30	($13.82)
Labor charge	Ag House	$444.37	$705.00	($260.63)
Fixed Costs:				
Interest, Housing & Ins. on machinery	Fin & Ins	$853.75	$1,011.01	($157.26)
Deprec. on machinery and equipment	Retail	$932.32	$1,032.98	($100.66)
NET INCOME OVER ALL COSTS EXCEPT MANAGEMENT	Ag House	($1,758.65)	($2,134.96)	$376.31
		Hours/100 Acres		
LABOR:				
Labor 1		69.2	109.9	(40.7)
Labor 2		0.0	0.0	0.0
Total Labor		69.2	109.9	(40.7)

Annex Table A-5. Changes in Farm Costs Associated with Conversion from Conventional to Sustainable Farming Practices in the Southwest Area

	Sector	Sustain. Total	Conv. Total	Changes in Costs
		($/100 ac)		
Direct Costs:				
Seed	Retail	$583.80	$424.51	$159.29
Fertilizer	Retail	$0.00	$335.15	($335.15)
Fertilizer application	Retail	$0.00	$0.00	$0.00
Herbicide	Retail	$0.00	$70.26	($70.26)
Herbicide application	Retail	$0.00	$0.00	$0.00
Insecticide	Retail	$0.00	$0.00	$0.00
Insecticide application	Retail	$0.00	$0.00	$0.00
Crop insurance	Fin & Ins	$92.10	$139.99	($47.89)
Storage	Retail	$195.55	$240.24	($44.69)
Drying	Retail	$0.00	$0.00	$0.00
Overhead	Retail	$417.70	$423.44	($5.74)
Custom machine hire	Service	$0.00	$0.00	$0.00
Fuel and lubrication	Retail	$279.08	$368.91	($89.82)
Machinery repair	Service	$572.00	$546.64	$25.36
Interest on non labor direct costs	Fin & Ins	$126.66	$150.85	($24.20)
Labor charge	Ag House	$589.05	$619.12	($30.07)
Fixed Costs:				
Interest, Housing & Ins. on machinery.	Fin & Ins	$853.08	$917.49	($64.41)
Deprec. on machinery and equipment	Retail	$998.28	$999.32	($1.04)
NET INCOME OVER ALL COSTS EXCEPT MANAGEMENT	Ag House	$583.77	$837.32	($253.55)
		Hours/100 Acres		
LABOR:				
Labor 1		91.8	96.4	(4.7)
Labor 2		0.0	0.0	0.0
Total Labor		91.8	96.4	(4.7)

Annex B

Alternative Estimates of Forward Linkage Effects

The method for computing baseline forward linkage effects was explained in the text portion of this monograph. Data in Annex Tables B-1 on volumes and values of grain and hay production were used in the baseline calculations. The resulting baseline estimates for first-round, forward-linked personal income changes -- shown in the text in Table 8 -- are reproduced in the first column of Annex Table B-3.

Some alternative estimates of forward-linked personal income effects are also shown in Table B-3. Estimates in the second column were based on a slightly different method of computing personal income generated by local elevators' handling of grain. It was assumed in the calculations for that column that for each bushel of grain handled by a local elevator, $0.16 of personal income was generated (Suhr, 1990). Personal income generated through trucking of hay was estimated the same way as in the baseline situation.

Estimates shown in the third column of data in Table B-3 were based on procedures similar to those used for the second column except that adjustments were made for the amounts of grain and hay fed on-farm. Hence, estimates of the change in volumes of grain and hay marketed were presumably more accurate. However, since we assumed that the livestock components were the same on the conventional farms as on the sustainable farms, the resulting estimated changes in personal income are almost the same in column 3 as in column 2. There is no difference at all in the estimates for the south-central area, where the sustainable farm had no livestock and we assumed the same to be the case for the conventional farm.

Data in the last column of Table B-3 are rather different in that they represent a combination of forward-linked personal income effects and changes in ag household personal income due to organic premiums. The forward-linked personal income effects for that last column were estimated as they were for the third column of data except that any grain marketed organically was assumed to go outside the local area for the first-round of handling and marketing. This is largely the case at present. Most grain sold organically that originates within any of the five areas shown in Figure 2 is presently sold to or through firms located outside the respective areas. Thus, we assumed there is zero forward-linked local personal income as a result of organic grain sales. For example, some of the grain from the east-central sustainable farm is marketed organically. Consequently, the estimated decline in forward linked personal income as a result of a changeover from the conventional to the sustainable rotation was $411 per 100 acres of farmland, (calculations not shown here), compared to the $366 shown in column 3 of Table B-3.

An additional step was involved in making the estimates shown in the last column, however. That step entailed calculating the increase in sustainable farmers' "net income to management" that results from selling

portions of their grain at premium prices in organic markets. Four of the five case sustainable farms (all except the south-central farm) do sell some of their grain organically. The personal income increases were calculated from data in Becker, et al. (1990, pp. 66 and 68). In the east-central area, for example, the sustainable farmer's "net income to management" when his organic premiums are accounted for is $500 more (per 100 acres of farmland) than when they are ignored. When that $500 **increase** is balanced against the $411 **decrease** in forward-linked personal income that was referred to in the previous paragraph, we get the $89 **increase** shown for the east-central area in the last column of Table B-3. We see in that last column that the combination of forward-linked personal income effects **and** increases in sustainable farmers' net income due strictly to organic premiums is **positive** in four of the five areas. It remains negative in the south-central area, since there were no organic premiums to account for on the case sustainable farm there.

Annex Table B-1. Changes in Output Volume Resulting from Conversion from Conventional to Sustainable Agriculture

	Sustain. Total	Conv. Total	Changes in bu/ton
	------per 100 acres-------		
South-central Area			
Total of Grain (bu)	2329.2	5196.3	(2867.0)
Total of Hay (tons)	----	26.3	(26.3)
East-central Area			
Total of Grain (bu)	2980.0	5417.3	(2437.27)
Total of Hay (tons)	48.6	35.8	12.8
Northeast Area			
Total of Grain (bu)	1011.3	2390.3	(1379.0)
Total Of Hay (tons)	37.5	22.0	15.5
Northwest Area			
Total of Grain (bu)	1324.2	1423.6	(99.4)
Total of Hay (tons)	----	----	----
Southwest Area			
Total of Grain (bu)	1777.8	2184.0	(406.2)
Total of Hay (tons)	0.8	10.6	(9.8)

Annex Table B-2. Changes in Output Value Resulting from Conversion from Conventional to Sustainable Agriculture

	Sustain. Total	Conv. Total	Change in Dollars
	------per 100 acres-------		
South-central Area			
Total of Grain	$12,349	$14,059	($1,710)
Total of Hay	---	$1,313	($1,313)
East-central Area			
Total of Grain	$8,429	$17,164	($8,735)
Total of Hay	$2,431	$894	$1,537
Northeast Area			
Total of Grain	$4,260	$7,429	($3,169)
Total of Hay	$1,875	$832	$1,043
Northwest Area			
Total of Grain	$3,485	$3,839	($354)
Total of Hay	---	---	---
Southwest Area			
Total of Grain	$6,489	$6,078	$411
Total of Hay	$39	$515	($476)

Annex Table B-3. Sensitivity Analyses for Forward Linkage Effects

Area	Change in Personal Income Based on Change in Grain and Hay Sales* (Baseline)	Change in Personal Income Based on Change in Volume (bu or tons), Ignoring Grain Fed to Livestock and Sold as Organic	Change in Personal Income Based on Change in Volume (bu or tons), Including Portion Fed to Livestock but Ignoring Organic Sales	Change in Personal Income Based on Change in Volume (bu or tons), Including Portion Fed to Livestock and Organic Sales**
	$ per 100 acres			
South-central	(102)	(446)	(446)	(446)
East-central	(419)	(365)	(366)	89
Northeast	(142)	(193)	(199)	518
Northwest	(15)	(14)	(14)	305
Southwest	13	(59)	(55)	499

* Data from Table 8.

** This column also includes the increase in ag household income due to organic premiums.

Annex C

Total Multiplier Effects of Adopting Sustainable Agricultural Practices

Annex Table C-1. Total Multiplier Effects of Adopting Sustainable Agricultural Practices in South-central SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Which Becomes Local Inc. (PSY)	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Direct Effect:					
Ag Households					
Labor Charge					($4.74)
Net Income To Management					($1,494.27)
Subtotal					($1,499.01)
Secondary Effects (change):					
a. Induced Effects = 1/1-(PCLh x PSY) = 1/1-(.85 x .40)					
Multiplier Total Induced Effect=($1,499.01)x 1/(1-(.85 x .40)) - ($1,499.01)					($772.22)
b. Indirect Effects, Backward Linkages = Change in Receipts or Farm Expenditure x PCLf x PSY					
Retail Trade	Farm Exp.	PCLf		PSY	
Seed	($142.28)	0.80	($113.82)	0.35	($39.84)
Commercial Fertilizer	($979.31)	0.80	($783.45)	0.35	($274.21)
Chemical Pesticide	($505.65)	0.80	($404.52)	0.35	($141.58)
Fuel & Lube	($21.40)	0.90	($19.26)	0.35	($6.74)
Depreciation on Machinery	($183.28)	0.90	($164.95)	0.35	($57.73)
Storage	($315.37)	1.00	($315.37)	0.45	($141.92)
Drying	($471.75)	1.00	($471.75)	0.45	($212.29)
Overhead	($16.51)	1.00	($16.51)	0.45	($7.43)
Subtotal	($2,635.55)		($2,289.63)		($881.73)
Service Trade					
Machinery Repair	($53.68)	0.95	($51.00)	0.42	($21.42)
Custom Machine Hire	$0.00	0.90	$0.00	0.42	$0.00
Subtotal	($53.68)		($51.00)		($21.42)
Finance & Insurance					
Crop Insurance	($50.01)	0.90	($45.01)	0.25	($11.25)
Interest on Nonlabor Direct Costs	($151.26)	0.95	($143.70)	0.30	($43.11)
Interest, Housing & Insurance on Machinery	($134.49)	0.90	($121.04)	0.30	($36.31)
Subtotal	($335.76)		($309.75)		($90.67)
Total Indirect Effects Backward Linkages =	($881.73) +	($21.42) +	($90.67) =		($993.83)
c. Indirect Effects, Forward Linkages = Farm Marketings x PMLf x PSY					
	Farm Market	PMLf		PSY	
County Elevators	($1,939.00)	0.95	($1,842.05)	0.08	($147.36)
Trucking Industry	($53.00)	0.95	($50.35)	0.40	($20.14)
Total Indirect Effects, Foward Linkages =	($147.36) +	($20.14)=			($167.50)
Total change in community income:					
1. Direct Effect			($1,499.01)		
2. Secondary Effects					
a. Induced Effects, Ag Household =		($772.22)			
b. Indirect Effects, Backward Linkages =		($993.83)			
c. Indirect Effects, Foward Linkages =		($167.50)			
subtotal			($1,933.55)		
TOTAL			($3,432.56)		
Ratio of Total Effect to Direct Effect =	($3,432.56) / ($1,499.01)=		2.29		

Annex Table C-2. Total Multiplier Effects of Adopting Sustainable Agricultural Practices in East-central SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Which Becomes Local Inc. (PSY)	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Direct Effect:					
Ag Households					
Labor Charge					$346.43
Net Income To Management					($4,908.12)
Subtotal					($4,561.69)
Secondary Effects (change):					
a. Induced Effects = 1/1-(PCLh x PSY) = 1/1-(.85 x .40)					
Multiplier Total Induced Effect=($4,561.69) x 1/(1-(.85 x .40)) - 4561.69					($2,349.96)
b. Indirect Effects, Backward Linkages = Change in Receipts or Farm Expenditure x PCLf x PSY					
Retail Trade	Farm Exp.	PCLf		PSY	
Seed	($506.51)	0.80	($405.21)	0.35	($141.82)
Commercial Fertilizer	($1,246.96)	0.80	($997.57)	0.35	($349.15)
Chemical Pesticide	($1,672.22)	0.80	($1,337.78)	0.35	($468.22)
Fuel & Lube	$132.39	0.90	$119.15	0.35	$41.70
Depreciation on Machinery	$14.05	0.90	$12.65	0.35	$4.43
Storage	($273.52)	1.00	($273.52)	0.45	($123.08)
Drying	($301.65)	1.00	($301.65)	0.45	($135.74)
Overhead	($21.75)	1.00	($21.75)	0.45	($9.79)
Subtotal	($3,876.17)		($3,205.68)		($1,181.68)
Service Trade					
Machinery Repair	$136.99	0.95	$130.14	0.42	$54.66
Custom Machine Hire	$0.00	0.90	$0.00	0.42	$0.00
Subtotal	$136.99		$130.14		$54.66
Finance & Insurance					
Crop Insurance	($87.32)	0.90	($78.59)	0.25	($19.65)
Interest on Nonlabor Direct Costs	($227.28)	0.95	($215.92)	0.30	($64.77)
Interest, Housing & Insurance on Machinery	$128.28	0.90	$115.45	0.30	$34.64
Subtotal	($186.32)		($179.05)		($49.78)
Total Indirect Effects Backward Linkages =	($1,181.68) +	$54.66 +	($49.78) =		($1,176.80)
c. Indirect Effects, Forward Linkages = Farm Marketings x PMLf x PSY					
	Farm Market	PMLf		PSY	
County Elevators	($8,930.00)	0.95	($8,483.50)	0.08	($678.68)
Trucking Industry	$26.00	0.95	$24.70	0.4	$9.88
Total Indirect Effects, Foward Linkages =	($678.68) +	$9.88 =			($668.80)
Total change in community income:					
1. Direct Effect			($4,561.69)		
2. Secondary Effects					
a. Induced Effects, Ag Household =		($2,349.96)			
b. Indirect Effects, Backward Linkages =		($1,176.80)			
c. Indirect Effects, Foward Linkages =		($668.80)			
subtotal			($4,195.56)		
		TOTAL	($8,757.25)		
Ratio of Total Effect to Direct Effect =	($8,757.25) / ($4,561.69)=		1.92		

Annex Table C-3. Total Multiplier Effects of Adopting Sustainable Agricultural Practices in Northeast SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Which Becomes Local Inc. (PSY)	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Direct Effect:					
Ag Households					
Labor Charge					($84.29)
Net Income To Management					($357.33)
Subtotal					($441.62)
Secondary Effects (change):					
a. Induced Effects = 1/1-(PCLh x PSY) = 1/1-(.80 x .35)					
Multiplier Total Induced Effect= ($441.62) x 1/(1-(.80 x .35)) - ($441.62) =					($171.74)
b. Indirect Effects, Backward Linkages = Change in Receipts or Farm Expenditure x PCLf x PSY					
Retail Trade	Farm Exp.	PCLf		PSY	
Seed	($131.43)	0.80	($105.14)	0.30	($31.54)
Commercial Fertilizer	($785.85)	0.80	($628.68)	0.30	($188.60)
Chemical Pesticide	($589.12)	0.80	($471.30)	0.30	($141.39)
Fuel & Lube	($33.17)	0.90	($29.85)	0.30	($8.96)
Depreciation on Machinery	($309.37)	0.85	($262.96)	0.30	($78.89)
Storage	($186.36)	1.00	($186.36)	0.40	($74.54)
Drying	($110.00)	1.00	($110.00)	0.40	($44.00)
Overhead	($25.35)	1.00	($25.35)	0.40	($10.14)
Subtotal	($2,170.65)		($1,819.65)		($578.07)
Service Trade					
Machinery Repair	($54.83)	0.90	($49.35)	0.37	($18.26)
Custom Machine Hire	$0.00	0.90	$0.00	0.37	$0.00
Subtotal	($54.83)		($49.35)		($18.26)
Finance & Insurance					
Crop Insurance	($105.33)	0.90	($94.80)	0.25	($23.70)
Interest on Nonlabor Direct Costs	($119.63)	0.90	($107.67)	0.27	($29.07)
Interest, Housing & Insurance on Machinery	($287.65)	0.85	($244.50)	0.27	($66.02)
Subtotal	($512.61)		($446.97)		($118.79)
Total Indirect Effects Backward Linkages =	($578.07) +	($18.26) +	($118.79) =		($715.11)
c. Indirect Effects, Forward Linkages = Farm Marketings x PMLf x PSY					
	Farm Market	PMLf		PSY	
County Elevators	($3,279.00)	0.90	($2,951.10)	0.07	($206.58)
Trucking Industry	$31.00	0.90	$27.90	0.35	$9.77
Total Indirect Effects, Foward Linkages =	($206.58) +	$9.77 =			($196.81)
Total change in community income:					
1. Direct Effect			($441.62)		
2. Secondary Effects					
a. Induced Effects, Ag Household =		($171.74)			
b. Indirect Effects, Backward Linkages =		($715.11)			
c. Indirect Effects, Foward Linkages =		($196.81)			
subtotal			($1,083.66)		
		TOTAL	($1,525.28)		
Ratio of Total Effect to Direct Effect =		($1,525.28) /	($441.62)=	3.45	

Annex Table C-4. Total Multiplier Effects of Adopting Sustainable Agricultural Practices in Northwest SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Which Becomes Local Inc. (PSY)	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Direct Effect:					
Ag Households					
Labor Charge					($260.63)
Net Income To Management					$376.31
Subtotal					$115.68
Secondary Effects (change):					
a.Induced Effects = 1/1-(PCLh x PSY) = 1/1-(.60 x .30)					
Multiplier Total Induced Effect=	$115.68	x 1/(1-(.60 x .30)) - 115.68			$25.39
b.Indirect Effects, Backward Linkages = Change in Receipts or Farm Expenditure x PCLf x PSY					
Retail Trade	Farm Exp.	PCLf		PSY	
Seed	$85.01	0.80	$68.01	0.25	$17.00
Commercial Fertilizer	$57.85	0.70	$40.50	0.25	$10.12
Chemical Pesticide	($112.24)	0.70	($78.57)	0.25	($19.64)
Fuel & Lube	($167.77)	0.85	($142.60)	0.25	($35.65)
Depreciation on Machinery	($100.66)	0.75	($75.50)	0.25	($18.87)
Storage	$33.81	1.00	$33.81	0.35	$11.83
Drying	$0.00	1.00	$0.00	0.35	$0.00
Overhead	($9.24)	1.00	($9.24)	0.35	($3.23)
Subtotal	($213.24)		($163.59)		($38.44)
Service Trade					
Machinery Repair	($70.44)	0.80	($56.35)	0.32	($18.03)
Custom Machine Hire	($30.01)	0.80	($24.01)	0.32	($7.68)
Subtotal	($100.45)		($80.36)		($25.72)
Finance & Insurance					
Crop Insurance	($20.52)	0.75	($15.39)	0.25	($3.85)
Interest on Nonlabor Direct Costs	($13.82)	0.80	($11.06)	0.25	($2.76)
Interest, Housing & Insurance on Machinery	($157.26)	0.75	($117.95)	0.25	($29.49)
Subtotal	($191.60)		($144.39)		($36.10)
Total Indirect Effects Backward Linkages =	($38.44) +	($25.72) +	($36.10) =		($100.25)
c. Indirect Effects, Forward Linkages = Farm Marketings x PMLf x PSY					
	Farm Market	PMLf		PSY	
County Elevators	($362.00)	0.85	($307.70)	0.06	($18.46)
Trucking Industry	$0.00	0.95	$0.00	0.30	$0.00
Total Indirect Effects, Foward Linkages =	($18.46) +	$0.00 =			($18.46)
Total change in community income:					
1. Direct Effect			$115.68		
2. Secondary Effects					
a. Induced Effects, Ag Household =		$25.39			
b. Indirect Effects, Backward Linkages =		($100.25)			
c. Indirect Effects, Foward Linkages =		($18.46)			
subtotal			($93.32)		
		TOTAL	$22.36		
Ratio of Total Effect to Direct Effect =		$22.36 /	$115.68 =	0.19	

Annex Table C-5. Total Multiplier Effects of Adopting Sustainable Agricultural Practices in Southwest SD

Sector Item	Total Change in Receipts	Proport. Receipts Remain in Area (PCLf)	Change in Receipts	Proport. Which Becomes Local Inc. (PSY)	Changes in Personal Income
	($/100ac)		($/100ac)		($/100ac)
Direct Effect:					
Ag Households					
Labor Charge					($30.07)
Net Income To Management					($253.55)
Subtotal					($283.62)
Secondary Effects (change):					
a.Induced Effects = 1/1-(PCLh x PSY) = 1/1-(.60 x .30)					
Multiplier Total Induced Effect= ($283.62) x 1/(1-(.60 x .30)) - ($283.43)					($62.26)
b.Indirect Effects, Backward Linkages = Change in Receipts or Farm Expenditure x PCLf x PSY					
Retail Trade	Farm Exp.	PCLf		PSY	
Seed	$159.29	0.80	$127.43	0.25	$31.86
Commercial Fertilizer	($335.15)	0.70	($234.60)	0.25	($58.65)
Chemical Pesticide	($70.26)	0.70	($49.18)	0.25	($12.30)
Fuel & Lube	($89.82)	0.90	($80.84)	0.25	($20.21)
Depreciation on Machinery	($1.04)	0.80	($0.83)	0.25	($0.21)
Storage	($44.69)	1.00	($44.69)	0.35	($15.64)
Drying	$0.00	1.00	$0.00	0.35	$0.00
Overhead	($5.74)	1.00	($5.74)	0.35	($2.01)
Subtotal	($387.41)		($288.45)		($77.16)
Service Trade					
Machinery Repair	$25.36	0.85	$21.56	0.32	$6.90
Custom Machine Hire	$0.00	0.80	$0.00	0.32	$0.00
Subtotal	$25.36		$21.56		$6.90
Finance & Insurance					
Crop Insurance	($47.89)	0.80	($38.31)	0.25	($9.58)
Interest on Nonlabor Direct Costs	($24.20)	0.85	($20.57)	0.25	($5.14)
Interest, Housing & Insurance on Machinery	($64.41)	0.80	($51.53)	0.25	($12.88)
Subtotal	($136.50)		($110.41)		($27.60)
Total Indirect Effects Backward Linkages =	($77.16) +	$6.90 +	($27.60) =		($97.86)
c. Indirect Effects, Forward Linkages = Farm Marketings x PMLf x PSY					
	Farm Market	PMLf		PSY	
County Elevators	$378.00	0.85	$321.30	0.06	$19.28
Trucking Industry	($20.00)	0.90	($18.00)	0.30	($5.40)
Total Indirect Effects, Foward Linkages =	$19.28 +	($5.40)=			$13.88
Total change in community income:					
1. Direct Effect			($283.62)		
2. Secondary Effects					
a. Induced Effects, Ag Household =		($62.26)			
b. Indirect Effects, Backward Linkages =		($97.86)			
c. Indirect Effects, Foward Linkages =		$13.88			
subtotal			($146.24)		
		TOTAL	($429.86)		
Ratio of Total Effect to Direct Effect =		($429.86) /	($283.62)=	1.52	

Annex D

Sales Tax Impacts

Annex Table D-1. Change in Sales Tax Receipts Associated with the Conversion from Conventional to Sustainable Farming Practices

Area	Taxable Item	Change In Receipts*	State Tax Rate	City Tax Rate**	Total Combined Tax Rate	State Tax Paid	City Tax Paid	Total Tax Paid
		per 100 acres						
South-central								
	Machine Repair	($51.00)	4%	0%	4%	($2.04)	$0.00	($2.04)
	Machine Depreciation	($164.95)	3%	0%	3%	($4.95)	$0.00	($4.95)
	Total Net Change in Tax Revenue							($6.99)
East-Central								
	Machine Repair	$130.14	4%	0%	4%	$5.21	$0.00	$5.21
	Machine Depreciation	$12.64	3%	0%	3%	$0.38	$0.00	$0.38
	Total Net Change in Tax Revenue							$5.58
Northeast								
	Machine Repair	($49.35)	4%	0%	4%	($1.97)	$0.00	($1.97)
	Machine Depreciation	($262.96)	3%	0%	3%	($7.89)	$0.00	($7.89)
	Total Net Change in Tax Revenue							($9.86)
Northwest								
	Machine Repair	($56.35)	4%	0%	4%	($2.25)	$0.00	($2.25)
	Machine Depreciation	($75.50)	3%	0%	3%	($2.27)	$0.00	($2.27)
	Total Net Change in Tax Revenue							($4.52)
Southwest								
	Machine Repair	$21.56	4%	0%	4%	$0.86	$0.00	$0.86
	Machine Depreciation	($0.83)	3%	0%	3%	($0.02)	$0.00	($0.02)
	Total Net Change in Tax Revenue							$0.84

* Shown in Column 1 is the change in receipts within the local trade area. Many of the sales occuring outside the local trade area may also occur within South Dakota, and would be subject to state sales tax, but those sales are not accounted for here.

** City sales taxes may apply for some cities within some or all of the five local trade areas. However, they are not included in this table.

Annex E

Impacts Estimated on County-wide Bases

Annex Table E-1. Summary of Direct and First-Round Secondary Effects, on County Bases

Column #	Direct Effects 1	First-round Secondary Effects: Backward Linkage 2	First-round Secondary Effects: Forward Linkage 3	First-round Secondary Effects: Total Secondary 2+3=4	Direct & First-Round Secondary Effects 1+4=5	Cropland Acres in County 6	County Direct Effects 1*6=7	County First-Round Secondary Effects 4*6=8	Total County Effects 7+8=9
	per 100 acres					(100 acres)	County-wide		
County									
Hutchinson (South-central)	($1,499.01)	($416.62)	($102.10)	($518.72)	($2,017.73)	4186.34	($6,275,365.52)	($2,171,538.28)	($8,446,903.81)
Lake (East-central)	($4,561.69)	($488.03)	($419.30)	($907.33)	($5,469.02)	2505.08	($11,427,398.39)	($2,272,934.24)	($13,700,332.62)
Brown (Northeast)	($441.62)	($373.20)	($141.97)	($515.17)	($956.79)	7751.37	($3,423,160.02)	($3,993,273.28)	($7,416,433.30)
Corson (Northwest)	$115.68	($71.10)	($15.40)	($86.50)	$29.18	3863.92	$446,978.27	($334,229.08)	$112,749.19
Haakon (Southwest)	($283.62)	($60.61)	$12.55	($48.06)	($331.68)	3627.44	($1,028,814.53)	($174,334.77)	($1,203,149.30)